Ultra-Low Fertility in Korea: The Role of Tempo Effect

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Short Abstract

Delayed childbearing is one of the main causes of ultra-low fertility in East Asia, but little is known about the extent of which the ongoing "postponement transition" depresses period total fertility rates in this region. We provide an in-depth analysis of the role of tempo effect in fertility decline in the Republic of Korea, a country that currently experiences very low period total fertility rate (TFR) and, at the same time, has seen a rapid increase in the mean age at first birth to one of the highest levels globally. Using tempo- and parity-adjusted total fertility rate (TFRp*) suggested by Bongaarts and Sobotka (2012), we show that the conventional TFR in Korea has been negatively affected by tempo effect since the early 1980s and tempo effect was the main force pushing the TFR to the "ultra-low" levels below 1.3 since the early 2000s. We also show that the fluctuations in Korean TFR have been strongly driven by changes in the timing of childbearing, with intensive postponement of childbearing largely fueling a rapid TFR decline in the early 2000s to a low of 1.1 in 2005. When tempo and parity composition effects are accounted for, Korean fertility shows more gradual, but continuous decline, falling for the first time to a 1.5 threshold in 2013. The decline in Korean fertility followed distinct phases, with a fall in third and higher-order fertility rates until the 1980s followed by a gradual decline in second-order TFRp* in the 1990s and then a gradual decline in first-birth rates combined with a faster decline in second-order TFRp* since the early 2000s. Further continuation of these trends would imply that Korean fertility would recover only slightly and would stay very low even once the postponement of childbearing comes to an end.

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Introduction

Republic of Korea (just Korea) is the largest among East Asian and South East Asian societies currently experiencing "ultra-low" or "lowest-low" period total fertility rates (TFR) below 1.3 (Jones et al. 2009; Lee and Choi 2015). In the course of four decades, Korea made a rapid transition from a high-fertility country towards a country with one of the lowest fertility levels globally. The period TFR fell from 6.3 in 1955-60 (UN 2015) to sub-replacement level in 1984, and then to the "lowest-low" level below 1.3 since 2002, bottoming at 1.08 in 2005. In parallel with a fast-paced fertility decline a rapid "postponement transition" (Kohler et al. 2002) took place since the early 1980s, with marriages and first births being shifted to ever higher ages. Since the early 1980s the mean age of mother at first birth increased by over six years, reaching 31 in 2014, the highest level among the larger countries globally.

The experience of very low fertility took policymakers by surprise and eventually created sense urgency in a country where official policies aimed until the 1980s to limit family size in order to curb population growth and limit overcrowding. Korean government abolished the long-lasting anti-natalist policy in 1996 and converted it soon into pronatalist policy in response to fertility decline and population ageing. Since 2006 Korean government has launched a three five-year plans that formulated a set of pronatalist policies that aim to encourage people to marry and have children in order to increase fertility rate in a country (Haub 2010; Lee and Choi 2015), with the latest, "The third basic plan for low fertility and aging society in Korea" announced in December 2015 (Samsik Lee 2015). These action plans are formulated on the basis of the observed trends in the period TFR, and they also set numerical targets in terms of the future levels of TFR. However, these policy efforts do not yet appear to have much effect (Lee 2009; Lee and Choi 2015).

Given that period TFRs are notoriously unstable and can be strongly affected by the shifts in the timing of childbearing, and therefore may provide misleading signals to policy-makers (Sobotka and Lutz 2011), the lack of attention to cohort trends and to alternative period fertility measures in policy-related debates in Korea is surprising. A similar situation prevails in other countries of the region as well. In Europe demographers have extensively discussed "tempo effect" in conventional period indicators of fertility and marriage focusing on its key role in driving these indicators to very low levels (Bongaarts and Feeney 1998, Sobotka 2004) and the rise in the TFRs observed in many countries in 2000s (Goldstein et al. 2009; Bongaarts and Sobotka 2012), but studies on East Asia mostly tend to ignore the impact of tempo effect on the TFRs.

We argue that the trend towards very low fertility in Korea has been partly fueled by the "tempo effect" and that, similar to many European countries, tempo effect might have been the decisive force that pushed the period TFR towards the lowest-low level. To understand rises and falls in fertility and cross-country differentials in fertility rates, fertility measurement should go beyond the period TFRs.

