CORVINUS
ECONOMICS
WORKING
PAPERS

02/2023

András Olivér Németh,
Petra Németh and
László Tőkés

A panel analysis of fertility trends in Europe, with a special emphasis on CEE countries

http://unipub.lib.uni-corvinus.hu/8094

CORVINUS UNIVERSITY OF BUDAPEST

A panel analysis of fertility trends in Europe, with a special emphasis on CEE countries

András Olivér Németh[1] – Petra Németh[2] – László Tőkés[3]

March 2022

Abstract

The aim of our research is to understand and reveal the key economic, demographic, labour market, and other factors behind the common fertility trends of CEE countries in the past decades. Our main research question is what driving forces played a role in the development of the total fertility rate in the CEE countries compared to the rest of Europe, if any. We measure the effect of potential influential factors on fertility with a multiple regression using the ordinary least squares method. We use macro-level data from 27 countries of the European Union with special attention to the 11 CEE countries (namely Bulgaria, Croatia, Czechia, Estonia, Latvia, Lithuania, Hungary, Poland, Romania, Slovakia, and Slovenia). Based on the availability of data, our examination period lasts from 1995 to 2020. Our results suggest that fertility in the CEE countries is much more sensitive to the state of the economy than in other European countries. Moreover, some of the demographic variables that are closely related to childbirth, also have a more recognisable effect on the TFR than in other parts of Europe. On the other hand, labour market and policy variables seem to be less important in Central and Eastern Europe.

Keywords: fertility; Central and Eastern European countries; demographic economics; economic uncertainty; panel data methods

JEL codes: J11, J13, J18, C33

[1] Assistant professor at Corvinus University of Budapest, nemeth.andras@uni-corvinus.hu
[2] Assistant professor at Corvinus University of Budapest, petra.nemeth@uni-corvinus.hu
[3] Assistant professor at Corvinus University of Budapest, laszlo.tokes@uni-corvinus.hu

1. Introduction

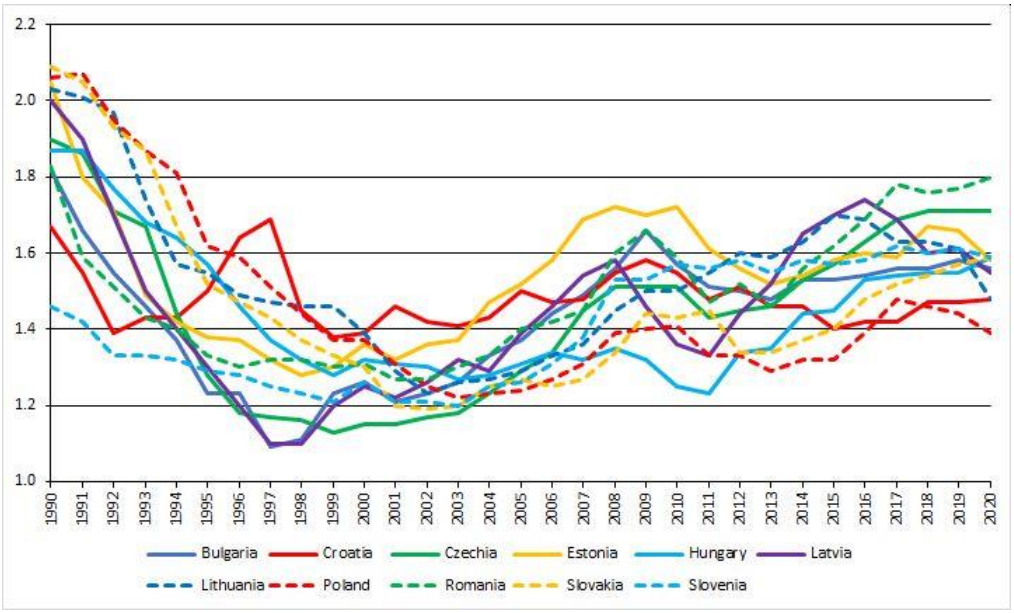
Besides the common trend of population ageing, we can see significant differences in the development of fertility rates in European countries during the past few decades. Many researchers deal with analysing the fertility trends according to the different regions of Europe (among others, see Frejka et al. (2008), Goldstein et al. (2009), Luci-Greulich and Thévenon (2013), Boongarts and Sobotka (2012)). As we can see, the Western, Southern, and Central European countries (in some time periods the German-speaking countries specifically) have shown very different fertility trends compared to the Central and Eastern European countries (from now on CEE countries) over the last decades (see Figure 1). Other groupings can also be found in the literature (for example Goldstein et al. (2009), Luci et al. (2011), Boongarts et al. (2012), Goldstein et al. (2013)). Our main objective is to understand and reveal the key economic, demographic, or other factors behind the common fertility trends of CEE countries compared to the rest of Europe. Therefore, in this paper, we focus mainly on the CEE countries within the European Union, so namely Bulgaria, Croatia, Czechia, Estonia, Latvia, Lithuania, Hungary, Poland, Romania, Slovakia, and Slovenia. Based on the availability of data, our examination period lasts from 1995 to 2020.

One of the main features in the fertility progression of the region is the rapid transformation from the highest-fertility region of Europe to the lowest-fertility one within a decade during the 1990s, measured by the total fertility rate[4] (TFR) (Sobotka (2011)). The low points of the total fertility rates of the region during the analysed period were between 1997 and 2003 (see Figure 1). Another remarkable similarity in the fertility trends of CEE countries is the gradual recovery after 2000 lasting until 2009 (Sobotka (2011)). Due to the financial crisis of 2007–09, we can experience a stalling or a decline in the total fertility rates after 2009 in the CEE region. The characteristics of the fertility trends were not significantly different from the Southern and some other European countries between 2010 and 2013 (see Figure 2). However, after a newer relapse, TFR shows a definitely increasing trend until 2016 in most CEE countries.

