‘MISSING BIRTHS’: DECOMPOSING THE DECLINING NUMBERS OF BIRTHS IN EUROPE INTO TEMPO, QUANTUM AND AGE STRUCTURE EFFECTS

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XXV IUSSP International Conference
Tours, France 18-23 July 2005
Session 164
“Prospects for below replacement fertility”

Draft: 27 June 2005

This is a preliminary and incomplete draft featuring first results of our analysis. Please do not quote without permission of the authors.

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ABSTRACT

Most European societies have experienced marked decline in the numbers of births during the last decades. This study aims to contribute to our understanding of the past twists in the numbers of births and our ability to foresee the future ones. It discusses various possibilities of decomposing changing numbers of births, starting from a basic decomposition that distinguishes tempo, quantum, and ‘mean generation size’ components, and illustrating further extensions of this decomposition. The empirical analysis focuses on the impact of the three main components on the declining numbers of births from the beginning of fertility postponement in 13 European societies. It reveals considerable variability: in all analysed countries, fertility postponement has put a downward pressure on the observed births, but only in Austria, Denmark, and Sweden, and in three post-communist societies—the Czech Republic, Hungary, and Poland—tempo distortions constituted the major force affecting negatively the numbers of births. The analysis of the recent role of tempo distortions in period fertility may be used for projecting the future trends. This paper argues that an explicit inclusion of assumptions concerning tempo effects may lead to a considerable improvement of the projection scenarios of fertility and births. Using examples of three countries with different intensity and duration of fertility postponement (Austria, the Czech Republic, and Finland) this study shows how the eventual stabilisation of the mean age at childbearing may affect numbers of births in the future.

1 INTRODUCTION

Changes in the number of births are frequently interpreted by the media in a direct way, as indicative of the ‘positive’ or ‘negative’ economic, social, and policy influences, which in turn affect women’s and couples propensity to have children. However, changing numbers of births frequently reflect shifts in the number of women in the prime childbearing ages or in the timing of childbearing rather than increasing or declining fertility level (‘quantum’). For these reasons, demographers usually ignore trends in total births and prefer to look at various ‘purer’ fertility measures instead. When doing so, however, it is often forgotten that it is the total number of births that is decisive for most of the social and economic consequences of population trends. Whether one is interested in the future of public schooling, labour markets, pensions, or social security systems it is always the size of cohorts that ultimately matters, which is a direct function of the number of births. Thus it is important to disentangle different factors that lead to fluctuations in the number of births in advanced societies, frequently causing distinctive baby booms and busts. Such an analysis is also essential for projecting future trends.

Our study focuses on the countries of European Union. While the total number of births in the present-day EU (25) was highest in 1964 (7.3 million), a gradual decline has been recorded in the subsequent decades, reducing the total births to 4.7 million in 2002 (EUROSTAT 2004). This long-lasting decline certainly deserves a careful examination, however, it also hides strong regional differences, which are even more compelling. In Sweden, for example, two distinctive baby booms brought the total live births to 123 thousand in 1966 and 124 thousand in 1994, subsequently dropping close to 92 thousand (1983) and 88 thousand (1999), respectively (Council of Europe 2005). In contrast, Spain recorded a continuing decline of the total number of births by almost a half between 1964 (698 thousand) and 1996 (363 thousand).

These trends were brought forward by a combination of different factors, namely changes in fertility level, changes in the number and parity composition of women at different reproductive ages, changes in fertility timing, and the interaction between these factors. This paper focuses particularly on the role of fertility postponement in reducing total number of births and contributing thus to the slow or negative population growth in most the regions of the European Union. In the context of low fertility, reached in all European countries, the effects related to changes in fertility timing (‘tempo effects’) are of a paramount importance for determining the total number of children born in a given period. While the contribution of tempo effects to very low fertility rates in many European countries has been studied extensively (e.g. Lesthaeghe and Willems 1999; Kohler, Billari, and Ortega 2002; Lutz, O’Neill, and Scherbov 2003; Sobotka 2004a and 2004b), their influence on the total births and total population size has been left unexamined to date.[1]

This study aims to contribute to our understanding of the past twists in the numbers of births and our ability to foresee the future ones. We use a simple method that enables to decompose period changes in the total number of births into the following effects: changes in the mean generation size of potential mothers, changes in fertility quantum, and changes in fertility tempo combined with changes in the parity

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[1] A framework of such decomposition has, however, been suggested earlier (see e.g., Ortega and Kohler 2002: 18).

distribution of women. This method employs multiplicative indexes, which give a relative weight to the influence of each of these factors in comparison with a selected reference year. The decomposition can be easily extended to capture the influence of parity-specific changes as well as the more detailed specification of changes in the age structure of women and the age distribution of fertility schedule. We illustrate how this decomposition can be used to assess the contribution of each factor to the absolute change in the number of births during the last decades, especially from the beginning of fertility postponement in various European countries. Our analysis of data for 13 European societies shows pronounced cross-country differences in the factors contributing to the swings in the total number of births.

The paper is structured as follows. The next section briefly describes the data used. The subsequent section introduces the main decomposition method, provides different examples of decomposing absolute and relative changes in total number of births, and discusses further extensions of the basic decomposition. The fourth section describes in detail major findings on the influence of changing tempo and quantum of fertility and mean generation size of mothers on the total births from the beginning of fertility postponement in 13 European countries. The fifth section shows on the example of three countries how the tempo distortions may be explicitly incorporated into projections and how different assumptions regarding tempo effects influenced the projected number of births. The next section concludes.

2 DATA

In order to estimate the size of tempo effects in fertility rates, we use detailed vital statistics data on the number of births by age of mother and birth order combined with the official estimates of age composition of the female population. In total, we analyse data for the following countries and regions: Austria, the Czech Republic, Denmark, England and Wales, Finland, France, Hungary, Italy, the Netherlands, Poland, Romania, Spain, and Sweden. Most of these data originate from the EUROSTAT New Cronos database (EUROSTAT 2005a); additional data sources are CBS (2004) for the Netherlands and POPIN CR (2002), CSU (2000), and FSU (1963-1989) for the Czech Republic.

Additional data on births by birth order and age of mother and on age and parity-specific cohort fertility were used to estimate order-specific fertility indicators. These additional data include the cohort parity distribution of women in Austria provided by the 2001 Population Census (Statistics Austria 2005) and in the Czech Republic as recorded by the 1980 Census (FSU 1982b), estimates of age and order-specific fertility rates realised before 1974 among Swedish women born in 1927-1957 (Johansson and Finnås 1983), tabulated data on age-parity distribution of Polish women in 1989 (Bolesławski 1993) as well as data on age and parity distribution of women in Finland (SF 2001). Furthermore, we use expert estimates of the ‘true parity’ distribution of first and second births by age of mother in England and Wales (Smallwood 2002 and ONS 2002) and reconstructed data on age and order-specific fertility rates in France (Toulemon and Mazuy 2001), which are based on the 1999 INSEE Study of Family History.

3 METHODS

This section introduces in detail the main decomposition method used and discusses its further extensions. Methodology used in the projection scenarios is discussed at the beginning of Section 5.

Our primary interest is to disentangle the effects of changing 'tempo' (timing) and 'quantum' (level) of period fertility on the total number of births recorded in different European countries. This decomposition requires a clear definition of tempo distortions. Most of our estimates of adjusted fertility rates, free of tempo effects, are based on a simplified version of the adjustment method proposed by Kohler and Ortega in 2002.[2] We estimate tempo-adjusted index of period fertility (*adjPATFR*) based on multiplicative age-parity fertility table for birth orders 1 and 2. To derive the total adjusted fertility, we combine these estimates with the conventional total fertility rate for birth order 3 and higher, reducing thus the instability of the adjusted rates, which is pronounced at higher parities.[3] In addition, when we do not have detailed data necessary for the computation of Kohler-Ortega adjustment, we make limited use of simpler and less data-intensive adjustment proposed by Bongaarts and Feeney in 1998. We employ this method for four countries during the initial years of fertility postponement (Denmark 1974-1980, Italy 1976-1980, the Netherlands 1972-1980, and Hungary 1980-1984).[4]

The basic decomposition utilised in this study estimates the effects of fertility quantum, tempo and the 'mean generation size' *G* on the total number of births. In addition, we discuss several extensions to this basic decomposition. The first extension distinguishes the following components of the 'mean generation size': changing size of the female population at fertile ages, shifts in the age distribution of fertility rates and the joint influence of both factors. The second extension enables to differentiate the change in fertility level (quantum) and tempo by birth order. In addition, we illustrate two possibilities how to distinguish between the influence of 'real' tempo distortions in fertility rates and the effects of changes in the parity composition of the female population on the observed number of births. These illustrations, however, do not capture all possible decompositions. For instance, we did not attempt to decompose changes in the number of births that are related to the influence of migrants and those that are due to the changes in the number of 'native' women or due to the changes in their fertility patterns. Many more possibilities for complex decompositions can be further elaborated as well.

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[2] We utilise age-parity birth probabilities as contrasted with the occurrence-exposure rates (birth intensities) used by the Kohler and Ortega. Furthermore, we did not smooth the observed set of age-parity probabilities before the adjustment nor did we apply an iterative procedure aiming to provide a correction for variance effects. In order to reduce irregularities in the adjusted fertility index, we restricted the age range of birth probabilities to be used for inferring all the parameters necessary for the adjustment to ages 20 to 40 for birth order 1 and 22 to 40 for birth order 2.

[3] Because fertility postponement is less intensive at higher birth orders and higher-order births have a relatively small share on the total fertility in many countries, substituting the adjusted fertility index for birth orders 3+ by the TFR does not alter much the overall estimate of fertility quantum.

[4] While the trends in fertility quantum and the size of tempo distortions depicted by both methods are usually in agreement, the Bongaarts-Feeney adjustment provides less stable results and indicates on average higher levels of fertility quantum (and more intensive tempo effects) than the Kohler-Ortega method.

3.1 Decomposing the overall change in the number of births: Basic equation incorporating the size of tempo distortion

Calot's (1984) concept of the *mean generation size* (*G*), which links the recorded number of live births *B* in a year *t* with the period total fertility rate (*TFR*) in that year, provides a starting point for our decomposition: $G = B / TFR$. The mean generation size *G* represents the number of women in fertile age, weighted at each age *x* by the relative contribution of fertility at this age to the total fertility rate:

$$G = \sum_x (fx \cdot Nx) / (\sum_x fx) = \sum_x (fx \cdot Nx) / TFR \qquad [1]$$

where f_x represents age-specific fertility rates (incidence rates) and N_x age-specific total population of women, estimated for the middle of the year. Combining the adjusted period fertility index (*adjPATFR*) and the conventional *TFR*, we estimate the index of tempo distortion, I_T, for each calendar year considered: $I_T = TFR / adjPATFR$. When fertility postponement takes place, the *adjPATFR* exceeds the observed *TFR* and the tempo distortion index I_T drops below 1.0. Its value signals an extent to which the total fertility rate and the number of births in a given year are affected by fertility postponement and the changes in the parity composition of the female population.[5] We frequently compare number of births in the year t_1 with the births observed in the selected reference year t_0. In the decomposition of change over time, the ideal choice of this 'benchmark year' is such that the tempo effects are absent and the number of births B_0 thus remains unaffected by fertility postponement or advancement. When, however, tempo effects influence the number of births in the year t_0, the index of tempo distortion for other years may be standardised to reflect the size of tempo distortions relative to the reference year: $I_{T(STAND)} = I_T(t_1) / I_T(t_0)$. Alternatively, the initial magnitude of tempo distortion in year t_0 may be taken into account in the analysis of subsequent trends. Using the expression of *G* specified above, we are able to estimate the hypothetical number of children born if there were no tempo effects during the period of observation (B_T') as well as the number of births 'lost' or 'gained' due to tempo distortions (β_T):

$$B_T' = B / I_T = G \cdot TFR / I_T = G \cdot adjPATFR; \; \beta_T = B - B'. \qquad [2]$$

Within this framework, the observed number of births *B* may be expressed as a function of the 'mean generation size' *G*, fertility quantum represented by the *adjPATFR,* and the size of tempo distortion I_T:

$$B = G \cdot adjPATFR \cdot I_T. \qquad [3]$$

This enables us to decompose the change in the total number of births between years t_0 and t_1 into three major components and introduce two additional indexes that account for this change—I_G, representing the relative change in the 'mean generation size' *G* between the years t_0 and t_1 and I_Q, representing the relative change in fertility quantum during this period: $I_G(t_1) = G(t_1) / G(t_0)$; $I_Q(t_1) = adjPATFR(t_1) / adjPATFR(t_0)$. Then, the observed number of births *B* in the year t_1 can be seen as a

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[5] Our main analysis does not distinguish between the effects caused directly by fertility postponement and the effects that are due to temporary shifts in the distribution of the female population by age and parity. For simplicity, we usually term both influences as 'tempo effects' or 'tempo distortions'. However, Section 3.2.2 below provides two examples of decomposition that distinguishes between the 'real' tempo effects and parity composition effects.

function of the observed number of births in the year t_0 and the indexes of change between these years:

$$B(t_1) = B(t_0) \cdot I_G(t_1) \cdot I_Q(t_1) \cdot I_{T(STAND,\, t_1)} = B(t_0) \cdot I_G(t_1) \cdot I_Q(t_1) \cdot (I_T(t_1) \,/\, I_T(t_0)). \qquad [4]$$

These indexes can be easily used to specify the total number of births 'missing' or 'gained' due to tempo effects during the period of interest in comparison with the reference year t_0. The overall change in the number of births ΔB between the years t_0 and t_1 can be decomposed as follows:

$$\Delta B(t_0, t_1) = \Delta B_G + \Delta B_Q + \Delta B_T + \Delta Bgqt\,, \qquad [5]$$

where, in an analogy with the indexes of change specified above,
ΔB_G represents the change in the number of births due to changing 'mean generation size of mothers,' i.e., changing number and age composition of the female population in conjunction with the change of the age distribution of fertility schedule;
ΔB_Q estimates the change in the number of births attributable to the changes in fertility quantum;
ΔB_T estimates the change in the number of births due to tempo distortions; and
$\Delta Bgqt$ represents all interactions between them.

Changes in the number of births over longer period of time may be derived as a sum of changes in each individual year during this period. Each indicator ΔB is computed from the corresponding index of change I and the initial number of births B_0 in year t_0.