To address our argument, we provide an in-depth analysis of period fertility trends in Korea over the course of more than three decades from 1981 to 2014. We compare changes in conventional TFR with *tempo- and parity-adjusted total fertility rate* (TFRp*) suggested by Bongaarts and Sobotka (2012) and their order-specific components. We identify distinct stages in Korean fertility decline, which was first fueled by falling fertility at third and higher birth order in the 1980s, and, most recently, by a gradual reduction in first birth rates and a faster decline in fertility rates of birth order 2. In addition, we compare changes in these two indicators with completed cohort fertility for women born until the 1970s. In line with our argument, we show that when tempo and parity composition effects are accounted for Korean fertility shows more gradual, but continuous decline, falling for the first time to a 1.5 threshold in 2013.

Low fertility and tempo effect in East Asian countries

Despite extensive research the discussion on tempo effects in fertility has not yet developed much in the low-fertility countries and territories of East Asia and Southeast Asia – Hong Kong SAR, Japan, Singapore, Taiwan, and South Korea. These countries have experienced low fertility since the 1980s, and their period TFRs further declined below 1.3 between 2001 and 2005 (Jones et al. 2009), although the TFR in Japan has soon bounced back above that threshold. The TFR in China has also been well below the replacement level since the early 1990s (Morgan et al. 2009). The TFR below 1.3 is often described as "lowest-low fertility" (Kohler et al. 2002), but it is also called as "ultra-low fertility" in East Asia. The term "ultra-low fertility" is preferred in East Asia in order to not rule out the potential for a further decline and also to distinguish it from European experience (e.g., Jones et al. 2009). Many studies pointed out that the ultra-low fertility is mainly attributable to delayed marriage and childbearing that is prevalent in this region (Frejka, Jones, and Sardon 2010; Jones 2007). In many East Asian countries women's mean age at marriage has increased for the past several decades, in parallel with a rise in age at childbearing.

Until recently these societies adhered to a universal marriage pattern. Recently, marriage rates have declined across the region and "younger" women and man increasingly remain single well into their thirties; also lifetime non-marriage has increased considerably (Jones and Gunhaju 2009; Rindfuss and Choe 2015). As births out of wedlock remain rare across the region, a decline in nuptiality along with the solid link between marriage and childbearing contributed strongly to the emergence of ultra-low fertility in East Asia, which is contrasting with the European experience characterized by a strong increase in non-marital childbearing. But is not clear whether East Asian ultra-low fertility is becoming a permanent phenomenon, or whether many marriages and births presumably delayed at younger ages will eventually take place at later ages, bringing a recovery in the period total fertility rate. A body of literature has studied socioeconomic factors, such as childrearing cost, educational expansion, economic recession, labor market conditions, values and attitudes and public policies, which may contributed to fertility decline (Anderson and Kohler 2013; Choe and Park 2006; Eun 2007; Jun 2005; C.-S. Kim 2007; D.-S. Kim 2005, 2013; H.S. Kim 2014; Kwon 2007; Ma 2013, 2014; Park et al. 2013; Woo 2012; Yoo 2006, 2014), but the nature of ultra-low fertility has not yet been sufficiently explored. Especially little is known about the size and role of the tempo effects in fertility in the region, in part due to lacking detailed data for many countries. Therefore, the role of tempo effect in bringing period TFRs across the region to ultra-low levels remains little acknowledged.

Data

Data for this study come from two different sources, Korean Population and Housing Census and vital statistics. Descriptive tables of both data are available online at Korean Statistical Information Service (KOSIS: kosis.kr). In Korea, population census is conducted every five years while birth registration data is available every year since 1981. To compute age- and order-specific fertility rates, we obtained the parity distribution of female population by age from 1985 census, and age- and order-specific number of births between 1981 and 2014 from birth registration data. Also, female population by age for each year was obtained from census-based population estimation provided Statistics Korea.