The common trend seems to disappear by the second half of the 2010s (see Figure 1). The TFR of Latvia, Lithuania and Poland shows a definitely decreasing trend, while in Czechia, Croatia, Hungary, Romania, and Slovakia, we can experience an increase in fertility rates. In summary, by 2020, TFR has surpassed its peak around 2009 in some CEE countries (Czechia, Latvia, Hungary, Romania, Slovakia, Slovenia), but in the rest of the group, TFR was almost the same (Bulgaria, Croatia, Lithuania, Poland) or lower (Estonia) than its maximum level before or around the crisis (see in more details in Appendix Table A.1).

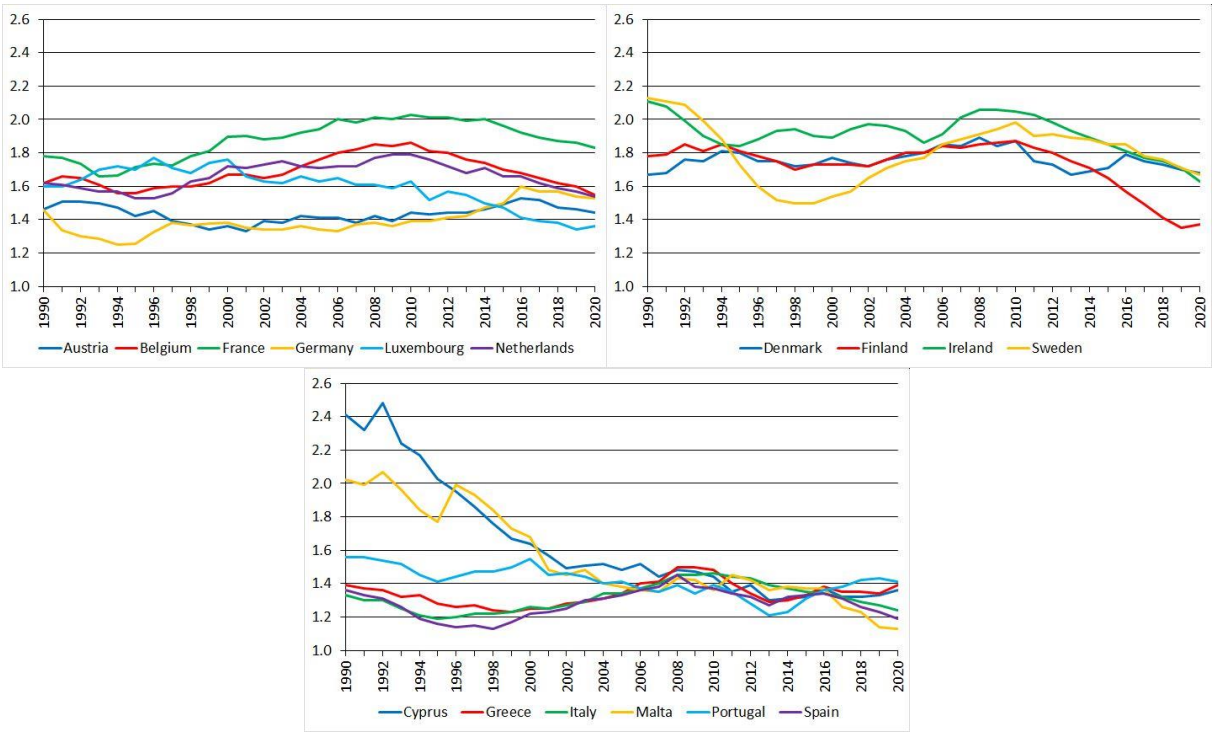
[4] „Total fertility rate (TFR) expresses to how many children a female would give birth during her life at the birth frequency by age of the given year" (HCSO (2022)).

Figure 1: Total fertility rates in CEE countries, 1990–2020



Source: Authors' graph based on the Eurostat Database (2022)

Figure 2: Total fertility rates in Western (top left panel), Northern (top right panel), and Southern European (bottom panel) countries, 1990–2020



Source: Authors' graph based on the Eurostat Database (2022) and the Human Fertility Database (2022)

Our main research question is what driving forces played a role in the development of TFR in the CEE countries. To what economic, demographic, and labour market factors can we track back the common fertility trend at macro level compared to the rest of Europe, if any?

Our results suggest that fertility in the CEE countries is much more sensitive to the state of the economy – if we measure the general economic situation with the economic sentiment indicator of the European Commission and the annual inflation rate of foods and non-alcoholic beverages – than other European countries. Moreover, the demographic variables that are closely related to childbirth (like the growth rate of the mean age of women at childbirth, the crude marriage rate and the proportion of live births outside marriage) have a way more recognisable effect on the TFR than in other parts of Europe. Meanwhile, variables related to the ageing of society, such as the old-age dependency ratio and life expectancy, are not decisive in the evolution of the TFR in Central and Eastern Europe.

The remainder of this paper is organised as follows. Section 2 describes the common characteristics of the CEE countries related to childbearing. Section 3 presents a literature review focusing on results from European countries. Section 4 presents the methodology, while Section 5 describes the data used in detail. Section 6 discusses the results, and finally, Section 7 puts forward conclusions.

2. The common characteristics of the CEE countries related to childbearing

Frejka and Gietel-Basten (2016) emphasize that the common socialist past and transformation is reflected in the demographic, social and economic characteristics of the CEE countries. We have to be aware of these important aspects, if we want to analyse and interpret the region's fertility and family trends. Until 1990, state socialist countries remained immune to the massive transformation of families taking place in the West. This stability can be explained by a mix of institutional and cultural factors. However, during the 1990s, fertility behaviour went through a great transformation in the CEE countries as well. We take a look at the cultural and demographic factors, and also the institutional and economic factors that are assumed to be behind these changes in fertility.