As an illustration, consider the change in the number of births attributable to the changing size of tempo distortion and its interaction with the 'mean generation size' between years t_0 and t_1. The direct effect of changes in the magnitude of tempo distortion is

$$\Delta B_T(t_0, t_1) = (I_{T(STAND,\, t_1)} - 1) \cdot B_0\,;$$

while the interaction effect between the change in the tempo distortion in fertility rates and the 'mean generation size' is

$$\Delta B_{gt}(t_0, t_1) = (I_G - 1) \cdot (I_T - 1) \cdot B_0\,.$$

In the presence of tempo changes in the reference year t_0, we analyse subsequent changes in the number of births either by incorporating the tempo effects in t_0 into our analysis, or taking the initial index of tempo distortion $I_T(t_0)$ as a standard against which the tempo effects in the following years are evaluated. The second alternative is more practical insofar as it unambiguously relates absolute changes in the total births to the reference year. However, from the point of view of analysing the overall influence of tempo distortions, the alternative approach is more sound: it enables to pinpoint the number of births "missing" or "gained" due to tempo effects already in the reference year. In all the subsequent years, changes in fertility quantum and the 'mean generation size' are related to the initial year t_0, while the index of tempo distortion I_T reflects the absolute size of tempo effects in any given year t_1.

3.2 Further extensions of the basic decomposition

3.2.1 Decomposition of the ‘mean generation size’ G

The indicator of the ‘mean generations size’ (G) proposed by Calot (1984) can be seen as capturing the ‘annual number of potential mothers’ (Toulemon 2001). Over time, G may change as a result of changing size and age composition of the female population, as a result of a shift in fertility schedule, or as a result of an interaction between them. Disregarding tempo effects and assuming that the TFR represents fertility quantum, the change in the ‘mean generation size’ between the years t_0 and t_1 may be expressed as follows:

$$I_G(t_1) = I_A(t_1) \cdot I_S(t_1) \cdot I_{AS}(t_1)\,, \qquad [6]$$

where I_A represents the effect of change in the number of women at each reproductive age, I_S represents the effect of change in the distribution of fertility schedule by age (given the initial age distribution of the female population) and I_{AS} represents the joint contribution of these two factors. This framework enables us to distinguish whether the ‘mean generation size’ G changed primarily as a result of changing number of women, or because of fertility schedule shifting towards the ages with a different size of female population. The individual decomposition indexes may be calculated as follows:

$$I_A(t_1) = B(t_1) / B'_A(t_1)\ ;\ I_S\,(t_1) = B(t_1) / B'_S(t_1)\ ;\ \ I_{AS} = I_G / (\,I_A(t_1) \cdot I_S(t1)) \qquad [7]$$

where $B(t_1)$ stands for the registered number of births in the year t_1, $B'_A(t_1)$ represents the hypothetical number of births in t_1 with the female population of t_0, and $B'_A(t_1)$ represents the hypothetical number of births in t_1 with the relative age distribution of fertility schedule ‘frozen’ in t_0. In other words, if the number of women in each reproductive age remained the same as in t_0, there would be $B'_A(t_1)$ births observed in the year t_1; if the number of women would change as observed, but the relative distribution of fertility schedule by age would remain the same as in t_0, there would be $B'_S(t_1)$ births recorded in t_1. If both age-specific number of women and the relative age-specific distribution of fertility schedule remained constant, the hypothetical number of births in t_1 would be given solely by the initial number of births in t_0 and the change in the total fertility rate: $B'_{AS}(t_1) = B(t_0) \cdot (TFR(t_1) / TFR(t_0))$. The observed number of births $B(t_1)$ is linked with the hypothetical number $B'_{AS}(t_1)$ by the change in the index of ‘mean generation size’ I_G: $B(t_1) = B'_{AS}(t_1) \cdot I_G(t_1)$. In analogy to Equation 4 above, the number of births observed in t_1 can be expressed as a function of the number of births in t_0 and change in the decomposition indexes (recall that the index of quantum change I_Q is based in section on the conventional TFR):

$$B(t_1) = B(t_0) \cdot I_G(t_1) \cdot I_Q(t_1) = B(t_0) \cdot I_A(t_1) \cdot I_S(t_1) \cdot I_{AS}(t_1) \cdot I_Q(t_1) \qquad [8]$$

Since the indexes I_A, I_S, and I_{AS} are based on age-specific changes in the number of women and fertility rates, this equation can be also expressed as a product of changes specified by age x:

$$B_x(t_1) = B_x(t_0) \cdot I_{A,x}(t_1) \cdot I_{S,x}(t_1) \cdot I_Q(t_1), \qquad [9]$$

where $I_{A,x}(t_1) = N_x(t_1) / N_x(t_0)$; $I_{S,x}(t_1) = \theta_x(t_1) / \theta_x(t_0)$; and $I_Q(t_1) = TFR(t_1) / TFR(t_0)$. The indicator θ_x denotes age-specific fertility rate, which is standardized to sum up to unity: $\sum\theta_x = 1$; $\theta_x(t) = f_x(t) / TFR(t)$.

The overall number of births in t_1 may be seen as a product of the initial number of births and age-specific changes in (1) the number of women N_x, (2) standardized fertility rate θ_x, and (3) the initial relative share of that age on the total number of births in t_0, combined with the relative change in the overall TFR:

$$B(t_1) = B(t_0)\sum_x \left(\frac{Nx(t_1)}{Nx(t_0)} \cdot \frac{\theta x(t_1)}{\theta x(t_0)} \cdot \frac{Bx(t_0)}{B(t_0)}\right) \cdot \frac{TFR(t_1)}{TFR(t_0)} \qquad [10]$$

Such detailed decomposition reveals that changes in the 'mean generation size' *G* may be strongly influenced by the shifts in the age distribution of fertility schedule. Table 1 illustrates the diversity of individual components of the overall change in *G* in three countries: Hungary (2001 compared with 1986), Poland (2002 vs. 1990), and Spain (2001 vs. 1981). All three societies experienced a pronounced decline in the number of births and the period *TFR* during the period of observation. In each of them, the change in the 'mean generation size' has offset to some extent the decline in the total fertility rate, reducing thus the birth deficit. In each country, the contribution of individual components to the overall change in *G* has differed. In Hungary, neither the change in the number of women in reproductive ages alone or the shift in the age-composition of fertility rates between 1986 and 2001 would produce any significant change in the number of births. But the conjunction between the changes in both factors had a positive influence on the number of births in 2001, as indicated by the $I_{AS}(t_1$=2001) of 1.08. In comparison, the value of the I_G index in Poland in 2002 (1.07) could be explained by equally strong positive effects of the change in the index of female population size I_A and in the index of schedule distribution I_S, whereas their additional joint influence was negligible. A comparison of Poland with Spain suggests itself: the total number of births at the beginning of observation period and the subsequent change in the total fertility rate (decline from slightly above 2.0 to 1.25) were almost identical in these countries. However, the number of births in Spain dropped only by 24% as compared with 35% in Poland. The positive influence of the mean generation size in Spain (I_G=1.24 in 2002) is explained solely by a strong increase in the number of women of prime reproductive ages (I_A=1.30), while the joint influence of the female age structure and the change in fertility schedule distribution was negative (I_{AS}= 0.94).

[TABLE 1 about here]

While this decomposition provides a useful extension of the general index of change in the 'mean generation size,' I_G, its inclusion into our main decomposition of changes in total births could be problematic: the shifts in the distribution of fertility rates by age, affecting the I_S and I_{AS} indexes, are frequently causing tempo distortions which are addressed separately by the index of tempo effects, I_T. However, this confounding effect becomes relatively small over a longer period of time, as the I_T index addresses only the magnitude of tempo effects in any given year, while the indexes I_S and I_{AS} refer to the cumulated influence of the transformation of fertility schedule by age between the years t_0 and t_1. Thus, a decomposition of I_G may be used for an approximation of the influence of different factors on the changing number of births also during the periods of changes in fertility timing. Combining equations 4 and 8, the number of births in year t_1 then may be expressed as follows:

$$B(t_1) = B(t_0) \cdot I_A(t_1) \cdot I_S(t_1) \cdot I_{AS}(t_1) \cdot I_Q(t_1) \cdot I_{T(STAND,\, t_1)}\,. \qquad [11]$$

3.2.2 Considering birth order and shifts in the parity distribution of women

So far we have introduced decomposition at the level of total indicators of fertility tempo, quantum, and 'mean generation.' Changes in all these components may be distinguished by birth order. Such more detailed approach has several potential advantages. Distinguishing order-specific factors of fertility change enables better understanding of past fertility behaviour among women as well as the formulation of more realistic projection scenarios. Furthermore, within the index of tempo distortion, I_T, order-specific decomposition enables to distinguish between the 'genuine' influence of tempo effects on the one side and the influence of temporary imbalances in the parity composition of the female population on the other side. The latter effect is a consequence of order-specific shifts in the quantum and timing of childbearing. These shifts modify parity distribution of women by age, which may as a result temporarily favour higher or lower fertility in comparison with the standardised age-parity composition given by the set of fertility tables for a given year (see also Ortega and Kohler 2002).

Order-specific decomposition of change in the number of births may be incorporated within the framework introduced in Section 3.1 above. Change in the number of births at each birth order is seen as an outcome of the changes in the 'mean generation size' of potential mothers (index I_G), change in fertility quantum I_Q, and the size of tempo distortions I_T. Figure 2 illustrates such decomposition using example of Spain in 2001 as compared with the reference year 1981. Since we did not consider tempo distortions at birth orders 3 and higher, we show the complete decomposition only for orders 1 and 2. The table aptly illustrates how the role of the three main factors considered differed widely by birth order. The positive influence of an increase in the 'mean generation size' was smaller for birth order 1 ($I_{G,1}$=1.17) and most pronounced for birth orders 3+ ($I_{G,3+}$=1.34). Index of tempo distortion, I_T, had more negative influence on the number of fist births in 2001 ($I_{T,1}(2001)$=0.84) than in 1981 ($I_{T,1}(1981)$=0.88), while its negative effect has almost disappeared for birth order 2 and remained stable at 0.93 for all births orders combined. Fertility quantum declined moderately for first births (index $I_{Q,1}$=0.85 in 2001), and strongly for second births ($I_{Q,2}$=0.57). Although the indexes I_Q and I_T were not computed for higher birth orders, the precipitous decline in the *TFR* for orders 3+ between 1981 and 2001 from 0.56 to 0.13 clearly indicates that fertility quantum fell approximately by three quarters and families with more than two children have become relatively unusual in Spain. These data provide compelling evidence how the overall interpretation of changes in total births may be modified once the order-specific components are taken into account. Although order-specific contrasts were very prominent in Spain, most other countries were also characterised by marked differences by birth order.

[Table 2 about here]

Because the index of tempo distortion I_T captures the mutual influence of tempo effects and the shifts in parity composition, it is worthwhile to distinguish these two components. One framework for such decomposition has been suggested by Ortega and Kohler (Ortega and Kohler 2002, Kohler and Ortega 2004). Adopting their approach, the index of tempo distortion, I_T may be decomposed into the index of 'genuine' tempo distortion, $I\tau$, and the parity composition index, I_D: $I_T = I_D \cdot I\tau$, where I_D and $I\tau$ may be derived for any given year t and birth order i as follows: $I_{D,i}$ =

$adjTFRI_i$ / $adjPATFR_i$ and $I_{Q,i} = TFR_i / adjTFRI_i$, where $adjTFRI_i$ is a hypothetical total fertility rate for birth order *i* corresponding to the given level of $adjPATFR_i$ and observed age-parity composition of the female population in that year[6]. A decline of I_D below 1.0 signals that the actual age-parity distribution of the female population has negative influence on the *TFR* (and hence on the observed number of births) in comparison with the equilibrium age-parity distribution implied in the set of adjusted age-parity birth probabilities (or intensities) for a given year. This is exactly what happened in Spain in the case of first births, where the lower part of Table 2 (Method 1) shows that the low value of the index of tempo distortion I_T in 2001 (0.84) was almost completely explained by the influence of age-parity composition index I_D (I_D=0.85). An alternative way of calculating I_T and I_D utilises the non-adjusted fertility indicator PATFR based on age-parity fertility tables: $I_{D,i} = TFR_i / PATFR_i$ and $I_{Q,i} = PATFR_i / adjPATFR_i$. In Table 2, this method is referred to as “Method 2.” As the data for Spain illustrate, both methods usually yield similar results and imply identical interpretation of the influences of ‘genuine’ tempo effects and parity composition changes. Surprisingly, the ‘real’ tempo effects did not negatively influence the overall fertility level in Spain in 2001, as the negative effect of the index I_T can be fully explained by changes in the parity composition (both I_T and $I\tau$ at 0.93).

4. THE ROLE OF TEMPO EFFECTS IN REDUCING THE NUMBER OF BIRTHS IN EUROPE: A CROSS-COUNTRY COMPARISON

Most societies of Western and Northern Europe have experienced more than three decades of continuing shift towards later timing of childbearing, which is frequently labelled as fertility ‘postponement.’ Other European countries experienced later start of this process, but once the shift in fertility timing had started there, it frequently proceeded with a surprising intensity. In the 1990s the increase in the mean age at first birth was most intensive in Southern Europe and in the post-communist societies of Central Europe, especially the Czech Republic, Slovenia, and Eastern Germany (see Sobotka 2004b). It is apparent that tempo effects, associated with progressively delayed parenthood, have been responsible for a portion of the declining number of births across Europe. But how important was their role in reducing the observed number of births and did it change over time in comparison with the effects of declining fertility quantum and changing size of the mean generation of mothers? Are there consistent regional patterns? We aim to address these issues using data covering the period from the early stages of fertility postponement in 13 European countries, representing well all major regions of Europe except the former Soviet Union.

In order to provide a meaningful comparative framework, we had to deal with several methodological and practical issues. We interpret trends in the period mean age at first birth, computed from the schedule of age-specific incidence rates, as indicative of whether the shift towards later timing of childbearing took place[7]. But considerable regional differences in the starting period of fertility delay make the comparison of

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[6] Note that the *adjTFRI* discussed here differs from the adjusted TFR proposed by Bongaarts and Feeney (1998).