In reconstructing age and parity composition of the female population of reproductive age this study builds on the method protocol (Jasilioniene et al. 2012) used for the Human Fertility Database (http://www.humanfertility.org). We constructed period fertility tables by age and birth order every year for the entire period and used these tables for computing tempo-adjusted estimates of period fertility. Among available censuses I considered the 1985 census as an initial ("golden") census because it is the first census between 1981 and 2004 in which age- and order-specific number of births are available. We first obtained age-specific parity distribution of female population from the 1985 census and then updated it with age- and order-specific fertility rates for the following years until the latest year available (2014). The same procedure was also conducted backward, from 1985 to 1981, subtracting in each year a given set of age- and order-specific fertility rates each year. In doing so, we assumed that women's migration and mortality are not affected by their fertility, since the information on migration and mortality by parity is not available This assumption should not be problematic in Korea because women's in- and out-migration rates remained below 1% until recent years, and women's mortality also stayed at a very low level through reproductive ages.

All demographic data were converted, mostly from Lexis triangle which is common in Korea, into Lexis vertical parallelogram, so that the events are classified by calendar year and age reached during the year (ARDY). We considered a full range of reproductive ages, from below 15 (<15) up to the open-ended age group of 50 or older (50+), assuming that all births before age 15 occur at age 14 and all births after age 50 took place between ages 50 and 54. For a few birth cohorts that the reconstructed sum of cohort ASFRs for birth order 1 was above 1.0, which is logically impossible, we adjusted it by dividing the ASFRs at all ages by their sum. Detailed adjustments for age-parity distribution of female population followed the HFD method protocol (see sections 3 and 5 in Jasilioniene et al. 2012).

Methods

Fertility tempo adjustments

In 1998 Bongaarts and Feeney suggested a simple way to remove a tempo distortion in the period TFR caused by the shift of childbearing to later ages. Since then, demographers have discussed the usefulness and interpretation of tempo-adjusted indicators (e.g., Bongaarts and Feeney 2000; Kim and Schoen 2000; Zeng Yi and Land 2001; Sobotka 2003; Ní Bhrolcháin 2011) and developed other indicators aiming to calculate the period fertility rates free of tempo effect and addressing the shortcomings of the Bongaarts-Feeney method. These new indicators also addressed changing variance in fertility schedules by age and the effects of changes in the parity composition of the female population (Bongaarts and Feeney 2008; Bongaarts and Sobotka 2012; Kohler and Ortega 2002; Kohler and Philipov 2001; Yamaguchi and Beppu 2004). These methods usually involve more complicated computation and often require more extensive data. Demographers have yet come to any consensus regarding which method is most useful in terms of removing tempo effects. Although the debate is still ongoing, the idea and significance of tempo effect in fertility is widely accepted in demographic research.

Period fertility measures

For this study we focus on comparing two period fertility measures: the conventional TFR and *tempo- and parity-adjusted TFR* (TFRp*; Bongaarts and Sobotka 2012); we also analyze their order specific components. For a brief comparison we also use the original tempo-adjusted TFR (denoted TFR*) proposed by Bongaarts and Feeney (1998).

In the Bongaarts-Feeney method, the tempo distortion is easily adjusted by taking the conventional TFR over (*1 - r*), where *r* indicates the annual rate of change in the mean age at childbearing. In order to get a better adjustment, this procedure can be done separately for each birth order. As the adjustment procedure is simple and intuitive, the TFR* is most popularly used in the literature among adjusted measures of period fertility. However, the TFR* also contains considerable year-to-year fluctuations and does not take account of the changing parity distribution of female population.

$$TFR^{*}{}_{(t)} = \sum_{i} TFR_{(t,i)}/(1 - r_{(t,i)})$$

To measure fertility rate free of tempo distortions we use *the tempo- and parity-adjusted TFR*, also called as TFRp*: among the range of available methods it is most stable and also closest to completed cohort fertility (Bongaarts and Sobotka 2012, see also below). This method, which is originally developed by Bongaarts and Feeney (2004 and 2006) and also by Yamaguchi and Beppu (2004) in a similar manner, is computed from fertility rates of the first kind ("hazard rates"). Like other measures that take into accounts parity composition, this method is also based on the life-table framework of order-specific fertility. The difference is that births with different birth order are considered as "separate non-repeatable events" in this method, and thus order-specific fertility tables are treated as independent from each other (Bongaarts and Sobotka 2012). This feature is distinguished from the increment-decrement life-table framework in the Kohler-Ortega method (Kohler and Ortega 2002). As a result, in computing fertility probability of *i*th birth, the "exposure" population for a denominator is not all women at (*i - 1)*th birth, but all women who have not yet reached *i*th birth. The way of adjusting tempo effect is also the same with that of the TFR* although the distortion index (*1 - r*) directly applies to order-specific fertility tables. Accordingly the TFRp* is defined as:

$$TFRp^*{}_{(t)} = \sum_i TFRp^*{}_{(t,i)} = \sum_i \left\{1 - \exp\left[-\sum_a \frac{p_{(a,t,i)}}{1 - r_{(t,i)}}\right]\right\}$$

where $p_{(a,t,i)}$ indicates the probability of having *i*th birth among all women who have not reached *i*th birth at age *a* during year *t* (Bongaarts and Sobotka 2012).

Measuring tempo distortions and decomposition analysis

The trends in tempo distortions and how that differs by birth order may be useful for understanding the recent development of the postponement–quantum interactions. The TFRp* is designed to measure the period quantum of fertility that is free from any tempo and parity-composition distortion. Therefore, the difference between the conventional TFR and the TFRp* should represent the extent of the distortion from tempo and parity-composition effects. Of course this distortion effect is further separable into order-specific distortions. The tempo distortion is equal to the sum of the order-specific differences between the TFRp* and the conventional TFR, which can be defined as follows:

$$TFRp^*{}_{(t)} - TFR_{(t)} = \sum_i \left(TFRp^*{}_{(t,i)} - TFR_{(t,i)}\right)$$

where *i* indicates birth order and *t* indicates year of interest.

A change in period fertility consists of a *period quantum* change and a *period tempo* change. The period quantum change indicates the change in period fertility attributable to a genuine increase or decrease in fertility rates while the period tempo change suggests the change responsible for an advance or postponement of fertility schedules. As it is designed, the TFRp* adjusts not only tempo effect but also parity-composition effect. As the parity-composition effect is closely related to a change in sequencing of births, it is also be considered as part of tempo effect caused by the shift of childbearing. Thus, in this study we regard the distortion from a tempo change and a parity-composition change together as a tempo distortion in a broad sense (or just "tempo and parity-composition effects").[3] For the decomposition analysis, we separate a change in the TFR into a quantum change and a tempo change—tempo and parity composition together. Both quantum and tempo changes are further split by birth order as described below.

$$TFR_{(t+10)} - TFR_{(t)} = \sum_i \left(TFR_{(t+10,i)} - TFR_{(t,i)}\right)$$

$$= \sum_i \left\{\left(TFRp^*{}_{(t+10,i)} - TFRp^*{}_{(t,i)}\right) + \left[\left(TFR_{(t+10,i)} - TFRp^*{}_{(t+10,i)}\right) - \left(TFR_{(t,i)} - TFRp^*{}_{(t,i)}\right)\right]\right\}$$

Selected findings

Fertility trends and tempo distortions

Figure 1 shows fertility trends between 1981 and 2014 in Korea. Three period fertility measures—the *conventional TFR*, *tempo-adjusted TFR* (TFR*), and *tempo- and parity-adjusted TFR* (TFRp*)—are contrasted to the lagged completed cohort fertility. Following previous studies (e.g., Sobotka 2003), we also used the completed cohort fertility lagged as much as the period mean age at childbearing. For instance, if the period mean age at childbearing is 30 in 2000, we obtained the completed fertility rate for women born in 1970 and contrasted it to three indicators of period fertility in 2000. The conventional TFR declined from 2.57 in 1981 to 1.20 in 2014 with vigorous fluctuations. The trend displays a dramatic decline in the early 1980s, a

[3] The tempo effect is a broader concept that includes tempo distortions (Bongaarts and Feeney 2010), but in this study we do not distinguish it from another and use it interchangeably.

minor bounce in the early 1990s, and a moderate decline between the 1990s and early 2000s followed by fluctuations between 1.09 and 1.30 afterward.

The two adjusted measures, the TFR* and TFRp*, also share a downward trend but their progression significantly differs from that of the conventional TFR. Compared to the TFR, the TFR* and TFRp* display consistently higher fertility rates over the observed period, except for the early 1980s. The substantial difference between the conventional TFR and two tempo-adjusted TFRs seems to have increased over time since the early 1980s, implying the rising tempo distortions. It is noteworthy that the TFRp* shows the most stable trend, which also contrasts to the TFR* showing considerable year-to-year variations. The TFRp* is also remarkably close to the lagged completed cohort fertility (Bongaarts and Sobotka 2012).