At the beginning of the 1990s, the mean age at birth[5] (MAB) in the CEE countries was still low compared to other European countries.[6] Furthermore, the births out of wedlock and childlessness were marginal, while abortion rates were high. CEE countries typically had full employment before the regime transition and their enrolment rates in tertiary education were low, both of which implied that most young adults were full-time earners by the age of 18, and the cumulative teenage fertility was significant (Sobotka (2011)).

However, the political regime changes between 1989 and 1991 led to a massive decline in the TFR that spanned to most of the 1990s. There are many different theories that try to explain this phenomenon. Many authors pointed out that in periods when MAB increases significantly, TFR decreases sharply because of the so-called 'tempo effect'. This is the postponement transition, which was decisive in the CEE countries (Philipov and Kohler (2001), Kohler et al. (2002), Goldstein et al. (2009), Frejka et al. (2011), Sobotka and Lutz (2011), Bongaarts and Sobotka (2012)). Another theory, that of the 'second demographic transition' (SDT), finds the central factor and driving force of the abovementioned phenomena in the change in values and culture (van de Kaa (1987), (2004)). This theory, according to Lesthaeghe (2010), is also valid for CEE countries. Frejka (2008) considers the social and economic

[5] „Mean age of child-bearing females: the mean age is indicated with a weighted arithmetical mean calculated on the basis of the age-specific live birth data of the females giving birth to children in the given calendar period." (HCSO (2022))

[6] The average of the MAB was 28.3 years in the EU15 countries and 25.4 years in the CEE countries in 1990.

transformation as the root cause behind the demographic transition. Other important factors include the educational expansion (Frejka (2008), Sobotka (2011)), the rise in female employment (Wesolowski and Ferrarini (2018)), and that contraception became more and more common (Sobotka (2011)). The economic transition was accompanied by strong economic downturns and transformation, with high inflation, rapidly increasing structural unemployment, decreasing real wages and the collapse of inefficient industries (Billingsley (2010), Sobotka (2011)). Finally, we have to mention that the real value of family allowances decreased, and the institutions of family policy were transformed or dismantled, which, to a lesser extent and to a different extent from country to country, contributed to the reduction of the TFR (Macura (2000), Sobotka (2011)).

Consequently, Central and Eastern Europe had extremely low fertility rates around 2000. With the exception of Croatia, the TFR of all CEE countries decreased to a level below 1.3, to the so-called 'lowest-low fertility' category (see Appendix Table A.1) (Kohler et al. (2002), Goldstein et al. (2009)). However, younger women in the 1990s did not all give up, mainly only postponed their childbirths. At older ages, they tried to realize at least some of their childbearing intentions; this is the time of recuperation (Frejka et al. (2011), Boongarts and Sobotka (2012)). When these children were born, the CEE countries again experienced an increase in the TFR during the 2000s. We witnessed a rapid transformation in the level and timing of fertility in Central and Eastern Europe (Sobotka (2011)). Goldstein and co-authors (2009) argue that in former socialist countries, the recovery after the serious economic and social crises of the 1990s had a fertility enhancing effect. The postponement of childbearing still continued in almost all developed countries, including the CEE countries also during the 2000s, but a decelerating pace of postponement has a TFR-increasing effect in itself (Goldstein et al. (2009)). According to Bergsvik et al. (2021), fertility recuperation in Central Europe is to some extent linked to the expansion of such family policies that support dual-earner families (regarding Eastern Europe, there are no studies on this topic). However, Frejka and Gietel-Basten (2016) found it that family policy might have had a positive impact on cohort fertility rates only in Slovenia and Estonia.

Many authors have found a significant negative relationship between fertility and unemployment rates across Europe during the financial crisis (among others, Goldstein et al. (2013), Comolli (2017), Matysiak et al. (2021)). Moreover, Matysiak et al. (2021) stated that worsening economic conditions during the recession were indeed associated with a stronger decline in fertility rates compared to the time period before the recession. According to them, the strongest decline in fertility was observed in countries and regions where labour market conditions deteriorated the most during the recession, like in Southern Europe, Ireland, and parts of Central and Eastern Europe. All in all, according to the authors, TFR in CEE countries shows a procyclical tendency, i.e., TFR increases with economic boom and decreasing unemployment and falls during economic recession, just as in most developed countries (Matysiak et al. (2021)).

By the end of the analysed period, the common trend in the TFR values of CEE countries seems to disappear. In Latvia, Lithuania and Poland, TFR has definitely started to decrease, while in Czechia, Croatia, Hungary, Romania, and Slovakia, TFR has an unbroken growth trend since the low point caused by the financial crisis until 2020.

3. Literature review

There is a rich literature of empirical studies about total fertility rates, especially regarding European countries and regions, and certain periods, such as the 1990s, or the impact of the financial crisis on fertility rates. The main focus of most papers is the investigation of the effects of different family policy instruments on childbearing. We now summarize some of the results of those empirical papers which

involve several European countries (including CEE countries as well) and a longer time period after 1990.

The purpose of Billingsley's (2010) econometric analysis is to find an empirical explanation for the developments of fertility in post-communist countries and at the same time to test the verifiability of competing theoretical approaches, such as the previously mentioned SDT, or postponement transition, or the importance of the transformational recession after the regime change. The author investigated the fertility rates of post-communist countries between 1990 and 2003 by pooled cross-sectional time-series analyses of age-specific birth rates and logistic regression. The results show that no single theoretical explanation is sufficient to explain the complex fertility decline, although the author emphasized that the economic downturn has a significant explanatory power for the declining TFR (Billingsley (2010)).