[7] We interpret a continuous increase of this indicator lasting for three or more calendar years and leading to an absolute rise in the mean age at first birth by at least 0.5 years as a sign of fertility ‘postponement.’

trends over time more difficult. One solution would be to adopt flexible time scale, putting all the countries at the same position at the start of fertility postponement (year "zero") and analysing the subsequent trends as measured by the time elapsed since this starting year. Rather, we opted for using conventional time, and divided the analysed countries into broader regional groups. Within each of these groups, most societies experienced the onset of first birth postponement at the same period. For some of them, lack of data does not allow us to make complete decomposition of the factors leading to changes in the number of births during the early years of fertility postponement. In such cases, we assume that there was no fertility postponement at the selected reference year (and the period *TFR* represents fertility quantum of that year) and decompose different factors only for the later period, for which we have all the necessary data. In all other cases, we incorporate the initial size of tempo distortion, if there was any, into the decomposition of the subsequent changes in the number of births. We first analyse countries of Western and Northern Europe, then we look at Austria, Italy, and Spain, followed by the analysis of births in four countries of Central-Eastern Europe.

4.1 Western and Northern Europe

This section presents results for three regions of Western Europe (England and Wales, France, and the Netherlands) and three Northern European countries (Denmark, Finland, Sweden). The reference year, capturing the period before or at the start of fertility postponement is 1972 except for Finland (1968) and Denmark (1974). Data for France refer to the period until 1996 and for the other countries to the period through 2000-2002.

The relative change in the total number of births from the beginning of observation (reference year) as well as the three indexes of change—index of tempo distortion I_D, index of quantum change I_Q, and the index of 'mean generation size I_G—are featured in Figure 1. All countries have experienced a short period of a relatively steep fall in total births at the beginning of fertility postponement, followed in most of them by a less marked increase and subsequent fluctuations. These fluctuations were particularly pronounced in Northern Europe and were mostly driven by the shifts in period fertility quantum. In all three Nordic countries there was a distinct peak in fertility quantum in the early to mid-1990s, small in Finland and very pronounced in Sweden. In all countries, tempo effects continued to put a downward pressure on the number of births throughout the whole period of observation, but the magnitude of tempo distortion was typically less than 10% by the late 1990s and early 2000s. In Western European countries, the negative influence of tempo effects, combined with the decline in fertility quantum, concentrated mostly into the 1970s and was partly offset by the increasing generation size of potential mothers. This effect was strongest in the Netherlands and has been diminishing since the late 1990s, as the baby-boom cohorts started to age beyond the prime childbearing years. In contrast to Western Europe countries, there was almost no effect of generation size of female populations in Denmark and Sweden, whereas the positive effect in Finland had started to dwindle already in the second half of the 1980s and became negative by the late 1990s.

[Figure 1 about here]

Further evaluation of the number of ‘missing’ and ‘gained’ births in each country is provided in Table 3 and Figure 2. Table 3 gives estimates of the mean absolute number of annual births ‘missing’ or ‘gained’ due to the main factors considered. Furthermore, it provides an estimate of the relative importance of each factor by relating mean annual ‘losses’ or ‘gains’ to the hypothetical number of births in the reference year that would be observed in the absence of tempo effects. This allows an evaluation of the long-term relative contribution of each factor. The effects of tempo distortions were more similar across all countries analysed here than were the influences of the other factors. Disregarding interaction with other factors, tempo effects reduced the observed number of births by almost 7% in Finland, 11% in Denmark, and 8-10% in the other four countries during the period analysed. In Finland, England and Wales, Finland, France, and the Netherlands, the initial decline in fertility quantum had more sizeable impact on the reduction in the number of births: its influence was roughly two times stronger there. In contrast, long-term changes in fertility quantum were only minor in Denmark (-3%), and negligible but positive in Sweden (+0.7%). The lowest part of Table 3 provides an estimate of the overall cumulative number of births ‘lost’ due to fertility postponement over the whole analysed period. The last line relates the estimated total births ‘lost’ to the recorded births in 2000. Since the period of analysis ranges from 20 years (1983-2002) in Finland to 28 years (1973-2000) in England and Wales, this figure is not comparable across countries. However, the estimated cumulative ‘loss’ due to tempo effects in order of 2.8 to 3.3 times the number of births in 2000 in Denmark, England and Wales, the Netherlands, and Sweden, is quite substantial.

[Table 3 about here]

Detailed graphs for each country further illustrate considerable cross-country variability. These figures capture the effects of shifts in fertility tempo and quantum that resulted in sizeable fluctuations in total births in the three Nordic countries. The most prominent and frequently discussed baby boom in Sweden around 1990 (see.g. Andersson 2000) occurred due to the combination of increasing fertility level (quantum) and diminishing tempo effects, and temporarily brought the number of births well above the numbers recorded in the early 1970s. In the late 1990s the influence of tempo effects was strongly reduced in Denmark and the Netherlands; in the former case leading to the increase in the number of births close to the levels recorded in the mid-1970s. In other countries, tempo effects continued to affect negatively fertility level and thus also the recorded number of births.

[Figure 2 about here]

4.2 Austria, Italy, and Spain

Fertility postponement in these societies started later than in most of Western and Northern Europe.[8] We chose 1976 as a reference year for Italy, 1980 for Austria, and 1981 for Spain. Although in 1981 the delay of childbearing in Spain was already in progress, we have chosen this benchmark year due to the lack of detailed data for

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[8] For this reason, we decided to include Austria in this section, although geographically and culturally it would fit better into the preceding section dealing with Northern and Western Europe.

earlier years.[9] The analysed data refer to the period until 1996 in Italy, 2001 in Spain, and 2002 in Austria.

From the initial stage of fertility delay, number of births had been falling in Italy and Spain until the mid-1990s, when it reached less than 70% of the number at the beginning of observation period (see Figure 3). In contrast, total births did not drop substantially in Austria until the second half of the 1990s, and even then the reduction in the number of births was considerably less pronounced. Decomposition indexes plotted in Figure 3 show that the decline in fertility quantum explains a large portion of differences in the number of “missing births” between Austria on one side and Italy and Spain on the other side. Both Italy and Spain faced a continuous decline in fertility level, which was probably coming to the end only in the late 1990s in Italy and after 2000 in Spain. By the mid-1990s, the index of quantum change in Italy and Spain declined to the levels around 0.7 as compared with the initial value of 1.0 and it declined further to 0.60 in Spain in 2001—signalling that tempo-free fertility level dipped by 40% in the course of two decades. This constitutes a considerably steeper fall in fertility than in the countries of Western and Northern Europe analysed in the preceding section (see Figure 1). In contrast, the index of quantum change remained remarkably stable in Austria, reaching a low of 0.90 in 1999. In addition to a pronounced reduction in fertility quantum, tempo effects were also more severe in Italy and Spain, and contributed thus to the observed sharp decline in the number of births. Especially in Spain, tempo effects were stronger than in Western and Northern Europe. In Austria, tempo effects was less pronounced and relatively stable over time, suggesting that fertility postponement was less intensive there.

[Figure 3 about here]

In all three countries, the mean generation of potential mothers increased in the 1980s and the early 1990s, offsetting thus partly strong negative influence of declining fertility quantum and sizeable tempo distortions in Italy and Spain, and preventing the decline in the number of births in Austria. With smaller generations entering reproductive years, the index I_G in Austria started to decline after 1992. In Italy and even more in Spain, sizeable birth cohorts of the late 1960s and early to mid-1970s have enabled further increase in the ‘mean generation size’ during the 1990s.

The decomposition presented in Table 4 shows the overall effect of the three components of change on the ‘missing’ number of births. In Austria, the mean tempo effects were similar to those in Western and Northern European countries, and reduced the annual number of births by about 11% in comparison with the reference year (1980). In Italy and Spain, tempo distortions had larger negative effect on the annual number of births—16% and 18%, respectively. In both countries, the effects of falling fertility quantum were even stronger. During the whole observation period covering two decades, cumulated influences of tempo distortions in Italy and Spain reduced the total number of births by an equivalent of 4.6 times the total births in Italy in 2000 and 5.4 times the total births in Spain. Comparative figure for Austria was

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[9] Moreover, period fertility level was relatively high in Spain until the late 1970s (the TFR in 1978, i.e., before the beginning of fertility postponement, was 2.53), and choosing this period as a reference for the subsequent analysis would reduce the comparability of results with Italy, where fertility postponement started at lower levels of fertility quantum (TFR, as well as the tempo-adjusted TFR, reached 2.10 in 1976).

2.3. This suggests that tempo distortions played more important role in reducing the number of births in Southern Europe than in most countries of Western and Northern Europe.

[Table 4 about here]

Country-specific graphs in Figure 4 trace the contribution of analysed factors over time. Austria constitutes a special case: relatively stable (negative) tempo effects and only minor changes in fertility quantum did not induce any stronger shift in the total number of births. The decline in total births in Austria during much of the 1990s can be mostly explained by the influence of falling 'mean generation size.' Graphs for Italy and Spain show very similar development over time, characterised by the negative influence of large tempo effects combined with a sharp reduction in the number of births due to declining fertility quantum, which has become more prominent over time. Without the positive impact of the mean generation size, the number of births in Italy would decline by half between 1976 and 1995, and the decline would be even larger in Spain. The negative impact of tempo effects has diminished in Spain in the late 1990s (no recent data are available for Italy), while the impact of declining fertility quantum reached the highest level—around 2000 its direct effect brought the observed number of births down by 45% in comparison with the total births in 1981.

[Figure 4 about here]

4.3 Central-Eastern Europe

Most countries of Central and Eastern Europe have experienced the beginning of fertility postponement in the early 1990s, following the profound societal changes after the breakdown of the state-socialist system. In the former GDR, Hungary, and Slovenia, the trend towards later parenthood had started already in the 1980s, although it initially progressed in a relatively slow pace. Among the four countries compared in this section, the reference year is 1989 in Romania, 1990 in the Czech Republic and Poland and 1980 in Hungary, where we aim to include the initial stage of fertility postponement.

All these countries recorded a substantial decline in total births during the 1990s. Hungary had experienced first dip already in the early stage of fertility delay after 1980. Decomposition indexes pictured in Figure 5 show that the decline in the total number of births in all four countries was driven by a substantial reduction in fertility level combined with an intensive postponement of childbearing. The latter effect was especially intensive in the Czech Republic, where the index of tempo distortion I_T dropped to the levels of 0.68-0.75 in 1994-2003. The decline was somewhat less intensive in Hungary and Poland, reaching 0.8 in 2001-2002, and in Romania, where the I_T reached 0.86 in 2002. At the same time, Romania experienced the strongest reduction in fertility quantum, which was mostly concentrated into the first two years of the transition period (1990-91), after the ban on abortion had been lifted and contraceptives had gradually become available (see e.g. Baban 1999). After 1992, fertility level declined only slightly in Romania; by 2001 the index of quantum change reached two thirds of the initial value of 1989. In the Czech Republic, Hungary, and Poland, a substantial part of the reduction in fertility quantum occurred between 1994 and 1998, when the I_Q index reached values around 0.8 in all three countries. In the Czech Republic and Hungary, there were signs of stabilisation thereafter, whereas in Poland a renewed decline has taken place after 2000. The strong negative effects of declining fertility quantum and intensifying fertility postponement have been offset to a small extent by the increasing 'mean generation size' during the 1990s. This increase was steeper in the Czech Republic, where the baby-boom cohorts of women born in the mid-1970s were entering prime childbearing years. In Hungary, the increasing size of the 'mean generation' in the 1990s constituted a trend reversal in comparison with the 1980s, when the mean size of mothers' generation had been declining.

[Figure 5 about here]

Table 5 shows relative contribution of fertility tempo, quantum, and 'mean generation' size to changing numbers of births during the whole analysed period. The negative influence of tempo effects played a prominent role in the Czech Republic, Hungary, and Poland, whereas in Romania, the decline in fertility quantum had a stronger impact on reducing the total number of births. Tempo distortions in the Czech Republic were more severe than in any other country considered: in comparison with the hypothetical number of births in 1990 (in the absence of tempo effects), 24% births were 'missing' on average every year during the 1991-2003 period due to the effects of fertility postponement. In comparison, about 13% of births in Hungary and Poland were 'missing' annually during the 1990s due to tempo distortions. In Romania, the decline in fertility level was the most important factor, reducing the annual number of births on average by 29% in 1990-2002 when compared with total births in 1989.

[Table 5 about here]

Country-specific graphs in Figure 6 reveal interesting differences in the contribution of tempo and quantum changes to the declining number of births observed during most of the 1990s. The Czech Republic has experienced a stable and very strong negative influence of tempo effects on the total births since 1994; between 1995 and 2003 around 38 thousand births were 'missing' annually due to the effects of fertility postponement compared with just over 90 thousand births that actually took place every year. Quantum decline has also contributed to the declining number of births, especially between 1995 and 1998, but its negative effects have been counterbalanced by the increasingly positive influence of the 'mean generation size' and the total births have remained stable since the mid-1990s. In Hungary, the negative effects of fertility postponement and declining fertility quantum intensified during the 1990s. In Poland, number of births was declining rapidly every year since 1990. Initially, fertility postponement had a prominent role in this trend, but in the second half of the 1990s and the early 2000s, decline in fertility quantum became the main factor. In Romania, fertility decline in 1990-91 was very sudden and had a strong negative influence, later followed by less sizeable negative effects of tempo distortions. In contrast to Poland or Hungary, the number of "missing births" due to tempo effects (over 100 thousand annually) and quantum decline (over 50 thousand annually) appears to be stable in Romania since 1995, with the initial slightly positive effect of the 'mean generation size' gradually disappearing.

[Figure 6 about here]

5 INCORPORATING TEMPO EFFECTS INTO PROJECTIONS: NUMBERS OF BIRTHS IN DIFFERENT SCENARIOS OF FERTILITY TIMING IN AUSTRIA, THE CZECH REPUBLIC, AND FINLAND

The analysis presented in the previous section has revealed that the relative share of changes in fertility quantum, fertility tempo, and age structure on the declining number of births in Europe differed widely between countries. Decomposing the role of these major factors in recent years may also serve as a basis for formulating projection scenarios. By explicitly considering tempo effects, our contribution constitutes an innovation to the projections of fertility and total births. Although the importance of tempo distortions in affecting the commonly used period fertility indicators has been increasingly recognised by demographers, it has rarely been considered for projection making. Notable exceptions are the contributions of W. Lutz and his colleagues (Lutz, O’Neill, and Scherbov 2003, Goldstein, Lutz, and Scherbov 2003, and Lutz and Skirbekk 2004), which discuss long-term consequences of tempo effects for the population scenarios of the countries of the European Union. Besides that, population projections for European countries with very low period total fertility rates frequently assume that fertility rates will increase in the future without specifying the reasons for such expected increase or explicitly referring to tempo effects (e.g. EUROSTAT 2005b, UN 2004).