As the shift of childbearing to later ages differs by birth order, the relative importance of tempo effects can be different for each birth order. Figure 2 depicts the gap between the conventional TFR and TFRp* by birth order. In the case of birth order 1, the TFR shows a downward trend with fluctuations while the TFRp* maintained the stable flat until 2002 and then began to decline moderately. The difference between the TFR and TFRp* was small in the 1980s, but gradually increased between the 1990s and 2000s reaching 0.35 in 2002. For birth order 2, both the TFR and TFRp* have a clear declining trend although the pattern is more dynamic. The distance between the TFR and TFRp* peaked in the mid-1980s, but became stabilized for the rest of the period. By contrast, in the figures of birth order 3 and birth order 4+, the marginal difference between the TFR and TFRp* observed in the 1980s gradually diminished over time, and the two lines of TFR and TFRp* eventually converged in the 1990s.

Figure 3 looks at the contribution of each birth order to the overall tempo effect in each year. A positive or negative value represents the extent of which the TFR is over- or underestimated, respectively, by order-specific tempo and parity-composition effects. With some variations, tempo distortions—both tempo and parity-composition changes together—have consistently depressed the TFR over the past three decades. The size of tempo distortion that includes all births together varied from a low of 0.08 in 1983 to a high of 0.58 in 2002. The trend in tempo distortions, measured by the gap between the TFR and TFRp* for all births, shows two different waves. The TFR-TFRp* difference first fell and rose between 1983 and 1992 reaching -0.43 at trough in 1986. The difference levelled off at around 0.19 for 4-5 years, but it began to fall again in 1995. The TFR-TFRp* difference reached the lowest point of -0.58 in 2002, which suggests that the tempo effect depressed the TFR as much as 0.58. Since then, the gap between TFR and TFRp* has gradually reduced, but still stands at -0.27 in 2014. While the first wave took just a decade, the second wave is still ongoing spending more than two decades. The latter is also much greater in size compared to the former. As a result, the changes in tempo and parity composition have depressed the conventional TFR of Korea to a great extent over the past three decades, and the effect of tempo distortion was most pronounced in 2002, right after the TFR reached lowest-low fertility level.

Decomposition analysis: three stages of fertility decline in Korea from low to ultra-low levels

A change in period fertility consists of a *period quantum* change and a *period tempo* change. Decomposition analysis breaks down a change in period fertility into a change in period quantum and a change in period tempo so that we can determine the relative significance between the two. In this study, we further divided it by birth order. Figure 4 represents the decomposition results for the three interdecadal periods. A blue colored bar represents a change in period quantum in absolute terms while an orange colored bar indicates a change in period quantum that includes both tempo and parity-composition effects. A gray dot represents a net effect between the two. In the period of 1981-1991 in which the TFR slid into the below-replacement level, the TFR decline reached as much as 0.86 and about 99% of the decline was attributable to a quantum change. The decline in period quantum is more salient among higher-order births, birth order 3 and 4+, which also proves that the transition from three or more children to two or less was still under way at the moment. At the same time, minor tempo effects at birth order 1 and 2 that lowered the TFR, were largely offset by the similar levels of tempo effects at birth order 3 and 4+ that operated in the opposite way. Accordingly the TFR decline attributable to the change in tempo effects was negligible in this period.

During the period of 1991-2001 in which the TFR further declined from 1.71 to 1.34, both quantum and quantum effects switched their roles in fertility decline. While the share of quantum changes to the TFR change dramatically declined, tempo changes became a dominant source that makes changes to the TFR. To be specific, a change in period quantum was trivial at all birth orders except a minor decline at birth order 2. By contrast a significant change in period tempo appeared at lower-order births, notably at first birth. Consequently around 88% of the TFR decline is attributable to the changes in period tempo, and four-fifths of the tempo changes were from birth order 1. The rise in tempo distortions suggests that the trend toward late childbearing was intensified in this period. In the meantime, the TFR decline owing to quantum change was just 12%, 0.05 children per woman.