Goldstein et al. (2013) argue that deep economic crises are associated with a decrease in fertility in Western European countries also, but they still assume that the market mechanism operated with less fluctuations in Western Europe, and it was more established and predictable than in the post-communist economies during the regime transition and in the subsequent period. The unemployment rate was used as an indicator of the economic crisis in their analysis. The results of fixed-effects modelling controlling for differences between countries and time periods showed that the unemployment rate is closely related to the evolution of fertility. (Goldstein et al. (2013)). Furthermore, Spéder (2019) assumed that where inflation was higher, people deemed the living conditions less predictable, and thus were more inclined to revise their plans, and to abandon their short-term intentions for having children.

Wesolowski and Ferrarini (2018) empirically tested the effects of different family policy settings on fertility in 33 industrialized countries (including Bulgaria, Czechia, Lithuania, Hungary, Romania, Slovakia, and Slovenia) using pooled time-series analysis with country fixed effects and stepwise control for female labour force participation, unemployment rates and GDP between 1995 and 2011. Their results indicated that earner–carer support is associated with higher fertility, while traditional family support is not. Furthermore, higher female labour force participation is associated with higher fertility if GDP is not controlled for. Meanwhile, as many other authors, they also verified the result that higher unemployment is associated with lower fertility levels (Wesolowski and Ferrarini (2018)).

Szabó-Morvai et al. (2019) focused mainly on the effect of social expenditure variables on fertility, besides other demographic and economic variables. They used a standard first-differenced model with a two-year lag, country and year fixed effects for the time period 2001–2014 and 19 European countries (including Czechia, Estonia, Hungary, and Slovakia). According to their estimation results, the total fertility rate is mostly influenced by economic and employment conditions and the old-age dependency ratio. A 1 percentage point reduction in the female unemployment rate would increase the TFR by 0.6 percent, and a 1 percentage point reduction in the old-age dependency ratio by 1.6 percent. Their analysis reinforces those according to whom cash benefits have no significant impact on fertility (Szabó-Morvai et al. (2019)).

4. Methodology

In order to measure the effect of potential influential factors on fertility, we estimate a panel regression in first differences using the ordinary least squares method. The left-hand-side variable is the change in total fertility rate, while the right-hand-side variables are the two-period lagged changes of the potential influential factors. The usage of two-period lags of the *X* variables reflects the fact that fertility decisions are lagging behind policy changes, i.e., it takes time for the population to realize that

policy changes have been implemented, and still, fertility decisions are hard to make and are needed a substantive consideration. The following equation is used to estimate our model:

$$\text{(EQ1)} \quad \Delta TFR_{i,t} = \alpha + \beta \cdot \Delta X_{i,t-2} + u_{i,t} \quad \text{, where}$$

i is the index of countries, and *t* refers to time. *TFR* on the left-hand-side is the total fertility rate, while *X* is the vector of the following potential influential factors: percentage change of the mean age of women at childbirth, old-age dependency ratio, life expectancy, crude marriage rate, proportion of live births outside marriage, economic sentiment indicator, food inflation rate, construction cost index, proportion of female and male labour force participation rates, employment rate of 25–49 years old females, part-time employment rate of 25–49 years old females, unemployment rate, total general government expenditure on families and children in percentage of GDP, tax break for families with two children. Detailed information about the data description is in Appendix Table A.2. Standard errors are corrected for country clustering.

An important issue that we wanted to address in a specification of our model is whether there is heterogeneity in the effects of the potential influential factors between the two country groups, i.e., the 11 CEE countries and the rest of the EU. Instead of including interaction terms of the X variables and the CEE dummy variable in the regression models, we divided all the X variables into two other variables using the following technique:

$X_{CEE,i} = X_i$ if the country belongs to the CEE group, and 0 otherwise

$X_{non\text{-}CEE,i} = X_i$ if the country belongs to the non-CEE group, and 0 otherwise

The $X_{CEE,I}$ and $X_{non\text{-}CEE,I}$ variables are included in the regressions, and this allows us to have interpretations that are more adequate from the point of view of our hypotheses.

5. Data

We use macro-level data from 27 countries of the European Union with special attention to the CEE countries. Our regression refers to the time period from 1995 to 2020. All data comes from the Eurostat (2022) online database, with the partial exception of the total fertility rate and mean age at birth time series, in case of which the data for Germany is available in the Eurostat database only from 2000. We use the TFR and MAB data from the Human Fertility Database (2022) for Germany for the years between 1995 and 1999.[7]

Table 1 shows the list of the variables we use, and the most important descriptive statistics.

[7] We think that the use of the Human Fertility Database to fill the gaps of the German time series is entirely acceptable, because the values in the two databases are quite similar for the remaining part of the analysed time period.

Table 1: Summary statistics of the database (1995–2020)

Variable	Unit of measurement	Mean	Standard deviation
Total fertility rate	number	1.546	0.203
Growth rate of the mean age of women at childbirth	percentage	0.004	0.003
Old-age dependency ratio	percentage	26.164	4.441
Life expectancy	year	79.032	3.055
Crude marriage rate	percentage	4.641	1.103
Proportion of live births outside marriage	percentage	39.172	12.980
Economic sentiment indicator	standardized index value	99.386	8.735
Food inflation rate	percentage	2.226	2.852
Construction cost index	Index (2015=100)	96.167	11.125
Relative labour force participation rate of females	proportion	0.848	0.075
Employment rate of 25–49 years old females	percentage	74.142	6.968
Part-time employment rate of 25–49 years old females	percentage	21.763	17.070
Unemployment rate	percentage	8.243	4.299
Total general government expenditure on families and children in percentage of GDP	percentage	1.909	0.958
Tax break for children	percentage point	0.018	0.018

6. Results

Our panel regression results (based on equation EQ1) can be seen in Table 2. We have estimated the effects of the independent variables using two different specifications. Specification 1 is the baseline model assuming homogenous effects of the potential influentials for both country groups (i.e., CEE and non-CEE countries) in the sample. On the other hand, Specification 2 accounts for some heterogeneity between the CEE countries and the rest of the EU members.