We distinguish between two aspects of tempo changes that are equally important for projection-making: the size of tempo effects and the expected future duration of change in fertility timing. We have selected three societies with different levels of period fertility and different pace and duration of fertility postponement—Austria, the Czech Republic, and Finland—to illustrate how the incorporation of various scenarios of future tempo changes in fertility may affect projected number of births. Since we are primarily interested in the influence of changes in fertility timing on period fertility and total births, we did not formulate alternative scenarios of fertility quantum. Instead, we assume that the recent levels of fertility quantum, as estimated by the adjusted PATFR levels, will persist into the future. This is arguably an ‘optimistic’ scenario, ignoring the possibility of a ‘fertility ageing effect,’ a decline in fertility level associated with delayed parenthood (e.g. Kohler, Billari, and Ortega 2002). Although our projections can be easily extended to accommodate various scenarios of fertility quantum, in order to keep the number of scenarios at a reasonable level we opted to focus solely on the consequences of different trends in fertility timing. Only our comparative scenario, ‘freezing’ the most recent set of age-specific fertility rates, is indicative of the effects of a possible decline in fertility quantum to the level of recently observed distorted TFR. It is important to stress, however, that realistic projections for individual countries should incorporate scenarios of changes in fertility level and, possibly, also accommodate different assumptions regarding international migration.

Our projection horizon extends until 2025, which enables us to utilise the medium variant of the latest EU projections scenarios of population by age and sex (EUROSTAT 2005). From the mid-2020s onwards our projections would have to incorporate differences in the size of birth cohorts of childbearing age resulting from the specific scenarios of our projection of births after 2004. For Austria and the Czech Republic, we evaluate the impact of following scenarios on the total number of births:

1) Baseline scenario assuming the continuation of fertility postponement until 2015 and a gradual ending of this timing shift by 2020
2) A ‘continuing postponement’ scenario assuming a continuation of tempo effects until the end of the projection horizon, i.e., until 2025
3) A ‘rapid recuperation’ scenario, assuming that fertility postponement and associated tempo effects will stop in the near future, between 2005 and 2010.

All scenarios are evaluated on the background of a comparative scenario, keeping the most recent observed set of age-specific fertility rates constant until 2025. Although we consider such development unlikely, for it would imply an instantaneous end of fertility postponement and no ‘recovery’ usually associated with it, we take this scenario as a background for evaluating possible effects of future changes in fertility timing. For Finland, we substituted the third, ‘rapid recuperation scenario,’ with a scenario envisioning a trend reversal, a gradual advancement of fertility towards lower ages. This reflects possible consequences of policy aims proposed by the Family Federation of Finland (see Section 5.3 below). We tried to keep all the scenarios within the range of plausible changes, including the realistic shape of age-specific fertility[10] and limiting the increase in the mean age at childbearing to 32 years in the ‘continuing postponement’ scenario. The next sections give a brief overview of the main results for each country. The analysis for each country is accompanied by the graphs showing the recorded values of the period TFRs, mean age of mother at childbearing, relative changes in the ‘mean generation size’ G, and total numbers of live births in 1980-2003 as well as projected values of these indicators for 2004(2005)-2025. Our results are further complemented by the medium variant of EUROSTAT (2005b) projection of the period TFR and total births.

5.1 Austria

Austria is a country with remarkably stable fertility trends since the mid-1980s. Low levels of the period TFR at around 1.4 have been accompanied by a moderate fertility postponement, which started in the early 1980s. Various alternative indicators of period total fertility, including indicators based on parity-duration fertility tables, indicate that fertility quantum, net of tempo distortions, hovered around 1.6-1.7 children per woman during this period (Sobotka et al. 2005). The major change in the observed number of births, a slight increase to over 95 thousand in 1992-93, followed by a fall to 75 thousand in 2001, was primarily driven by the shifts in the mean generation of potential mothers *G*, which peaked in 1993 and subsequently declined by about 13% during the next 10 years (Figure 7; see also Section 4.2 and Figure 6).

[Figure 7 about here]

Our fertility scenarios assume that the end of fertility postponement in Austria would bring the period TFR to 1.60, which represents the estimated tempo-adjusted total fertility index (adjPATFR) in the early 2000s. This relatively modest fertility

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[10] Fertility rates by single years of age were modelled to correspond with scenario-specific parameters of the indexes of tempo distortion and corresponding period TFR and the mean age at childbearing for each analysed year. More details on the projections scenarios can be obtained from authors upon request.

‘recovery’ would be translated into a moderate increase in the number of births from 77 thousand in 2003 to 84-85 thousand, reached in 2010-2018 in the “rapid recuperation scenario” and in 2020-2021 in the baseline scenario. Number of births would remain relatively stable, around 74-75 thousand until 2021, if fertility postponement would further continue, and would be only slightly lower if fertility rates remained constant after 2003. Interestingly, the medium variant of EUROSTAT (2005b) projection, which is also plotted in Figure 7, assumes no significant future increase in the period TFR and the projected number of births thus comes close to our “continuing postponement” scenario. All scenarios indicate that the number of births will start to decline gradually after 2021 as a result of the shrinking number of potential mothers.

Although tempo effects have not been particularly strong in Austria, the differences in the projected numbers of births in various scenarios are not negligible. Whereas the scenario assuming constant fertility rates after 2003 implies mean annual number total of 72.3 thousand births in 2005-2025 (6% below the 2003 level), the ‘rapid recuperation scenario’ would bring the mean annual total to 82.8 thousand, i.e., 8% above the number recorded in 2003 (see Table AP-3 in the Appendix).

5.2 Czech Republic

Because of the past trends in period fertility—a fall in fertility quantum during the 1990s progressing hand in hand with an intensive postponement of childbearing—different scenarios of future tempo effects produce more varied projection of births than in the case of Austria. All scenarios are, however, strongly affected by the “echo effects” of the falling numbers of births in the 1990s: the mean generation size of potential mothers will start shrinking rapidly after 2010, leading eventually to a baby bust which can be hardly offset by increasing fertility rates.

The main results of the projection scenarios for the Czech Republic are displayed in Figure 8. Although the period TFR in the Czech Republic had dropped below 1.2 in 1996-2003, which is well below the TFR recorded for Austria, our estimates of tempo-adjusted fertility index in the early 2000s converged for both countries at the level of 1.60. Our baseline scenario assumes that the intensity of fertility postponement in the Czech Republic would gradually decline after 2005, resulting nevertheless in a convergence towards the Austrian level, bringing the mean age of mothers in both countries to 30.6-30.7 years by 2020. The scenario assuming a continuation of fertility postponement during the whole projection period also projects that the intensity of tempo distortions would decline over time, which would cause a gradual increase in the period TFR to 1.40 by 2025, whereas the mean age at childbearing would rise to 32.2 years[11]. Our scenarios have vastly different implications for the projected number of births after 2005. The scenario of rapidly ending fertility postponement produces a marked increase in the projected births from

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[11] We considered the possibility that the pace of fertility postponement recorded between 1994 and 2004 would continue until 2025 as unrealistic, since it would imply that the mean age at childbearing would reach around 34.5 years by 2025—way above the record-high European level of 30.8 in Spain in 2002. Even our baseline scenario implies that the Czech Republic would shift from an early childbearing pattern with the mean age of mothers below 25 to the late pattern with the mean age surpassing 30 during a relatively short period of 20 years (1993-2013).

98 thousand in 2004 to 122 thousand in 2010. This distinct baby boom would be of a short duration, however, since the declining 'mean generation size' eventually implies a rapid reduction in total births after 2010, dropping below the 2004 level since 2020. Because of the combination of gradually increasing total fertility rates and shrinking numbers of women in prime childbearing ages, the baseline scenario results in a relatively stable number of births around 100 thousand until 2020. The 'continuing postponement' scenario gives a gradually declining number of births after 2010, while the continuation of fertility rates observed in 2004 would have long-lasting negative consequences: it implies a steep uninterrupted decline in total births during the whole projection period from 98 thousand in 2005 to 63 thousand in 2025. This would lead to a reduction in the number of births by two thirds in comparison with the high values over 190 thousand reached during the baby boom of the mid-1970s.

[Figure 8 about here]

The medium variant of EUROSTAT (2005b) projection foresees a gradual increase in the period total fertility rates, bringing the projected TFR after 2010 halfway between our baseline scenario and "postponement continues" scenario. However, despite higher projected TFRs after 2010, projected total births in EUROSTAT projection remain consistently below or around the level of our "postponement continues scenario." The explanation lies in the double effects of the changing timing of childbearing and changing size of potential mothers' generations. Our "postponement continues" scenario assumes a marked shift of childbearing towards later ages. Although the 'mean generation size' declines rapidly in all scenarios after 2010, the decline is strongest in the "constant 2004 rates" scenario, and less pronounced in the "postponement continues" scenario. In other words, intensive fertility postponement in combination with larger number of women in the late childbearing ages results in higher projected numbers of births. Although this advantage is temporary, it means that—everything else being equal—later childbearing may temporarily have a positive effect on the total number of children born during the next two decades.

5.3 Finland

Tempo distortions were relatively minor in the late 1990s and early 2000s. Due to relatively high fertility quantum and a low intensity of fertility postponement, the period TFR in Finland remained well above the levels recorded in Austria and the Czech Republic, oscillating around 1.75 for most of the 1990s. Declining 'mean generation size' was the main factor pushing the number of births downwards during the 1990s (see Section 4.1 and Figure 2). Our computations put the most recent (2002) value of tempo-adjusted period fertility index (adjPATFR) at 1.86, which is also our estimate of tempo-free total fertility in the projection scenario. Considering that the (distorted) period TFR in 2003 reached 1.76, this constitutes a relatively narrow difference which does not translate into marked contrasts in the projection scenarios. As a result, we did not specify the "rapid recuperation" scenario for Finland and modified the "continuing postponement scenario" in that it assumes a slight acceleration of postponement and tempo effects and a resulting decline in the TFR to 1.70 for the whole projection period until 2025.

However, our main interest in Finland lies in the exploration of the potential effects of long-standing fertility advancement on increasing the number of births. Lutz and Skirbekk (2004: 7) have argued that "policies aimed at creating the conditions that allow women to have their children at an earlier age, or at least not being driven into further delays, could turn out to be win-win strategies, combining individual health concerns with public demographic concerns." Such policies, if successful, would turn the issue of "missing births" due to fertility postponement upside down, resulting in "gained births" due to tempo effects related to fertility advancement. This possibility resonates with recently proposed policy aims of the Family Federation of Finland, namely increasing the total fertility from 1.8 to 1.9 and reducing the 'average age at first birth' from 28 to 26 years (Söderling 2005). Our analysis shows that the end of fertility postponement would probably bring the period TFR close to the 'target' of 1.9 (1.86), while the 'rejuvenation' of fertility is likely to push the total fertility well above this level. This possibility is addressed in our third projection scenario, which investigates the consequences of a shift towards the earlier timing of parenthood on the period TFR and the recorded number of births. We assume a decline of the overall mean age at childbearing from 28.9 in 2004 to 28.4 in 2020, i.e., by about 0.1 year annually[12]. Our estimates indicate that such a shift is likely to bring the period TFR above 2.0 (specifically, to 2.03 in our scenario) during this period (Figure 9).

[Figure 9 about here]

In a sharp contrast to the likely future trends in the Czech Republic presented in the preceding section, all scenarios for Finland envisage a remarkable stability in the numbers of births during the next two decades. This is mostly due to the projected stability in the 'mean generation size.' Keeping fertility rates constant at the 2003 level brings the projected number of births to 55 to 57 thousand during the 2004-2025 period—just as many as were recorded in 2003 (56.6 thousand). This is also close to the medium scenario of EUROSTAT (2005b). The "continuing postponement" scenario brings the mean annual projected number of births to 54.5 thousand, while the baseline scenario results in a gradual increase to almost 60 thousand births in 2020, followed by a slight decline. Only the "earlier childbearing" scenario makes a marked difference in the projected births: it implies an increase in births to about 65 thousand during the period with projected advancement of childbearing, i.e., 2007-2020. This is 9 % above the baseline scenario and 15 % above the "continuing postponement" scenario. However, the possibility of such a pronounced shift towards earlier motherhood is questionable, as it would require a trend reversal in the long-standing fertility postponement as well as reordering of life course transitions among many young men and women. If this does not happen and if fertility quantum remains relative stable, Finland may be one of few European countries that would not experience any significant baby boom or bust in a foreseeable future.

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[12] This is roughly in line with the aim of reducing the mean age of mothers at first birth from 28 to 26 in the same period, as the shifts in the age at first births are usually more pronounced than the overall changes in the age at motherhood. In 1986, when the mean age at first birth in Finland surpassed 26, the overall mean age at childbearing reached 28.4 (authors' computations based on SF (2001) data).

6 SUMMARY AND DISCUSSION

Most European societies have experienced marked changes in the numbers of births in the last decades. More often, numbers of births have been plummeting, but some countries have also recorded peaks of varying magnitudes. Our contribution has discussed various possibilities of decomposing the observed changes, starting from a basic decomposition distinguishing tempo, quantum, and ‘mean generation size’ components, and illustrating further extensions of this decomposition. The empirical analysis, which has focused on the impact of these three main components on declining numbers of births since the beginning of fertility postponement, has uncovered a large variability between the 13 societies under study. In all of them, fertility postponement has put a downward pressure on the observed births, but only in Austria, Denmark, and Sweden, and in three post-communist societies—the Czech Republic, Hungary, and Poland—tempo distortions constituted the major force affecting negatively the numbers of births. In Italy and Spain, tempo effects had a profound negative impact as well, but the increasingly negative influence of falling fertility quantum has been even larger. With the exception of Hungary and Sweden, rising number of women in childbearing age partly helped to offset the negative influences of tempo and quantum changes. Trends over time differed as well: Austria, England and Wales, France, or Romania had reached relatively stable levels of tempo and quantum effects on the number of births for extended periods of time. Italy, Poland, and Spain, on the other hand, experienced a growing impact of declining fertility quantum on the total number of births. In the absence of fertility postponement, two Nordic countries (Denmark and Sweden) and Austria would recently record a similar number of births as at the start of fertility postponement.

