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

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Approved by

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Contents

Abstract

Background: The total fertility rate (TFR) in South Korea has fallen below 1.3 since 2001. However, little is known about the role of the rapid shift towards late childbearing in driving Korean fertility decline to this “ultra-low” level.

Objective: We provide an in-depth analysis of period fertility trends by birth order in South Korea from 1981 to 2014 when the period TFR fell from 2.66 to extreme low levels.

Methods: We combine census and birth registration data to estimate period and cohort fertility indicators by birth order. We compare changes in conventional TFR with tempo- and parity-adjusted total fertility rate (TFRp*) and their birth order-specific components.

Results: Tempo effect linked to the shift towards delayed childbearing has had a strong and persistent negative influence on period TFRs in Korea since the early 1980s. Without the shift to later childbearing, period fertility rates in Korea would consistently stay higher and would decline more gradually, falling below a threshold of very low fertility, 1.5, only in 2014. The postponement of childbearing and the resulting tempo effect were strongest in the early 2000s, when Korean TFR reached the lowest levels. More recently, Korean fertility has been characterized by diminishing tempo effect and falling first and second birth rates. This trend marks a break with the previous pattern of almost universal fertility and a strong two-child family model.

Contribution: Our study demonstrates the importance of tempo effect in explaining the shift to “ultra-low” fertility in Korea and in East Asia.

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1 Introduction

Republic of 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 & Choi 2015). In the course of four decades South Korea (hereafter Korea) has experienced a rapid transition from a high-fertility country towards a country with one of the lowest fertility levels globally. 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 2001, 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 (Sobotka 2017).

The experience of very low fertility took policymakers by surprise and eventually created sense of urgency in a country where official policies aimed until the 1980s to limit family size in order to curb population growth and reduce 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 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 & Choi 2015), with the latest and third basic plan, "Plan for ageing society and population: 2016-2020" announced in December 2015 (Government of the Republic of Korea 2015; Lee 2015). These action plans are formulated on the basis of the observed trends in the period TFR and they also set numerical targets of TFR levels, with the third plan aiming to achieve a TFR of 1.50 by 2020 (Government of the Republic of Korea 2015). However, these policy efforts do not yet appear to have much effect (Lee 2009; Lee & Choi 2015).

With a few exceptions (Park 2007; Yoo 2014) the analytical studies and policy documents addressing fertility in Korea continue focusing solely on conventional period TFRs and age-specific fertility rates (e.g., Choe & Park 2006; Lee 2012; Government of the Republic of Korea 2015; Lee 2015). Because period TFRs are notoriously unstable and often strongly affected by the shifts in the timing of childbearing, they may give misleading perceptions of fertility trends and provide wrong signals about policy effects (Sobotka & 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. Whereas in Europe demographers have extensively discussed tempo effect in conventional period indicators of fertility and marriage and identified its key role in driving these indicators to very low levels (Bongaarts & Feeney 1998, Sobotka 2004) as well as in stimulating the TFR increases observed in many countries in 2000s (Goldstein et al. 2009; Bongaarts & Sobotka 2012), 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 when the period TFR shifted from 2.66 to "lowest-low" levels below 1.30. We compare changes in conventional TFR with tempo- and parity-adjusted total fertility rate (TFRp*) suggested by Bongaarts & Sobotka (2012) and their order-specific components. We identify three distinct stages in Korean fertility decline. This decline was first fueled by falling fertility at third and higher birth orders in the 1980s, then by a strong tempo effect linked to the postponement of first and second births in the 1990s, and most recently, by a gradual reduction in first birth rates and a faster decline in fertility rates at birth order 2. In addition, we compare changes in these two period indicators with completed cohort fertility of women born until the 1970s. We show that when tempo and parity composition effects are accounted for, Korean fertility displays more gradual but continuous decline, falling for the first time to a 1.5 threshold in 2014.

2 Low fertility and tempo effect in East Asian countries

Similarly to Korea, other East Asian countries - Hong Kong, Japan, Singapore, and Taiwan - 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 in East Asia it is also labelled as "ultra-low fertility." This term does not rule out the possibility of a further decline in fertility to yet lower levels, potentially distinguishing East Asian fertility declines from earlier experiences in European countries (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 East Asia (Frejka, Jones, & 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, with marriage closely connected with childbearing and, for women, usually also a withdrawal from the labor force and a "specialization" on household tasks, childrearing and care for the elderly (e.g., Bumpass et al. 2009 for Japan). Recently, marriage rates have declined across the region and women and men increasingly remain single well into their thirties. Lifetime non-marriage has also increased considerably (Jones & Gubhaju 2009; Rindfuss & Choe 2015; Yoo 2016). As births out of wedlock remain rare across the region and childbearing remains exclusively linked to marriage, a decline in nuptiality implies fewer births and contributes strongly to the emergence of ultra-low fertility in East Asia. This contrasts with the European experience of a strong increase in non-marital childbearing, especially within cohabiting unions, which has taken place in all major regions of Europe during the last three decades (Perelli-Harris et al. 2012; Coleman 2013; Thomson 2014).