Table 2: Regression results

	Specification 1	Specification 2
VARIABLES	**Dependent variable: Δ TFR_{t+2}**	**Dependent variable: Δ TFR_{t+2}**
Δ MAB growth rate	–0.6421* (0.3482)	–0.4540 (0.4931)
Δ MAB growth rate (CEE)		–1.1175* (0.5476)
Δ old-age dependency ratio	–0.0137* (0.0075)	–0.0192** (0.0084)
Δ old-age dependency ratio (CEE)		0.0086 (0.0078)
Δ life expectancy	0.0170*** (0.0055)	0.0215*** (0.0070)
Δ life expectancy (CEE)		0.0119 (0.0086)

Δ crude marriage rate	0.0344*** (0.0111)	0.0276* (0.0140)
Δ crude marriage rate (CEE)		0.0460** (0.0166)
Δ proportion of live births outside marriage	0.0060** (0.0026)	0.0050 (0.0033)
Δ proportion of live births outside marriage (CEE)		0.0100** (0.0039)
Δ economic sentiment indicator	0.0006* (0.0003)	0.0003 (0.0003)
Δ economic sentiment indicator (CEE)		0.0014** (0.0006)
Δ food inflation rate	–0.0007 (0.0006)	0.0008 (0.0006)
Δ food inflation rate (CEE)		–0.0020** (0.0009)
Δ construction cost index	–0.0010 (0.0011)	–0.0003 (0.0009)
Δ construction cost index (CEE)		–0.0016 (0.0014)
Δ relative labour force participation rate of females	–0.4465 (0.3406)	–0.5187 (0.4353)
Δ relative labour force participation rate of females (CEE)		–0.2012 (0.5705)
Δ employment rate of females 25–49 years old	0.0032 (0.0031)	0.0036 (0.0048)
Δ employment rate of females 25–49 years old (CEE)		0.0027 (0.0037)
Δ part-time employment rate of females 25–49 years old	0.0028 (0.0020)	0.0043*** (0.0015)
Δ part-time employment rate of females 25–49 years old (CEE)		–0.0022 (0.0041)
Δ unemployment rate	–0.0027 (0.0033)	–0.0007 (0.0047)
Δ unemployment rate (CEE)		–0.0009 (0.0051)
Δ total general government expenditure on families and children	–0.0032 (0.0112)	–0.0016 (0.0153)
Δ total general government expenditure on families and children (CEE)		–0.0097 (0.0210)
Δ tax break for children	0.3298 (0.4856)	0.9285** (0.4490)
Δ tax break for children (CEE)		0.3743 (0.6399)
Constant	0.0023 (0.0070)	–0.0011 (0.0060)
Observations	419	419
R-squared	0.1604	0.2209

Notes: Regression results estimated by equation (EQ1). Clustered standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

The list of variables in Table 2 starts with five demographic and social variables, all of which have a statistically significant effect on the change of the TFR. As it can be seen from the estimation results, a faster rate of increase in the mean age at birth has a statistically significant negative impact on the change of the total fertility rate in the baseline specification. This result is in accordance with the results of several other authors cited above: an acceleration of the increase in the MAB means that women postpone having children and it also leads to a lower total number of children as well, since some of the previously planned children are not only born with a delay, but not born at all. On the other hand, a deceleration of this process in itself has a positive effect on the TFR, since it means that women start to realize their previously postponed intentions of having children. However, as it can be seen from the results of Specification 2, the effect of the MAB growth rate is statistically significant only for the CEE country group. A possible explanation of the heterogeneity among the regions may be found in the fact that most of the Western European countries already had a higher MAB at the beginning of the 1990s, while the remarkable increase of the mean age at childbirth in Central and Eastern Europe mostly took place during the time period of our analysis.

The old-age dependency ratio also has a negative estimated coefficient in the baseline specification, however, this effect holds only for the non-CEE country group, as Specification 2 shows. This result is similar to that of Szabó-Morvai et al. (2019), and its possible explanation can be that a larger proportion of elderly people means that more time, money and other resources have to be used for their support, therefore both the individuals and the society as a whole have less resources that can be used to raise children. On the other hand, life expectancy at birth has a strong positive effect on the TFR, but again it is true only for the non-CEE countries, as there is no significant effect in the case of the CEE countries in Specification 2. At a first glance, the fertility-enhancing effect of longevity may seem somewhat contradictory, since higher life expectancy usually goes together with population ageing, i.e., an increasing share of elderly people within the society. However, life expectancy at birth measures the general health status of people, and it is quite straightforward that better health status increases fertility both directly and indirectly through a higher level of welfare and more means to raise children.

We have also included two other demographic and social variables in our models: the crude marriage rate and the proportion of live births outside marriage. Both of these variables have statistically significant positive coefficients in the baseline specification. The two variables measure two different social aspects of having children. The crude marriage rate captures the intentions of people to formally start a family (although, having children is naturally not the only possible reason to get married), while the proportion of live births outside marriage can show how socially acceptable it is to have children without living in a legally formalized family. It is also worth mentioning that these two variables are not entirely independent from each other, because a higher marriage rate usually decreases the share of children born out of wedlock. However, if a higher marriage rate also comes together with a higher frequency of divorces, then it does not necessarily mean a larger proportion of people living (therefore, a larger proportion of children born) in marriage. In the case of the crude marriage rate the heterogeneity between the two country groups is only presented in quantity, since the effect is positive and significant in both cases, but the magnitude is different. On the other hand, the positive effect of the proportion of live births outside marriage is estimated only for the CEE countries, there is no statistically significant effect for the non-CEE countries.