We have argued that an inclusion of assumptions concerning tempo distortions may lead to an improvement of the projection scenarios of fertility and births. Medium variants of fertility projections produced by EUROSTAT and the United Nations typically envisage that countries with very low fertility levels will eventually experience some recovery of fertility rates, but remain muted about the main reasons for such a change. Explicit incorporation of assumptions regarding the duration and intensity of future shifts in fertility timing, based on sound analysis of the past trends, could make these projections more realistic, but also more transparent and accountable in ex-post evaluations. Ideally, country-specific scenarios should be parity-specific and capture different assumptions regarding the future changes in fertility tempo and quantum.

Using examples of three countries with different intensity and duration of fertility postponement, we have shown that the potential impact of the stabilisation of the mean age at childbearing on the numbers of births differs widely. Finland has the smallest potential for any larger increase in the number of births associated with the ending of fertility postponement: Only a marked reversal of recent trends, with an extensive advancement of childbearing, could bring a significant gain in the number of birth in the near future. In Austria, the stabilisation of the mean age at childbearing is likely to be associated with a modest increase in the number of births. In the Czech Republic, in contrast, the potential impact of such development is huge: Rapid ending of fertility postponement would bring a short-term baby boom, while a gradual ending of delay implies a relative stability in the projected numbers of births until about 2020.

Past swings in the numbers of births imply that there is a considerable degree of instability built in the future birth trends in most European countries. Although many ups and downs are to some extent unavoidable, changing size of tempo effects may become to some extent a surprise factor affecting the future trends. In most European countries, the pace of fertility postponement is likely to slow down or even come to the end in the near future. This may temporarily act as a counterbalancing factor, offsetting or reducing the effect of declining numbers of potential mothers born after the baby boom period. We plan to investigate the implications of different possible future trends in fertility timing for the number of births in the whole European Union in our further research.

In conclusion, we would like to call for more attention to the possible future consequences of baby booms and busts for the economy, culture, and social change. Such a research has a long tradition in the U.S., where numerous works of Easterlin (1976, 1978, 1987), Macunovich (2000, 2002), and other researchers have posited that the relative size of young cohorts entering labour market has far-reaching implications for wages, inflation, and unemployment rates, as well as their own living standards and family behaviour. According to Easterlin (1987), due to 'crowding mechanisms' large birth cohorts face adverse economic and social conditions, higher unemployment and lower than expected wages that are at odds with their material aspirations. As a result, they postpone family formation and have fewer children. In a broader perspective, Elder (1980) proposed that the status of young people in society is inversely related to their numbers. In his view, the roots of social unrest in the late 1960s may be partly seen as a consequence of coming of age of large baby boom cohorts facing intense competition and constrained life prospects. Will the small size of birth cohorts of the 1990s in Italy, Spain, or Central-Eastern Europe have a long-lasting impact on the economy and society? Will these men and women face different life chances and options just because of the size of their births cohorts? McDonald and Kippen (2001: 22) predicted that stagnating or decreasing labour supply "will present difficulties for economies in most advanced countries in the next 30 to 50 years." However, the research on the Easterlin hypothesis has often been inconclusive in European context and different possible effects of changing cohort size, if there are any, remain largely unexplored. Clearly, there lies an uncharted territory with a huge potential for innovative research.

ACKNOWLEDGEMENT

We gratefully acknowledge help of Steve Smallwood, Laurent Toulemon, and Andres Vikat, who provided data used in parts of this study.

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FIGURES AND TABLES

TABLE 1: Decomposition indexes of change in the number of births in Hungary (2001 compared with 1986), Poland (2002 compared with 1990), and Spain (2001 vs. 1981)

	Hungary	**Poland**	**Spain**
T_0	1986	1990	1981
T_1	2001	2002	2001
Total recorded births			
$B(t_0)$	128204	545817	533008
$B(t_1)$	97047	353765	406380
Index $B(t_1) / B(t_0)$	0,76	0,65	0,76
$TFR(t_0)$	1,839	2,053	2,035
$TFR(t_1)$	1,307	1,248	1,249
Index I_Q (based on the *TFR*)	0,711	0,608	0,614
$G(t_0)$	69714	265863	261920
$G(t_1)$	74252	283466	325364
$I_G(t_1)$	1,07	1,07	1,24
Of which:			
$I_A(t_1)$	1,00	1,03	1,30
$I_S(t_1)$	0,99	1,03	1,01
$I_{AS}(t_1)$	1,08	1,00	0,94

Note: This decomposition disregards tempo distortions and uses the period *TFR* for the computation of the index of change in fertility quantum I_Q

TABLE 2:

a) Decomposition of change in the number of births in Spain by birth order (2001 compared with 1981);

b) Decomposition of the index of tempo distortion I_T in Spain in 2001 (lower part of the table)

	Birth order 1	**Birth order 2**	**Birth orders 3+**	**TOTAL**
Births ($B(t_0)$) in 1981	230096	168050	134862	533008
Births ($B(t_1)$) in 2001	216715	146888	42777	406380
$B(t_1) / B(t_0)$	0,942	0,874	0,317	0,762
$TFR_i(t_0)$ in 1981	0,832	0,647	0,556	2,035
$TFR_i(t_1)$ in 2001	0,669	0,448	0,132	1,249
$adjPATFR(t_0)$; 1981	0,941	0,794	..	2,177
$adjPATFR(t_1)$; 2001	0,798	0,456	..	1,343
$G(t_0)$; 1981	276558	259737	242558	261920
$G(t_1)$; 2001	323939	327875	324068	325364
$I_G(t_1)$	1,17	1,26	1,34	1,24
$I_Q(t_1)$	0,85	0,57	*0,24 1)*	0,62
$I_T(t_0)$; 1981	0,88	0,81		0,93
$I_T(t_1)$; 2001	0,84	0,98		0,93
$I_{T\,STAND}(t_1)$; 2001	0,95	1,21		0,99
I_T decomposition in 2001:	**Birth order 1**	**Birth order 2**		**TOTAL**
$PATFR(t_1)$; 2001	0,784	0,452		1,342
$AdjTFR''(t_1)$; 2001	0,662	0,458		1,252
$I_T(t_1)$, 2001	0,84	0,98		0,93
METHOD 1				
$I_D(t_1)$	0,85	0,99		0,93
$I\tau(t_1)$	0,98	0,99		1,00
METHOD 2				
$I_D(t_1)$	0,83	1,00		0,93
$I\tau(t_1)$	1,01	0,98		1,00

NOTE: Tempo distortions are disregarded for birth orders 3+. Therefore, no estimation or further decomposition of the index I_T is provided. The index of quantum change I_Q at birth orders 3+ is based solely on changes in the period *TFR*.

WESTERN AND NORTHERN EUROPE

FIGURE 1: Changes in the total number of births from the beginning of fertility postponement and relative contribution of tempo effects, quantum, and mean generation size. Western and Northern Europe.

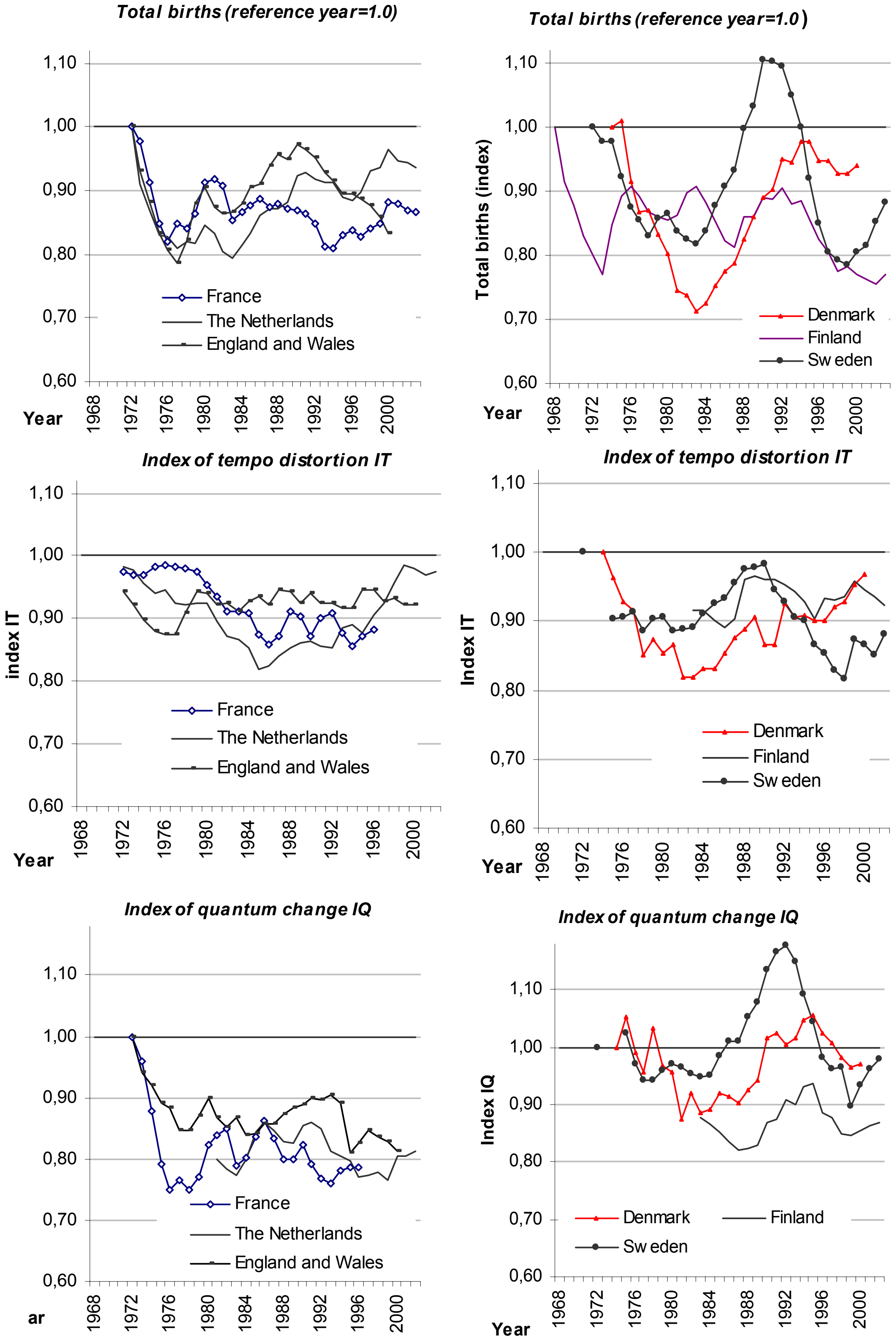


FIGURE 1 (continued)

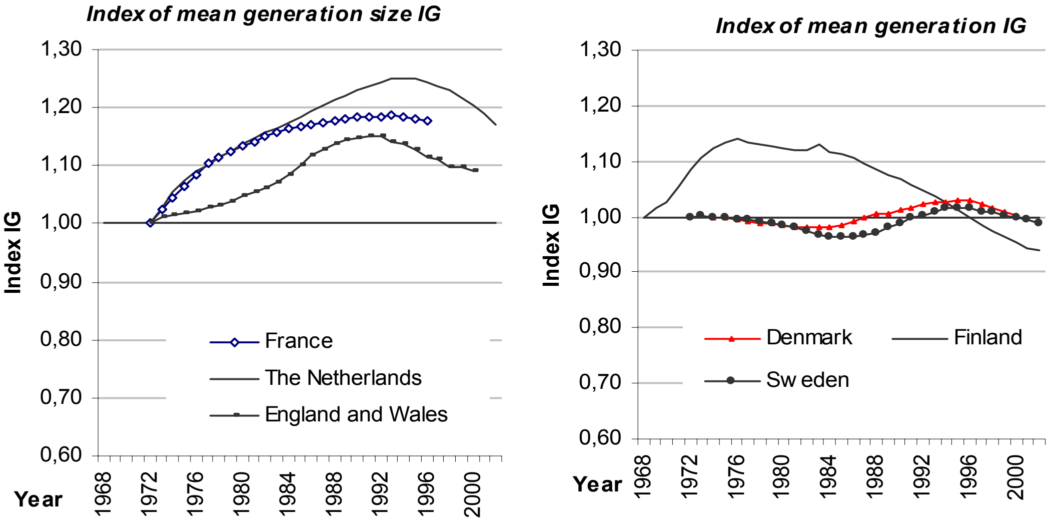


TABLE 3 Decomposition of changes in the total number of births from the beginning of fertility postponement; six countries of Western and Northern Europe. Mean annual numbers of “missing” or “gained” births (thousand) and relative contribution of the main factors.

	France	**The Netherlands**	**England & Wales**	**Denmark**	**Finland**	**Sweden**
Reference year t_0	1972	1972	1972	1974	1968	1972
Analysed period t_1	1973-1996	1981-2002	1973-2000	1975-2000	1983-2002	1976-2002
Births in the reference year t_0	875.1	214.1	725.2	71.3	73.7	112.3
Hypothetical births in t_0 (without tempo effects)	898.6	217.9	768.0	71.3	73.7	112.3
Mean annual births in t_1	761.3	187.7	646.7	61.9	61.8	101.2
Mean annual "missing" or "gained" births in t_1	-137.3	-30.2	-121.4	-9.5	-11.9	-11.1
Of which due to						
Tempo effects	-72.9	-20.9	-60.0	-7.9	-4.9	-11.0
Quantum changes	-172.5	-41.3	-123.3	-2.1	-9.7	0.7
Mean gen. size G	129.5	38.8	68.0	0.2	5.4	-1.1
Interaction	-21.4	-6.8	-6.1	0.4	0.1	0.2
Mean annual influence of different factors (relative to the hypothetical births in the reference year t_0)						
Tempo effects	-8.1%	-9.6%	-7.8%	-11.1%	-6.7%	-9.8%
Quantum changes	-19.2%	-19.0%	-16.1%	-2.9%	-13.2%	0.7%
Mean gen. size G	14.4%	17.8%	8.9%	0.3%	7.4%	-1.0%
Interaction	-2.4%	-3.1%	-0.8%	0.5%	0.1%	0.2%
Total births missing due to tempo effects						
Absolute	-1750.6	-627.4	-1680.4	-205.1	-98.0	-295.8
Relative to births in 2000	2.3	3.0	2.8	3.1	1.7	3.3

Figure 2: Decomposition of changes in the total number of births from the beginning of fertility postponement (tempo effects in the initial year are taken into account).