Despite its persistence, it is not yet clear whether East Asian ultra-low fertility is likely to become a permanent phenomenon, and whether cohort fertility will also fall to such low levels. Many marriages and births presumably delayed at younger ages will eventually take place at later ages, bringing at least a minor recovery in the period TFR. Such a trend has been observed in the first East Asian country experiencing low fertility, Japan, during the last decade, when the period TFR rose gradually from a low of 1.25 in 2005 to 1.46 in 2015. An extensive body of literature has studied socioeconomic factors contributing to fertility decline in Korea, such as childrearing and costs of education, educational expansion, economic recession, labor market conditions, changing women's position and gender roles, values and attitudes, and public policies (Anderson & Kohler 2013; Choe & Park 2006; Eun 2007; Jun 2005; C-S Kim 2007; D-S Kim 2005, 2013; HS Kim 2014; Kwon 2007; Ma 2013, 2014, 2016; Park et al. 2013; Woo 2012; Yoo 2006, 2014; D-S Kim & Yoo 2016; Tan et al. 2016). However, the nature of ultra-low fertility has not yet been sufficiently explored. Especially little is known about the role of the tempo effects in depressing fertility in the region. We partly bridge this gap by providing an in-depth analysis of trends in order-specific period fertility indicators in Korea since the early 1980s. As order-specific data have become widely available for other countries in the region (especially Japan and Taiwan) due to Human Fertility Database (*www.humanfertility.org*) and Human Fertility Collection (www.fertilitydata.org), tempo effects can now be studied for a wider set of East Asian countries as well.

3 Data

Data for this study come from two different sources, Korean Population and Housing Census and vital statistics. Descriptive tables derived from both data sources 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 annually since 1981. To compute age- and parity-specific fertility rates, we combined the 2000 census data on parity distribution of female population by age with annual birth registration data on the number of births by age of mother and birth order in 1981 to 2014. Female population by age for each year was obtained from census-based population estimates provided by Statistics Korea. All these data are available as aggregate tabulations from KOSIS, but some of them are provided in Korean only (Statistics Korea 2017).

To compute period indicators by age and parity, especially the tempo-adjusted indicator proposed by Bongaarts & Sobotka (2012), we needed first to reconstruct age and parity composition of the female population of reproductive age during the entire period analyzed here, 1981-2014. This study builds on the method protocol used for the Human Fertility Database (Jasilioniene et al. 2015; http://www.humanfertility.org), where the annual distribution of the female population by age and parity is reconstructed from the initial dataset (referred to as "Golden Census") combined with the series of age- and order-specific fertility rates for the subsequent years. In this study we have modified this approach as we did not use the earliest available dataset (based on the population census 1985 or 1990), but rather decided to reconstruct the age- and parity distribution on the basis of a census that took place in 2000. This decision was motivated by the higher accuracy of the more recent dataset and, also, by the fact that combining earlier censuses with subsequent vital statistics data yielded parity distribution results that were clearly biased for some cohorts.[1]

Because data in Korean censuses on children ever born are collected only for the ever-married women, we had to assume that all the never-married women were childless. As the proportion of non-marital births has stayed below 3% for the observed period, this assumption should not affect our results significantly. Starting from the 2000 census, our dataset of age and parity distribution of the female population was then extended forward for the period up to 2015, cumulatively adding annual fertility rates by age (year of birth) and birth order for 2000-2014 to the estimated cohort parity distribution. Analogous procedure was also applied backward, subtracting annual fertility rates by age (year of birth) and birth order in 1981-1999 from the parity composition recorded in the 2000 census. These estimations of age-parity distribution of the female population followed the HFD method protocol (see sections 3 and 5 in Jasilioniene et al. 2012). Since the information on migration and mortality by parity is not available, we assumed that women's migration and mortality were not affected by their fertility. This assumption should not be problematic in Korea because women's in- and out-migration rates remained low (below 1%) in the observed period and women's mortality at prime reproductive ages also stayed at a very low level in the 1980s-2010s.

Most of the birth data were initially classified by age of mother and birth cohort (Lexis triangles). We have converted them into a cohort format (Lexis vertical parallelograms), so that the births were classified by calendar year and mother's age reached during the year (ARDY). Consequently, the TFRs we computed differ slightly from the officially reported fertility indicators by Statistics Korea. For most years, the difference in the resulting TFRs is marginal (below 0.1 in absolute terms) and we consistently use our computations throughout this study.