The next few variables in Table 2 try to capture different aspects of the general economic situation. First, the economic sentiment indicator (ESI) calculated by the European Commission has a significant and positive effect on the change in TFR. However, the average effect in the baseline model is driven by the CEE countries, since, as it can be seen in Specification 2, there is no significant effect for the non-CEE countries. This indicator is based on business and consumer surveys and shows a general

picture of how people assess the economic situation. Although it is not an objective measure of some aspect of the economy, such a sentiment indicator mirrors the economic situation: generally, if the economy performs better, most of the respondents of such surveys will also feel an improvement in their situation and market environment. A better economic situation can increase fertility rates directly, because it means that people have more resources that may make them more able and willing to have children. However, there can be an indirect effect as well that can reinforce this direct effect: a better current economic situation may make people more optimistic about their future opportunities, which is naturally also very important since having children is a decision with long-lasting consequences, i.e., potential parents have to take into account not just their current ability to bear the costs of raising children, but their future ability as well.

Another economic variable included in our model is the harmonised index of consumer prices in the case of foods and non-alcoholic beverages. We use this measure because it is one of the most direct ways in which people can feel the changes in their personal economic situation. If food prices increase significantly (just as it happened in 2022 in Europe, especially in Hungary), then people quickly and directly realise that their real income (or more generally: the purchasing power of their assets) decreases. Therefore, we can expect that a higher inflation rate in the case of food products leads to lower ability and willingness to have children. However, our results are somewhat mixed in this regard. In the baseline specification, food inflation has a negative, but statistically insignificant coefficient. When we allow for heterogeneity among the country groups in Specification 2, the estimated coefficient for the non-CEE countries is insignificant, while in the case of the CEE countries it is negative and statistically significant.[8]

The heterogeneity in the effects of the ESI and the food inflation rate means that people in the CEE countries react more strongly to changing economic situations in modifying their child-bearing intentions. In other words, our results suggest that the economic stability or uncertainty is an important explanatory variable for the movements in the TFR only in the CEE countries.

We have assumed that construction costs may also be an important factor in affecting fertility rates, because having a home to live is an elementary condition of starting a family and have children. However, the construction cost index was found to be statistically not significant in both specifications.

It is also worth noting that the labour market indicators that we included in our models all have statistically insignificant coefficients in the baseline specification, although their signs are mostly as expected: negative in the case of unemployment (as higher unemployment also shows a worsening economic situation) and the relative labour force participation of women (as the higher labour market activity of women may drive them away from having children), and positive in the case of part-time employment of females (as a more flexible labour market makes it easier to have children and be employed at the same time). Naturally, the statistical insignificance of the coefficients does not necessarily mean that labour market conditions are irrelevant in fertility decisions, instead it may show that effects of labour market indicators are already captured by other explanatory variables (either by the demographic and social variables or by the economic sentiment indicator). It is noteworthy that when we allow for heterogeneity among the country groups, the coefficient of one labour market variable becomes significant: the share of part-time employment among females in non-CEE countries. On the

[8] It is also worth mentioning that food prices tend to have a higher rate of increase in Central and Eastern Europe than in the Western part of the continent. In the period between 1999 and 2022 (for which annual food inflation rates are available for all 27 member states in the Eurostat database), the unweighted average of the 11 CEE countries was higher than the unweighted average of the other 16 EU member states in 19 out of the 24 years. The difference was extraordinarily high in 2022: 19.2 percent compared to 10.3 percent.

one hand, this may mean that a flexible labour market is less important in Central and Eastern Europe from the perspective of fertility decisions than in the Western part of the continent. However, it also should not be forgotten that part-time employment rates are both much higher and show a larger variability in non-CEE countries than in Central and Eastern Europe.[9]

Finally, we also wanted to examine whether family-related government policies have an effect on the TFR. Therefore, we included two policy variables in our model, one from each side of the budget: government expenditures on families and children as a percentage of GDP, and a measure of tax allowances for children, namely, the difference between the tax burden of couples with no and with 2 children, if both members of the couple earn the national average. The coefficient of family-related government spending is statistically insignificant in both specifications, which means that the amount of such expenditures does not seem to be an important factor in child-bearing decisions. On the other hand, the picture is more interesting in the case of tax deductions for children. The coefficient in the baseline specification is positive, but insignificant. However, again we can see heterogeneity among the country groups in Specification 2: while the coefficient is not significant in the case of CEE countries, it is positive and significant for the other EU member states. Therefore, while tax deductions may be effective in increasing the willingness of families to have children, it seems that in Central and Eastern Europe other social and economic factors are more important in affecting child-bearing decisions.

7. Conclusions

In this paper, we have conducted a panel analysis of the main (economic and social) determinants of the total fertility rate. Besides depicting the general European situation, we have also focused on the Central and Eastern European region and analysed the main factors that can explain the significantly different picture in CEE countries regarding the evolution of the TFR in the last few decades. Our main academic contribution lies in adding to the empirical literature regarding Central and Eastern Europe with the use of panel econometric techniques in analysing fertility rates in the region. The related literature contains quite few papers with empirical research focusing on these countries.