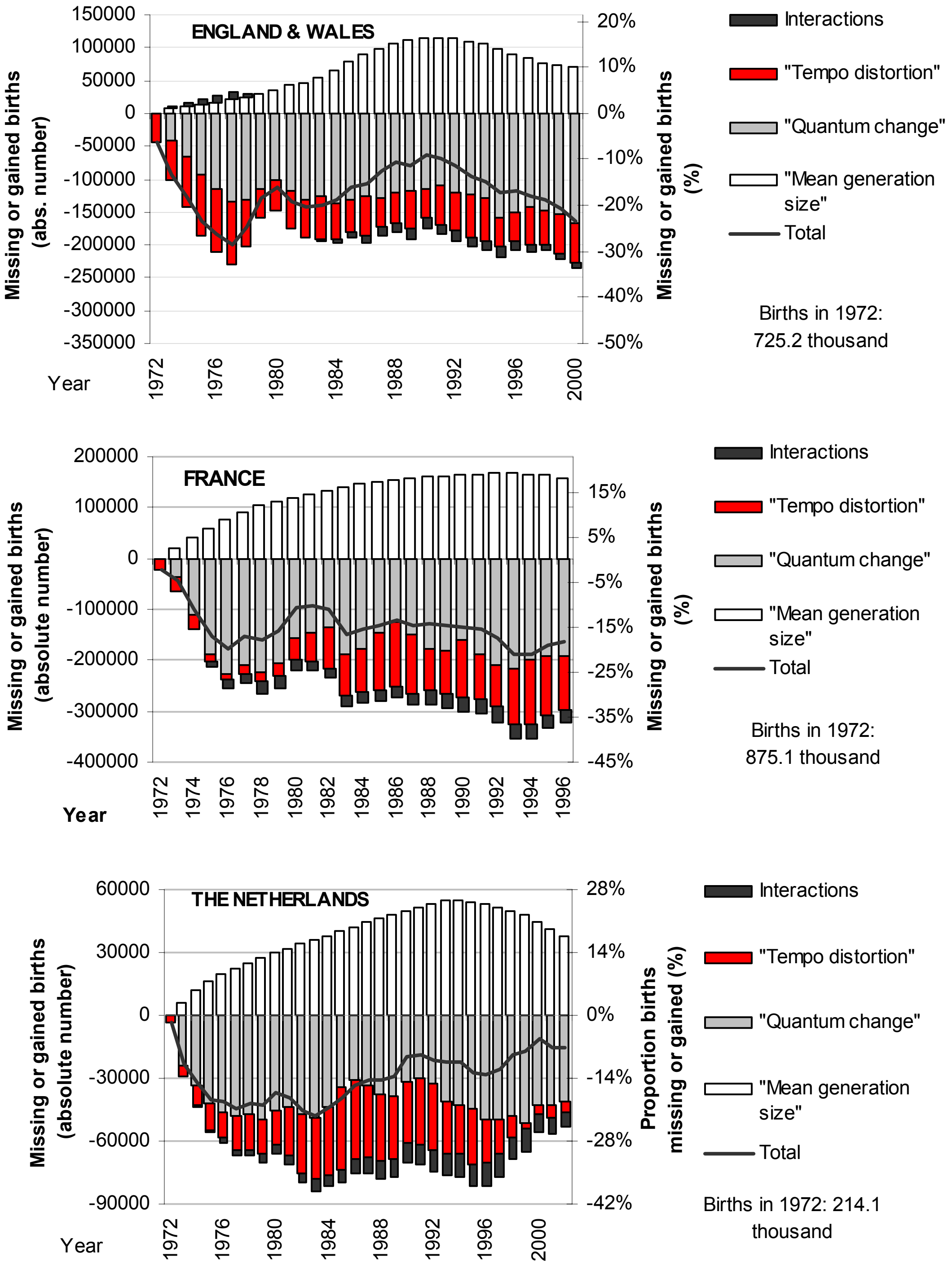
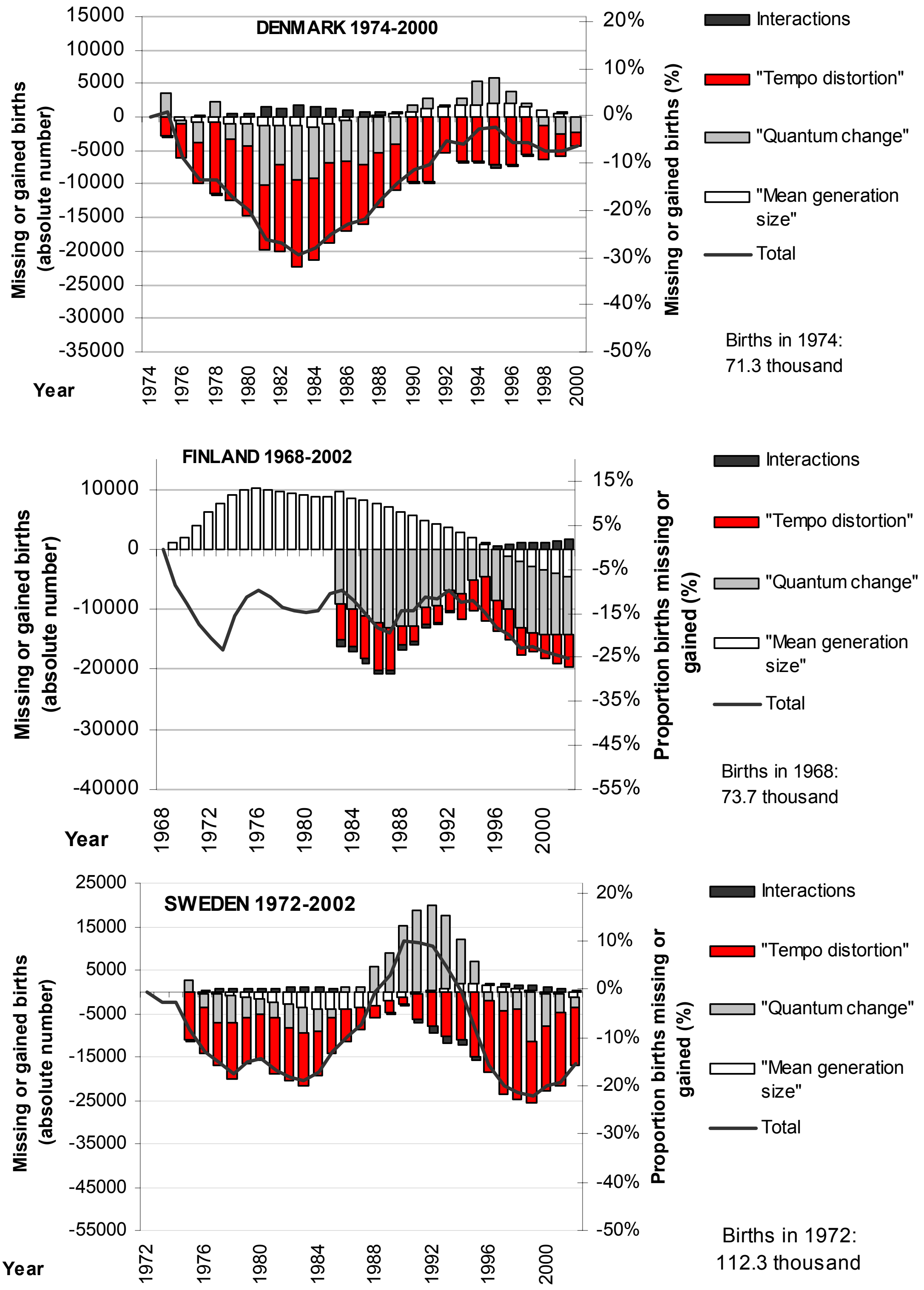


Figure 2 (continued):



AUSTRIA, ITALY, AND SPAIN

FIGURE 3: Changes in the total number of births from the beginning of fertility postponement and relative contribution of tempo effects, quantum, and mean generation size in Austria, Italy, and Spain.

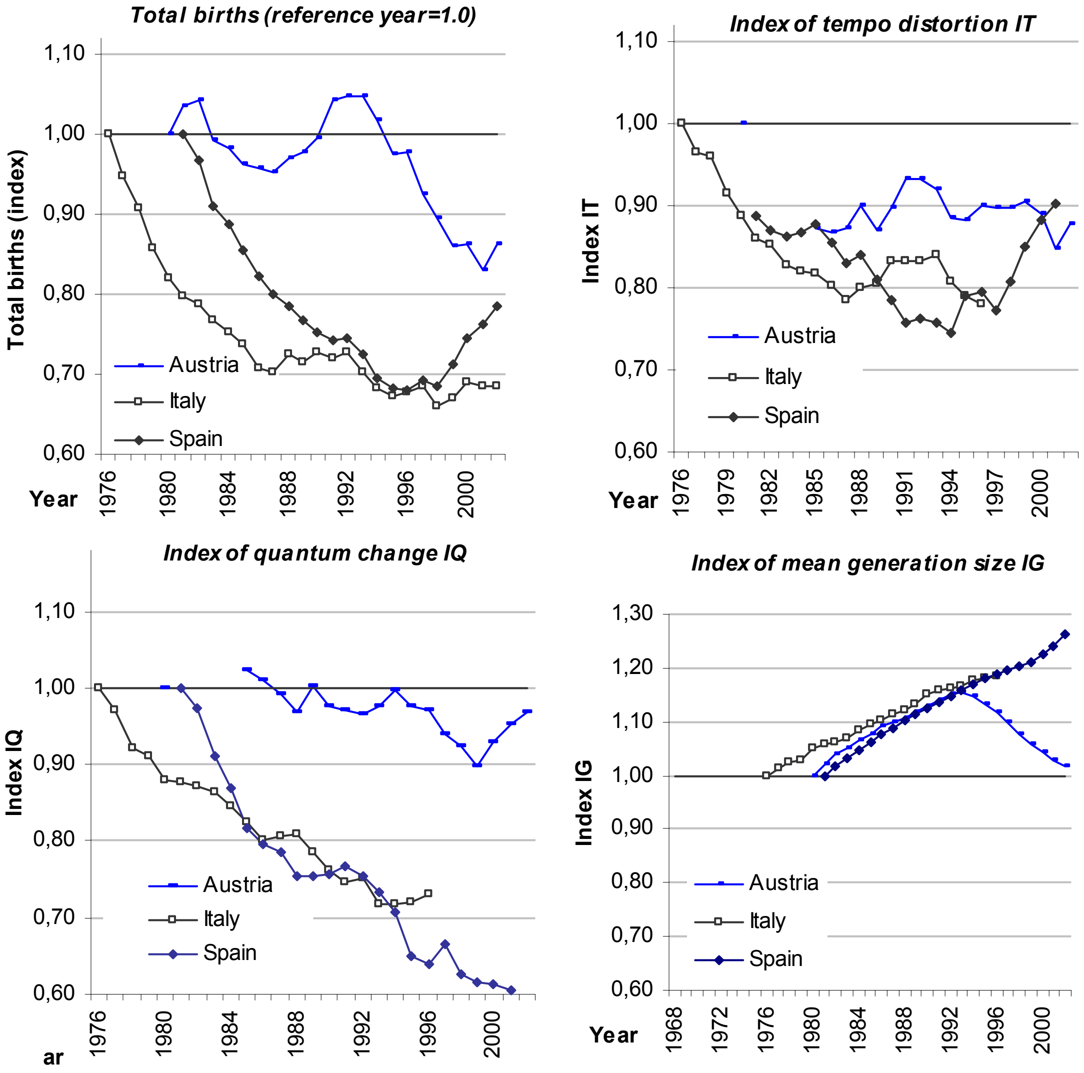
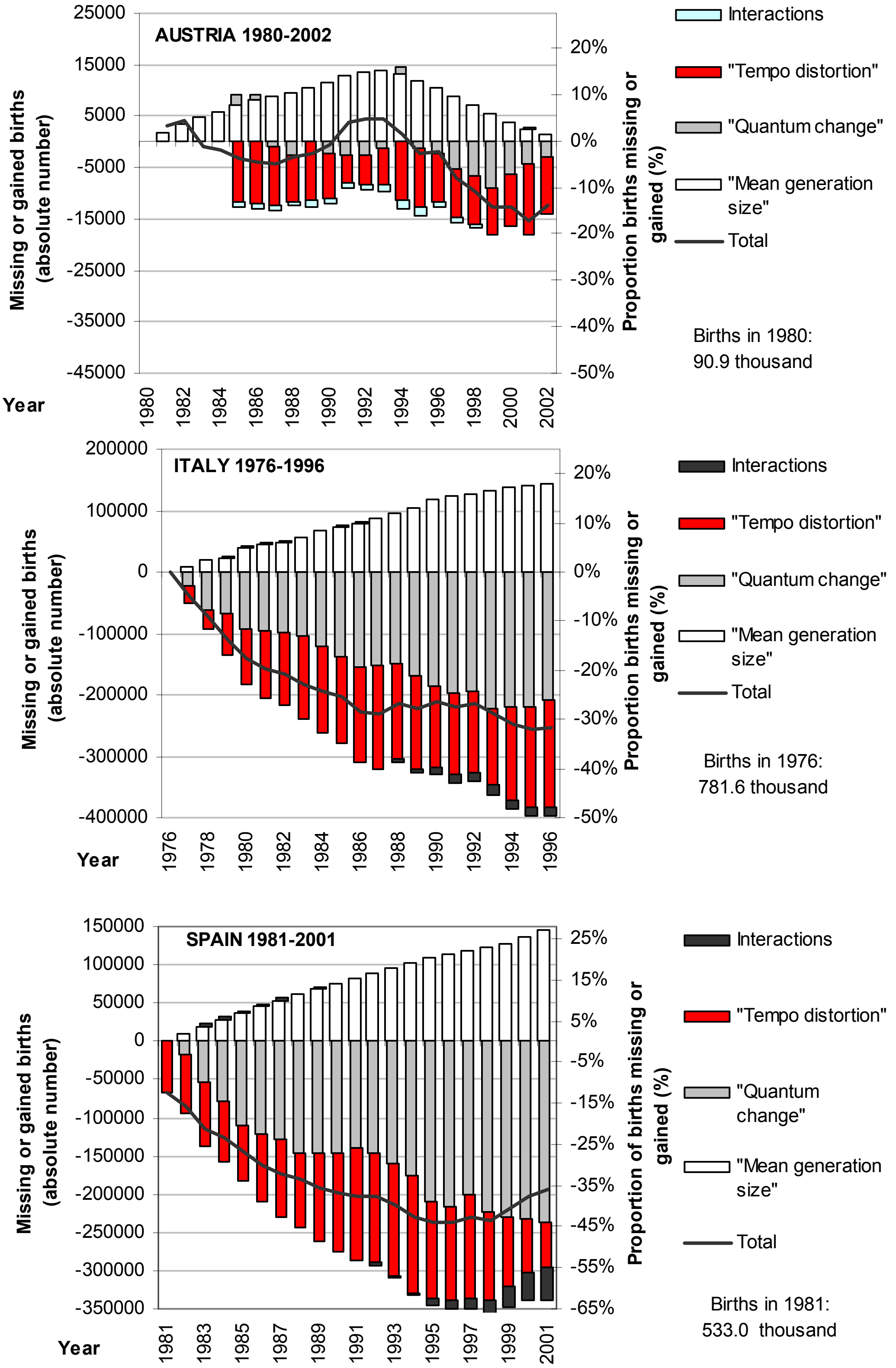


TABLE 4: Decomposition of changes in the total number of births from the beginning of fertility postponement in Austria, Italy, and Spain. Mean annual numbers of “missing” or “gained” births (thousand) and relative contribution of the main factors.