In the last period of the ultra-low fertility between 2001 and 2014, both period quantum and tempo changes worked in opposite ways. The drop in period quantum contributed to the TFR decline to a great extent while the relaxed period tempo in part rather alleviated the declining trend in TFR. It should be noted that the positive values of tempo changes do not indicate the reversal of postponement transition, but instead suggest relative reduction in its size between

2001 and 2014. As was seen above, the tempo effect measured by the TFR-TFRp* remains substantial until 2014, which reflects the ongoing postponement transition. It is also noteworthy that changes in both period quantum and tempo effects were concentrated in lower-order births, birth order 1 and 2 in this period. Those at higher-order births have shown little influence on fertility changes since 2001.

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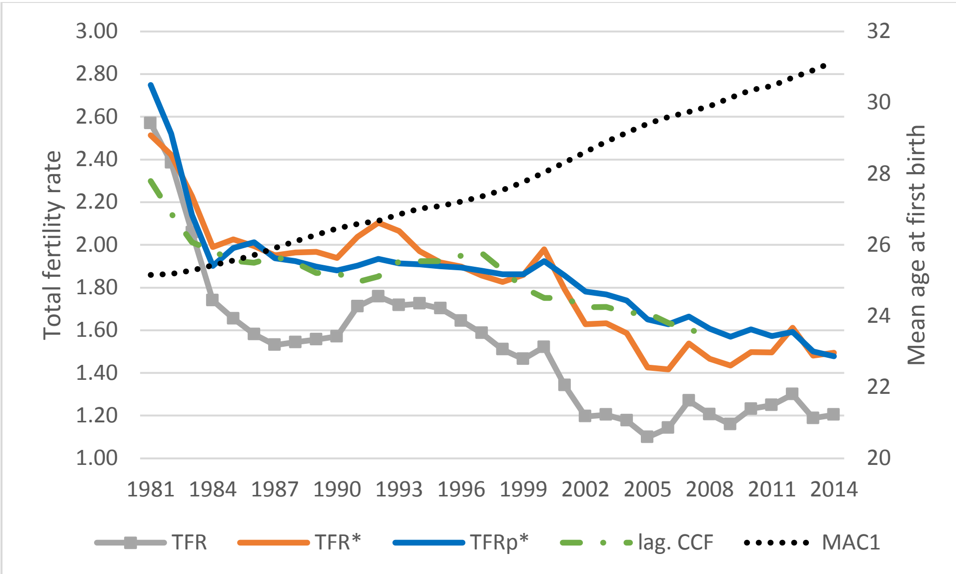
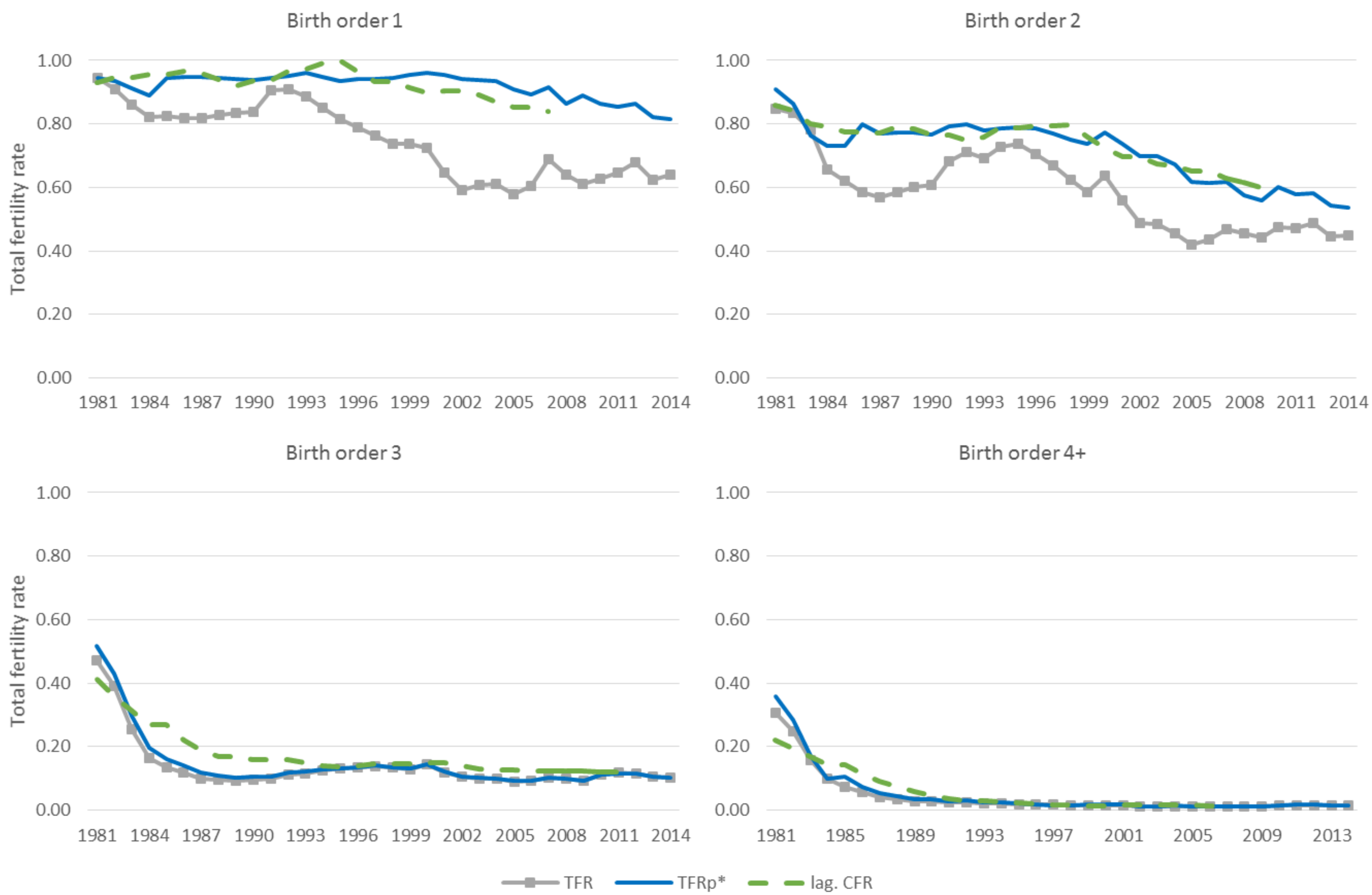
Figure 1. Fertility trends in South Korea, 1981-2014