Our results suggest that the factors affecting fertility the most include variables describing attitudes towards marriage and childbearing: crude marriage rate, proportion of live births outside marriage, and the changes in the mean age at birth. The general health status of the population (measured by life expectancy) also matters, while population ageing (measured by the old-age dependency ratio) decreases the total fertility rate as it shifts resources from childbearing to the support of elderly people, both on an individual and on a social level. Our results also indicate that there are indeed differences in the determinants of the TFR in Central and Eastern Europe; CEE countries seem to be significantly more sensitive to changes in the economic situation. We have seen this phenomenon both in the case of the economic sentiment indicator and the inflation rate of food products. We believe that this finding is important as the economies of CEE countries tend to be more volatile and vulnerable than the more developed economies of Western Europe. The finding that the average willingness to childbearing is especially sensitive to the economic situation in the region may also be a relevant input for policymakers in designing family policies. There are other differences as well between the

[9] In 2002 (the first year for which the Eurostat database contains part-time employment rates for all 27 EU member states), the unweighted average for CEE countries was 6.2 percent (with a standard deviation of 2.7 percentage points), while for non-CEE countries the unweighted average was 26.2 percent (with a standard deviation of 16.2 percentage points). The difference between the two unweighted averages was very similar in 2021 as well (6.8 percent versus 27.4 percent), although the difference between the standard deviations was somewhat more moderate (3.9 percentage points versus 14.4 percentage points).

determinants of TFR among CEE and non-CEE countries: the growth rate of the mean age at childbirth, and the proportion of children born out of wedlock were found to be significant only in Central and Eastern Europe, while the coefficients of the old-age dependency ratio, life expectancy at birth, the share of part-time employment, and the tax break for children are significant only in the case of the non-CEE country group.

Our future research plans include the adjustment of the data set that we use in the analysis. We plan to include some further time series as potential explanatory variables, e.g., regarding the expansion in higher education. We would also try to incorporate a more detailed analysis of the possible effects of family policies on fertility. We expect that the general findings remain valid in this more detailed analysis as well.

References

Bergsvik, J., Fauske, A. and Hart R. K. (2021). Can policies stall the fertility fall? A systematic review of the (Quasi-) Experimental Literature. *Population and Development Review* 47(4): 913–964 (December 2021)

Billingsley, S. (2010). The post-Communist fertility puzzle. *Population Research and Policy Review*, 29 (2), 193–231.

Bongaarts, J. and Sobotka, T. (2012). A demographic explanation for the recent rise in European fertility. *Population and Development Review* 38 (1): 83–120.

Comolli, C. L. (2017). The fertility response to the great recession in Europe and the United States: Structural economic conditions and perceived economic uncertainty. *Demographic Research* 36: 1549–1600.

Eurostat (2022). Online Database. https://ec.europa.eu/eurostat/data/database. Last accessed 10 November 2022.

Frejka T. (2008). Determinants of family formation and childbearing during the societal transition in Central and Eastern Europe. *Demographic Research* 19(7): 139-170.

Frejka, T., Hoem, J.M., Sobotka, T. and Toulemon, L. (2008). Childbearing trends and policies in Europe. *Demographic Research,* Special Collection 7, 19(8): 1-1178.

Frejka, T. and Sobotka, T. (2008). Fertility in Europe: Diverse, delayed, and below replacement. *Demographic Research*, Special Collection 7, 19(3): 15-46.

Frejka, T., Lesthaeghe, R., Sobotka, T. and Zeman, K. (2011). Postponement and recuperation in cohort fertility: new analytical and projection methods and their application. *European Demographic Research Papers*. No. 2. Vienna Vienna Institute of Demography. Vienna

Frejka, T. and Gietel-Basten, S. (2016). Fertility and family policies in Central and Eastern Europe after 1990. *Comparative Population Studies* 41(1): 3-56.

Goldstein, J.R., Sobotka, T. and Jasilioniene, A. (2009). The end of 'lowest-low' fertility? *Population and Development Review* 35(4): 663–699.

Goldstein, J.R., Kreyenfeld, M., Jasilioniene, A. and Örsal, D.K. (2013). Fertility reactions to the 'Great Recession' in Europe: Recent evidence from order-specific data. *Demographic Research* 29(4): 85–103. doi:10.4054/DemRes. 2013.29.4.

HCSO (2022): Online Database. Hungarian Central Statistical Office, Budapest. www.ksh.hu Last accessed 10 November 2022.

Human Fertility Database (2022): Online database. www.humanfertility.org Last accessed 10 November 2022.

Kohler, H. P., Billari, F. C. and Ortega, J. A. (2002): The emergence of lowest-low fertility in Europe during the 1990s. *Population and Development Review* 28(4): 641–680.

Lesthaeghe, R. (2010). The unfolding story of the second demographic transition. *Population and Development Review* 36 (2): 211–251.

Luci-Greulich, A. and Thévenon, O. (2013). The impact of family policies on fertility trends in developed countries. *European Journal of Population* 29: 387-416.

Macura, M. (2000). Fertility Decline in the Transition Economies, 1989–1999: Economic and Social Factors Revisited. Geneva, United Nations Economic Commission for Europe, 189–207.

Matysiak, A., Sobotka, T. and Vignoli, D. (2021). The great recession and fertility in Europe: A sub-national analysis. *European Journal of Population* 37:29–64 https://doi.org/10.1007/s10680-020-09556-y

Philipov, D. and Kohler, H.-P. (2001). Tempo effects in the fertility decline in Eastern Europe: Evidence from Bulgaria, the Czech Republic, Hungary, Poland and Russia. *European Journal of Population* 17(1): 37–60.

Sobotka, T. (2011): Fertility in Central and Eastern Europe after 1989. Collapse and gradual recovery. In: *Historical Social Research* (Special issue Fertility in the 20th Century: trends, policies, theories, discourses) 36(2): 246-296.

Sobotka, T., Skirbekk, V. and Philipov D. (2011). Economic recession and fertility in the developed world. A literature review. *Population and Development Review* 37(2): 267–306. doi:10.1111/j.1728-4457.2011.00411.x.