	Austria	**Italy**	**Spain**
Reference year t_0	1980	1976	1981
Analysed period t_1	1985-2002	1977-1996	1982-2001
Births in the reference year t_0	90.9	781.6	533.0
Hypothetical births in t_0 (without tempo effects)	90.9	781.3	599.9
Mean annual births in t_1	86.6	591.4	410.9
Mean annual "missing” or "gained" births in t_1	-4.3	-189.9	-189.0
Of which due to			
Tempo effects	-9.8	-124.6	-107.5
Quantum changes	-2.5	-144.0	-156.3
Mean gen. size *G*	9.0	83.6	82.0
Interaction	-0.8	-4.8	-7.2
Mean annual influence of different factors (relative to the hypothetical births in the reference year t_0)			
Tempo effects	-10.9%	-15.9%	-17.9%
Quantum changes	-2.8%	-18.4%	-26.1%
Mean gen. size *G*	9.9%	10.7%	13.7%
Interaction	-0.9%	-0.6%	-1.2%
Total births missing due to tempo effects			
Absolute	-177.5	-2492.1	-2150.0
Relative to births in 2000	2.3	4.6	5.4

Figure 4: Decomposition of changes in the total number of births from the beginning of fertility postponement (tempo effects in the initial year are taken into account).



CZECH REPUBLIC, HUNGARY, POLAND, AND ROMANIA

FIGURE 5: Changes in the total number of births from the beginning of fertility postponement and the relative contribution of tempo effects, quantum, and mean generation size in the Czech Republic, Hungary, Poland, and Romania.

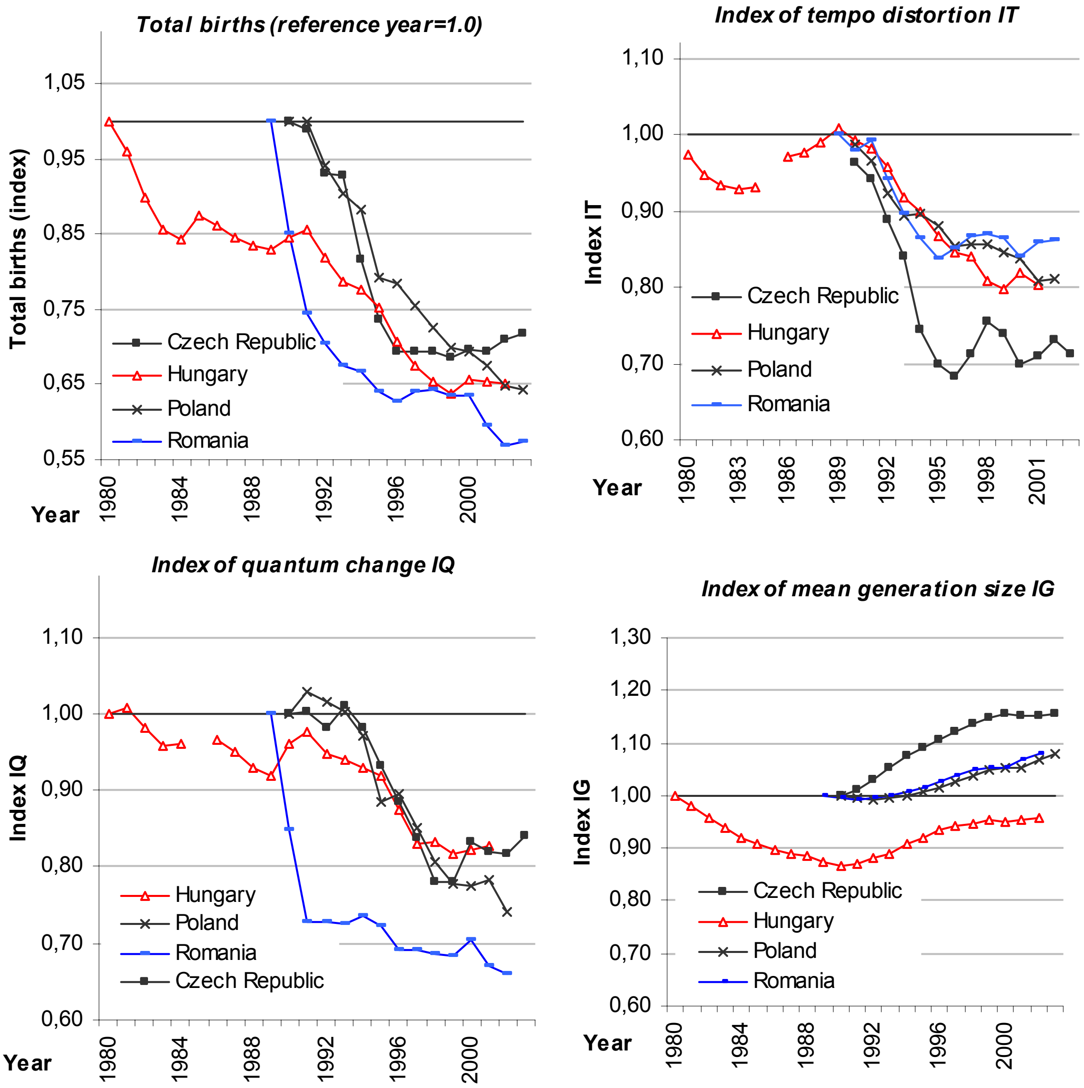


TABLE 5: Decomposition of changes in the total number of births from the beginning of fertility postponement in Czech Republic, Hungary, Poland, and Romania.
Mean annual numbers of “missing” or “gained” births (thousand) and relative contribution of the main factors.

	Czech Republic	**Hungary (1)**	**Hungary (2)**	**Poland**	**Romania**
Reference year t_0	1990	1980	1990	1990	1989
Analysed period t_1	1991-2003	1981-2001	1991-2001	1991-2002	1990-2002
Births in the reference year t_0	130.6	148.6	125.7	545.8	369.5
Hypothetical births in t_0 (without tempo effects)	135.5	152.6	126.7	552.9	369544
Mean annual births in t_1	100.3	117.7	107.8	432.1	245.3
Mean annual "missing” or "gained" births in t_1	-35.2	-34.8	-18.9	-120.8	-124.2
Of which due to					
Tempo effects	-32.8	-13.8	-16.9	-72.9	-42.1
Quantum changes	-15.6	-11.6	-10.1	-67.4	-105.6
Mean gen. size *G*	14.4	-12.6	8.4	13.2	18.0
Interaction	-1.1	3.2	-0.3	6.3	5.8
Mean annual influence of different factors (relative to the hypothetical births in the reference year t_0)					
Tempo effects	-24,2%	-9,0%	-13,3%	-13,2%	-11,4%
Quantum changes	-11,5%	-7,6%	-8,0%	-12,2%	-28,6%
Mean gen. size *G*	10,6%	-8,3%	6,6%	2,4%	4,9%
Interaction	-0,8%	2,1%	-0,3%	1,1%	1,6%
Total births missing due to tempo effects					
Absolute	-426.9	-289.8	…	-874.6	-547.9
Relative to births in 2000	4.7	3.0	…	2,3	2,3

Figure 6: Decomposition of changes in the total number of births from the beginning of fertility postponement (tempo effects in the initial year are taken into account).

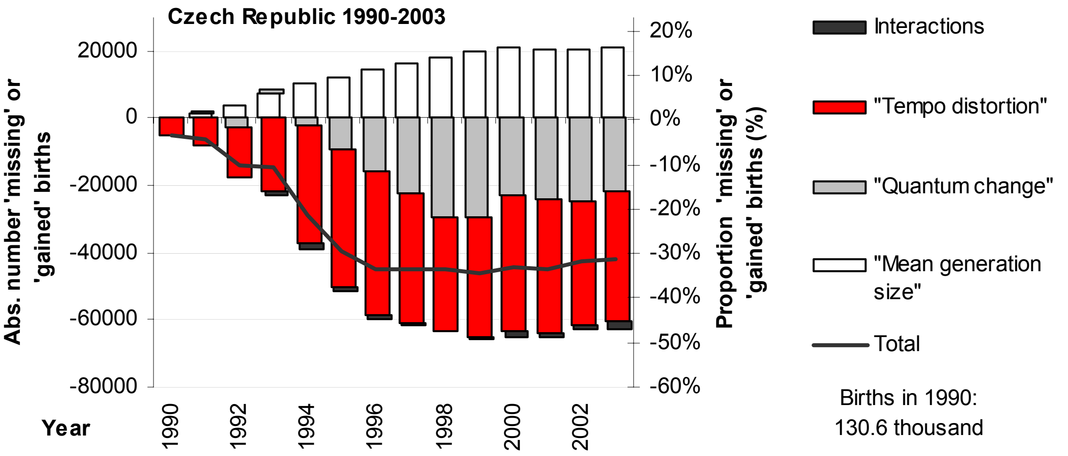


Figure 6 (continued):

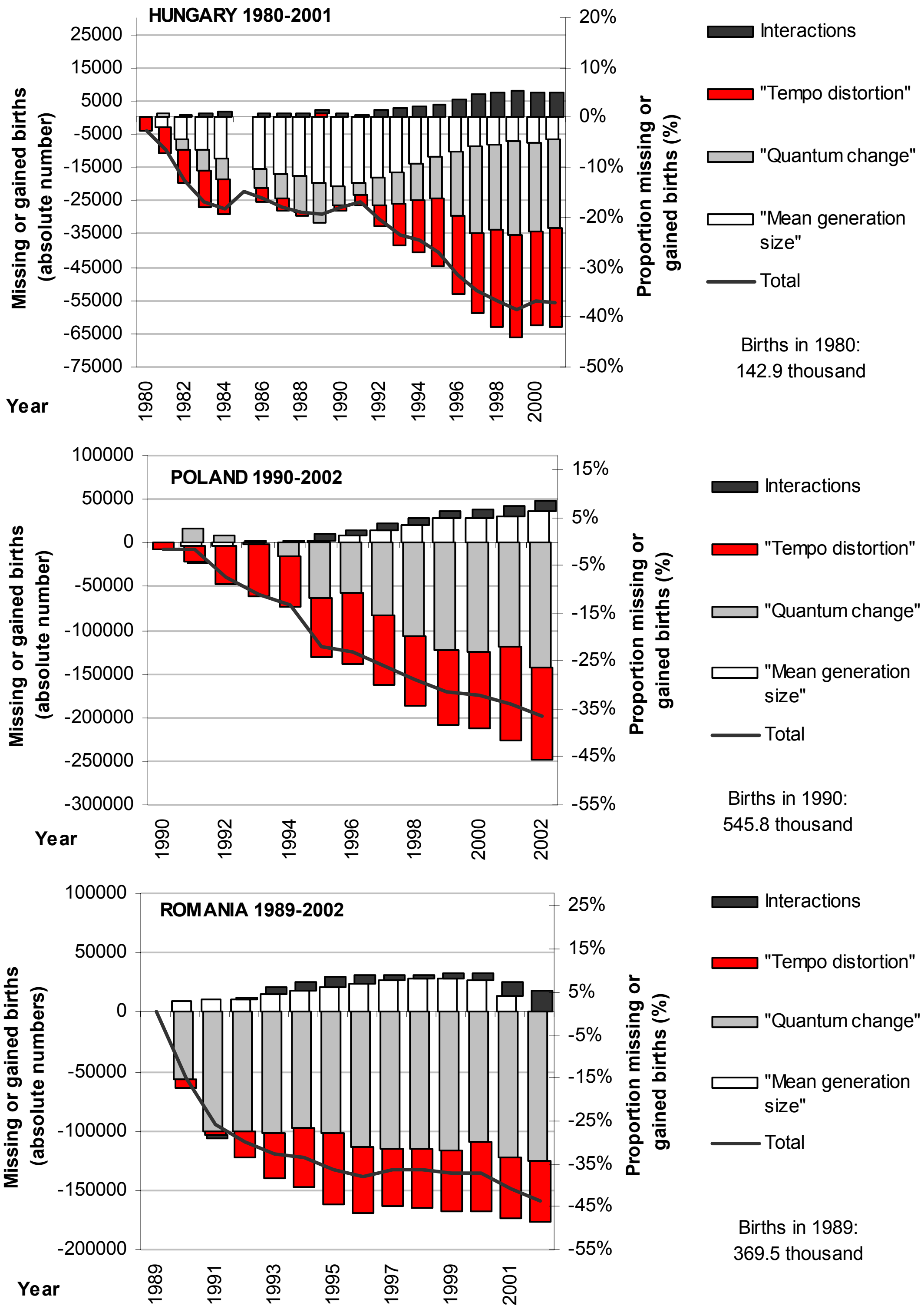


Figure 7: Main results of the birth projection scenarios for Austria in 2004-2025 as compared with the observed trends in 1980-2003.