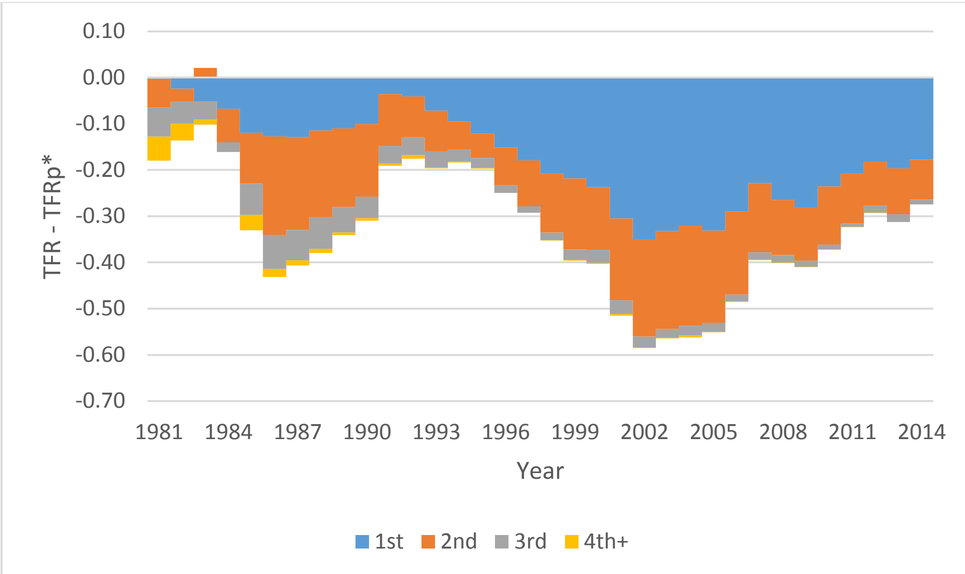
Source: own calculations based on vital statistics and census data.