Sobotka, T. and Lutz, W. (2011). Misleading policy messages derived from the period TFR: Should we stop using it? *Comparative Population Studies–Zeitschrift für Bevölkerungswissenschaft*. 35(3): 637–664.

Spéder, Zs. (2019). A hazai termékenységi magatartás nemzetközi összehasonlításban. (in Enlish: *Domestic fertility behavior in international comparison*) Academic Doctoral Dissertation. Budapest. 2019.

Szabó-Morvai, Á., Balás, G., Bördős, K. and Herczeg, B. (2019). Evaluation of family policy measures and their impact on fertility. *HÉTFA Research Institute*. Budapest, 2019.

Van De Kaa, D. (1987). Europe's second demographic transition. *Population Bulletin* 42 (1) 1–57.

Van De Kaa, D. (2004). Is the second demographic transition a useful research concept. Questions and answers. *Vienna Yearbook of Demography*: 4-10.

Wesolowski, K. and Ferrarini, T. (2018). Family policies and fertility. Examining the link between family policy institutions and fertility rates in33 countries 1995-2011. *International Journal of Sociology and Social Policy* 38(11/12): 1057-1070. DOI 10.1108/IJSSP-04-2018-0052

Appendix

Table A.1: Trends in the CEE countries' TFR

CEE countries within the EU	TFR in 1990	Minimum TFR values around 2000		Maximum TFR values before or around the financial crisis		Minimum TFR values after the financial crisis		TFR in 2020
		year	value	year	value	year	value	
Bulgaria	1.82	1997	1.09	2009	1.66	2013	1.48	1.56
Croatia	1.67	1999	1.38	2009	1.58	2011	1.48	1.48
Czechia	1.9	1999	1.13	2009	1.51	2011	1.43	1.71
Estonia	2.05	1998	1.28	2010	1.72	2013	1.52	1.58
Latvia	2	1998	1.1	2008	1.58	2011	1.33	1.55
Lithuania	2.03	2002	1.23	2009	1.5	2013	1.59	1.48
Hungary	1.87	2003	1.27	2008	1.35	2011	1.23	1.59
Poland	2.06	2003	1.22	2011	1.41	2013	1.29	1.39
Romania	1.83	2002	1.27	2009	1.66	2013	1.46	1.8
Slovakia	2.09	2002	1.19	2011	1.45	2012	1.34	1.59
Slovenia	1.46	2003	1.2	2010	1.57	2013	1.55	1.59

Source: Eurostat Database (2022), Human Fertility Database (2022)

Table A.2: Description of macroeconomic variables

Variables	**Source and availability**	**Definition**
Total fertility rate (TFR)	Eurostat (demo_frate) 1995–2020 Data available completely from 2000 to 2020, the missing data of Germany (1995–1999) is replaced by TFR values from the Human Fertility Database	"TFR expresses to how many children a female would give birth during her life at the birth frequency by age of the given year." (HCSO (2022))
Mean age of women at childbirth (MAB)	Eurostat (demo_find) 1995–2020 Data available completely from 2000 to 2020, the missing data of Germany (1995–1999) is replaced by MAB values from the Human Fertility Database	"MAB: the mean age is indicated with a weighted arithmetical mean calculated on the basis of the age-specific live birth data of the females giving birth to children in the given calendar period." (HCSO (2022))
Old-age dependency ratio	Eurostat (demo_pjanind) 1995–2020	The ratio of the population aged 65 years or over to the population aged 15 to 64 years
Life expectancy	Eurostat (demo_mlexpec) 1995–2021 Data available completely from 2002 to 2021	Life expectancy at birth for females and males in total

Crude marriage rate	Eurostat (demo_nind) 1995–2020	The number of marriages in a year per 1000 persons
Proportion of live births outside marriage	Eurostat (demo_find) 1995–2020	The proportion of live births where the mother's marital status at the time of birth is other than married
Economic sentiment indicator	Eurostat (ei_bssi_m_r2) 1995–2020 Hungarian data is available from 1996, Croatian data is available from 2008	The economic sentiment indicator is calculated by the DG ECFIN of the European Commission based on business and consumer surveys. Seasonally adjusted, but not calendar adjusted monthly data
Food inflation rate	Eurostat (prc_hicp_aind) 1996–2021 Data available completely from 1999 to 2021	Harmonised Index of Consumer Prices – Annual average rate of change on food and non-alcoholic beverages
Construction cost index	Eurostat (sts_copi_a) 1995–2020	Construction cost of residential buildings, except residences for communities Unadjusted annual data, index (2015 = 100)
Relative labour force participation rate of females	Eurostat (lfsa_argan) 1995–2020 Data available completely from 2002 to 2021	Ratio of the labour force participation rates (economically active population over total population aged 20–64 years) of females and males
Employment rate of females 25–49 years old	Eurostat (lfsa_ergan) 1995–2021 Data available completely from 2002 to 2020	Ratio of the employed female population to the total female population aged 25–49 years
Part-time employment rate of females 25–49 years old	Eurostat (lfsa_eppga) 1995–2021 Data available completely from 2002 to 2021	Part-time employment as percentage of the total employment among females aged 25–49 years
Unemployment rate	Eurostat (une_rt_a_h) 1995–2020 Data available completely from 2000 to 2020	Ratio of unemployed population to the labour force aged 20–64 years, males and females in total
Total general government expenditure on families and children	Eurostat (gov_10a_exp) 1995–2020 Data available completely from 2001 to 2020	Total general government expenditure on families and children (COFOG GF1004), percentage of gross domestic product
Tax break for children	Eurostat (earn_nt_net) 2000–2021 Data available completely from 2013 to 2021	Difference between the average tax rates of a two-earner couple without children, both earning the national average and a two-earner couple with two children, both earning the national average