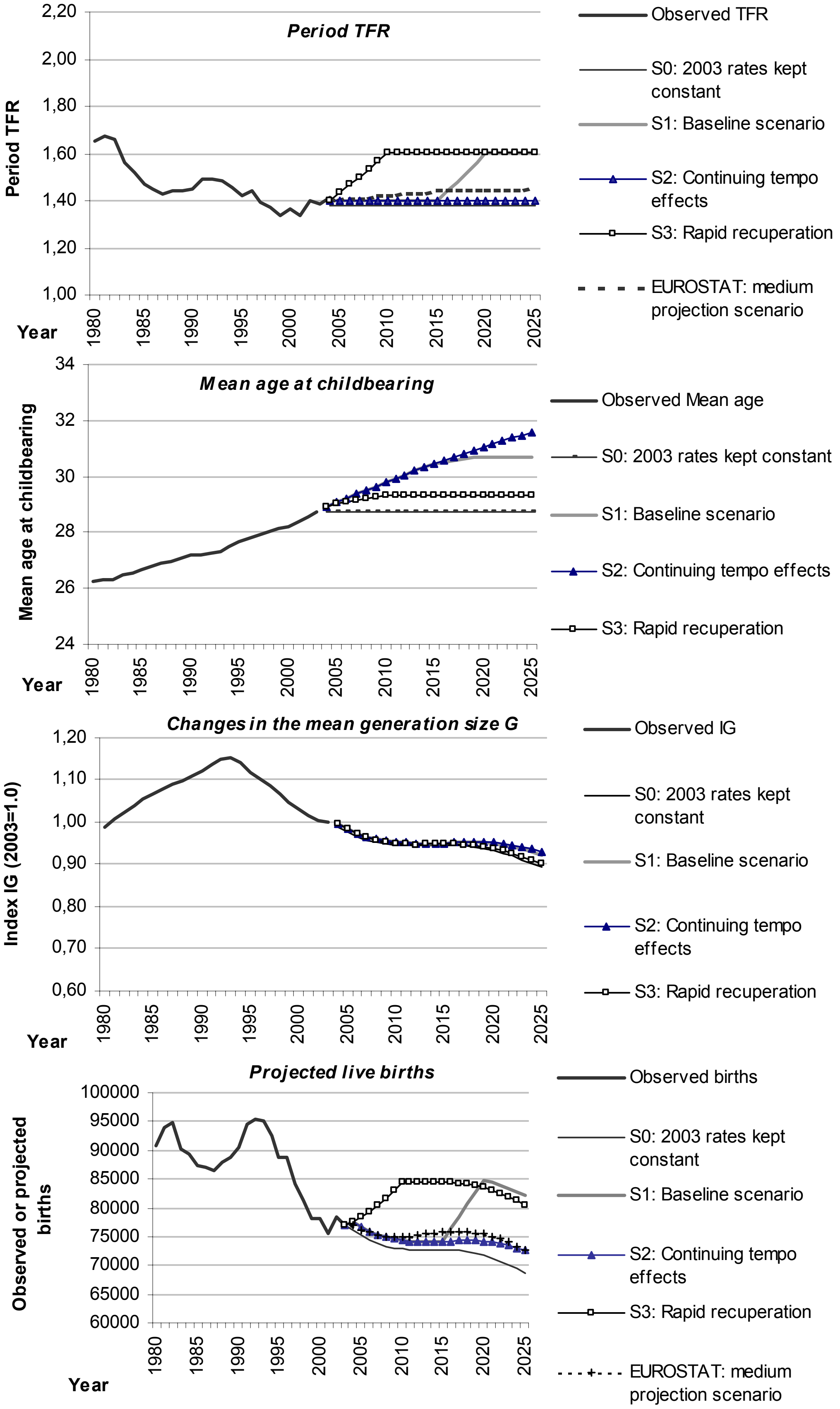


Figure 8: Main results of the birth projection scenarios for the Czech Republic in 2005-2025 as compared with the observed trends in 1980-2004.

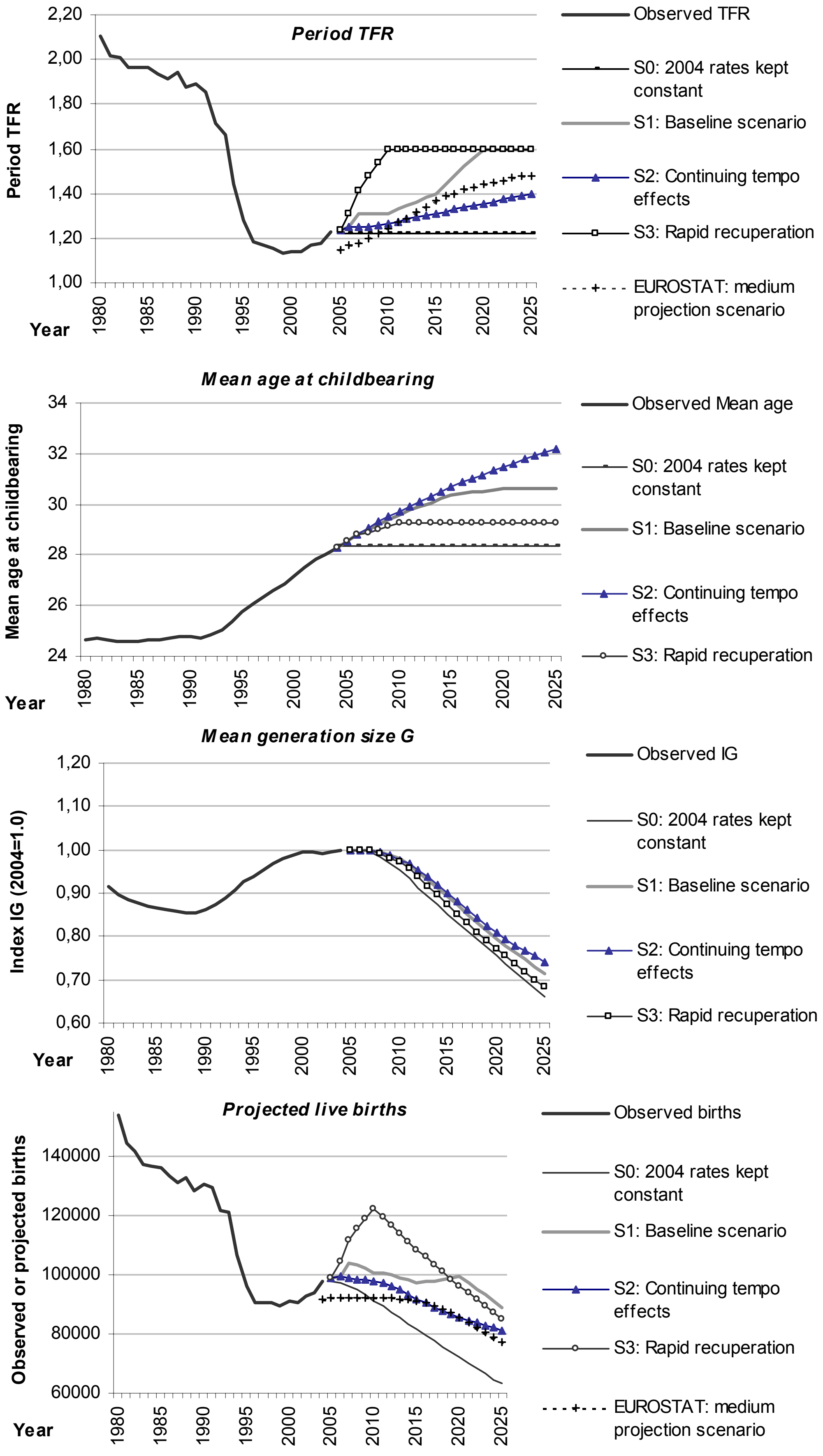
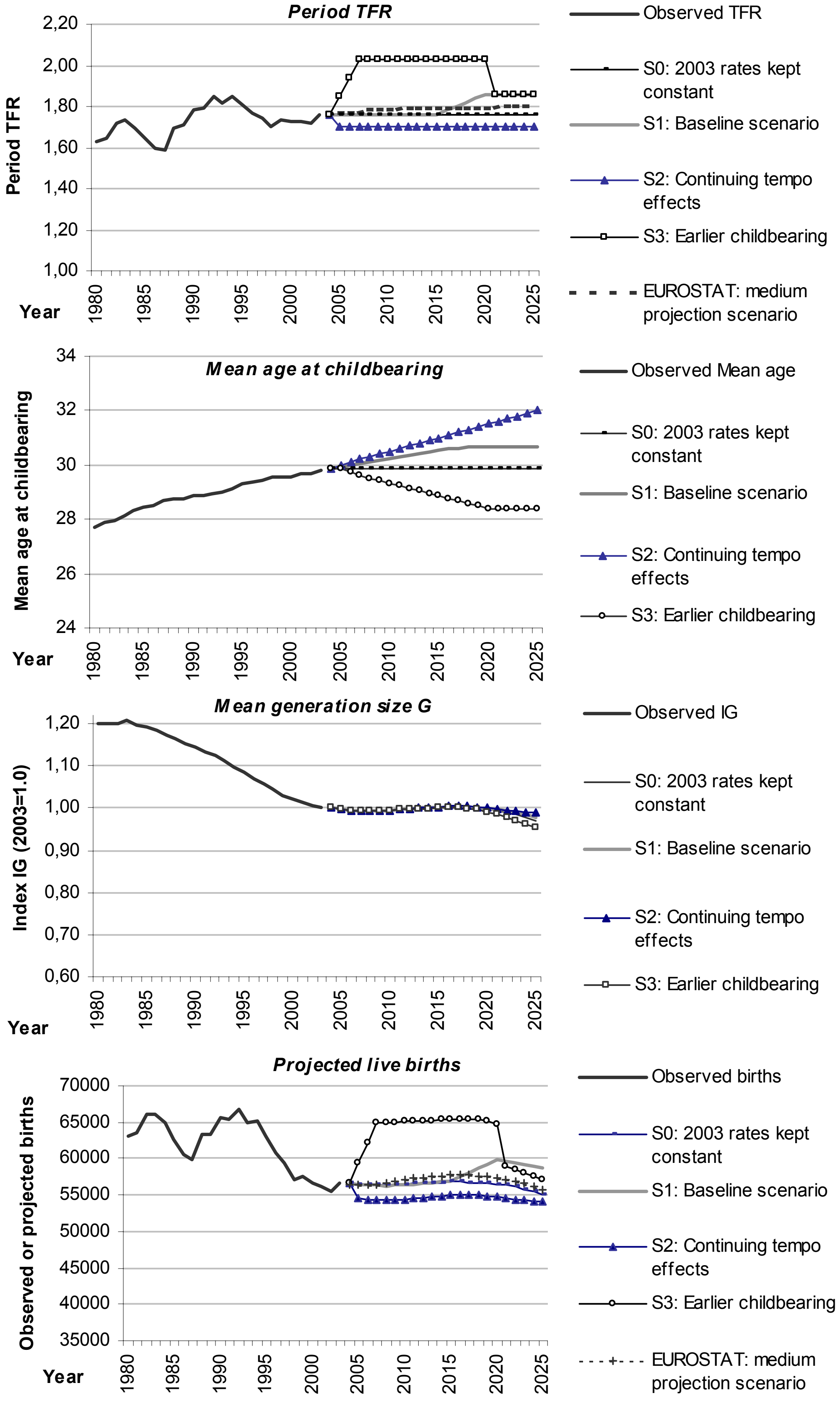


Figure 9: Main results of the birth projection scenarios for the Finland in 2004-2025 as compared with the observed trends in 1980-2003.



APPENDIX 1

Table AP-1: Decomposition of changes in the total number of births during the periods of fertility postponement (Czech Republic 1991-2002 and Finland 1984-2002) and fertility advancement (Czech Republic 1971-1979).
Fertility quantum, tempo distortions, and mean generation *G* in the reference year taken as a standard for the analysis.

Period	**Czech Republic** 1991-2002	**Czech Republic** 1971-1979	**Finland** 1984-2002
Reference year t_0	1990	1970	1983
Total births in the reference year	130564	147865	66150
Mean annual births in the analysed period t_1	100857	178415	61509
Total births missing or gained	-29707	30550	-4641
Mean annual number of "missing" or "gained" births; Kohler-Ortega approach			
Due to the change in the 'mean generation size'	13350	1283	-5083
Due to quantum change	-14600	12524	-701
Due to tempo effects (non-standardised)	-27405	11885	1252
Due to interaction effects	-1052	4858	-109
Proportion of births "missing" or "added" in comparison with the reference year (%)			
Due to the change in the 'mean generation size'	10,2%	0,9%	-7,7%
Due to quantum change	-11,2%	8,5%	-1,1%
Due to tempo effects (non-standardised)	-21,0%	8,0%	1,9%
Due to interaction effects	-0,8%	3,3%	-0,2%
Total births missing or gained	**-22,8%**	**20,7%**	**-7,0%**

Table AP-2: Decomposition incorporating tempo effects in the reference year.

Period	**Czech Republic** 1991-2003	**Czech Republic** 1971-1979	**Finland** 1984-2002
Reference year t_0	1990	1970	1983
Total births in the reference year	130564	147865	66150
Missing or gained births due to tempo effects in reference year	-4921 (-3,6%)	-2954 (-2,0%)	-5988 (-8,3%)
Hypothetical number of births in the reference year t_0	135485	150819	72138
Mean annual births in the analysed period t_1	100857	178415	61509
Mean annual number of "missing" or "gained" births; Kohler-Ortega approach			
Due to the change in the 'mean generation size'	13853	1332	-5266
Due to quantum change	-15150	12996	-726
Due to tempo effects (non-standardised)	-32327	8931	-4499
Due to interaction effects	-1005	4337	394
Total births missing or gained	**-34629**	**27595**	**-10098**
Proportion of births "missing" or "added" in comparison with the hypothetical total in the reference year (%)			
Due to the change in the 'mean generation size'	10,2%	0,9%	-7,3%
Due to quantum change	-11,2%	8,6%	-1,0%
Due to tempo effects (non-standardised)	-23,9%	5,9%	-6,2%
Due to interaction effects	-0,7%	2,9%	0,5%
TOTAL	**-25,6%**	**18,3%**	**-14,0%**

Table AP-3: Mean annual number of births in Austria, the Czech Republic, and Finland in 2005-2025 under different scenarios of tempo effects.

	Austria	**Czech Republic**	**Finland**
Observed births in 2003	76944	93685	56630
Projected mean annual number of births in 2005-2025			
S0: 2004 rates kept constant	72294	81422	56364
S1: Baseline scenario	78165	98161	57667
S2: Continuing tempo effects	74294	91387	54595
S3: Rapid recuperation	82786	104422	
S3 (Finland): Earlier childbearing			63061
EUROSTAT (medium variant)	75093	88423	57066
Projected mean annual number of births in 2005-2025 relative to the observed total births in 2003			
S0: 2004 rates kept constant	0,94	0,87	1,00
S1: Baseline scenario	1,02	1,05	1,02
S2: Continuing tempo effects	0,97	0,98	0,96
S3: Rapid recuperation	1,08	1,11	
S3 (Finland): Earlier childbearing			1,11
EUROSTAT (medium variant)	0,98	0,94	1,01