Figure 2. Order-specific fertility trends, 1981-2014



Source: own calculations based on vital statistics and census data.

Figure 3. Tempo distortions from tempo and parity composition by birth order, 1981-2014



Source: own calculations based on vital statistics and census data.

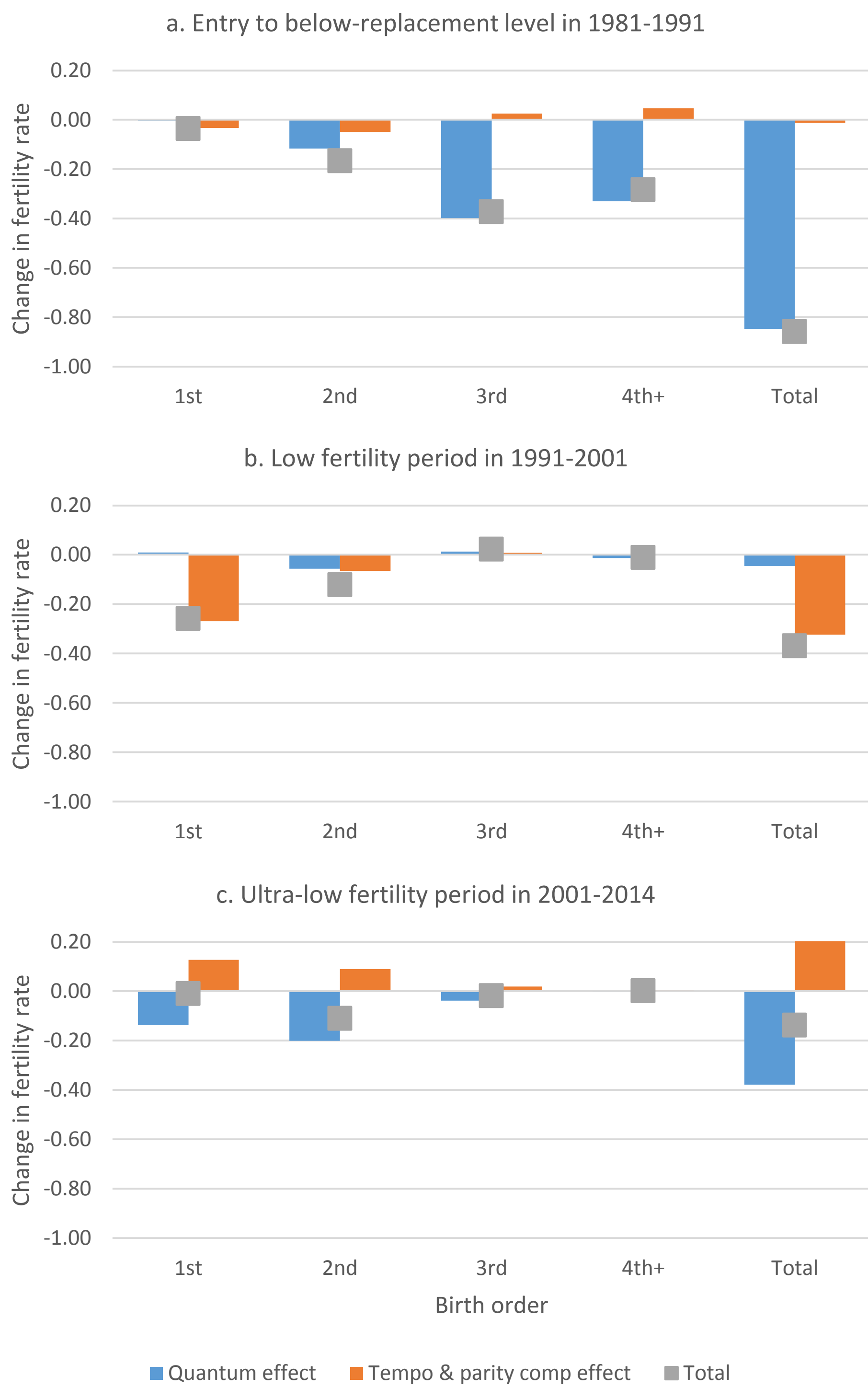


Figure 4. Decomposition analysis of changes in period total fertility for three different periods

Source: own calculations based on vital statistics and census data