4 Methods

In this study we focus on three distinct indicators, specified by birth order (we distinguish birth orders 1, 2, 3, and 4+). We compare the conventional period *TFRs*, which are widely used as main fertility indicators in the region with the tempo- and parity-adjusted TFR (denoted TFRp*; Bongaarts & Sobotka 2012) and with a lagged indicator of completed fertility rate (CTFR). The CTFR by birth order was reconstructed in three steps. For the women born until 1950, we used the number of children ever born reported in the 2000 census. For the women born between 1951 and 1965, we combined the cumulated fertility observed in the 2000 census with annual age/cohort- and order-specific fertility rates in 2000-2014 to obtain their order-specific CTFRs at age 50. Finally, for the young cohorts born after 1965, their cumulated age- and order-specific fertility rate was estimated up until the end of 2014, using the same procedure as for the 1951-65 cohorts. To estimate their completed fertility and parity distribution, we have estimated their fertility at higher childbearing ages assuming that the most recent age- and order-specific fertility rates observed in 2014 will remain unchanged in the subsequent years. We have used this

[1] Using the 1985 census as a starting "golden census" to reconstruct the age- and parity distribution of the female population yielded some obviously erroneous results, with the first-order cohort fertility rate (CTFR1) exceeding unity for the cohorts born in 1965 and 1968. We did not obtain such "impossible" estimates when basing our reconstructions on the 2000 census.

estimation for the women born in 1966-77, who were aged 37 or older on 1 January 2015 and for whom more than 90% of their estimated CTFRs were realized at that time.

Fertility tempo adjustments

In 1998 Bongaarts & Feeney suggested a simple way to remove a distortion in the period TFR caused by the shift in childbearing towards earlier or later ages. Since then, demographers have discussed the usefulness and interpretation of tempo-adjusted indicators (e.g., Bongaarts & Feeney 2000; Kim & Schoen 2000; Zeng & 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 & Feeney 2008; Bongaarts & Sobotka 2012; Kohler & Ortega 2002; Kohler & Philipov 2001; Yamaguchi & Beppu 2004). These methods usually involve more elaborate computation and require more extensive data. Although demographers have not reached consensus regarding the usefulness of various tempo adjustment methods, the idea and significance of tempo effect in fertility (and also in mortality and marriage rates) has become widely accepted in demographic research (Luy 2011).

Tempo- and parity-adjusted total fertility rate (TFRp)*

In the original Bongaarts-Feeney (1998) method, the tempo distortion at each birth order is easily adjusted by dividing the conventional TFR by birth order (TFR_i) by ($1 - r_i$), where r_i indicates the annual rate of change in the mean age at childbearing at birth order *i*. The overall tempo-adjusted TFR (TFR*) is then computed as a sum of its order-specific components, TFR_i*:

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

As this adjustment procedure is simple and intuitive and can be computed for most low-fertility countries with the available data, it is also the most widely used. However, the TFR* also suffers several shortcomings. It assumes that the shape of fertility schedule remains constant over time, even as births are shifted to earlier or later ages. In reality this assumption is often violated (Zeng & Land 2001), and the variance in fertility schedules in the rich low-fertility countries has typically increased in the last decades (Bongaarts & Sobotka 2012). The TFR* is based on order-specific indicators which control only for age, but not for the changing parity distribution of the female population, which can be a source of additional distortion. Partly because of these factors, the TFR* often displays considerable year-to-year fluctuations, which are difficult to interpret (Sobotka 2003).

To measure fertility rate free of tempo distortions we therefore chose a more sophisticated alternative, *the tempo- and parity-adjusted TFR* (TFRp*). Among the range of available methods it gives most stable results and its values are closest to completed cohort fertility (Bongaarts & Sobotka 2012). This method was originally developed by Bongaarts & Feeney (2004 and 2006) and by Yamaguchi & Beppu (2004). It is computed from fertility rates of the first kind (“hazard rates”) that are computed separately for each parity. The main difference from most other parity-specific indicators is that births of different birth order are considered in this method as "separate non-repeatable events", and thus order-specific fertility indicators are treated as independent from each other (Bongaarts & Sobotka 2012). This feature distinguishes the method from the increment-decrement life-table framework applied in the Human Fertility Database and used, for instance, in the tempo adjustment method proposed by Kohler and Ortega (2002). In the Bongaarts-Sobotka framework, the hazard rate of *i*th birth at age *a* is not computed for women at parity *i-1* only, but for all women who have not yet given birth of order *i*.

Tempo effect by birth order is computed in the same manner as in the simple Bongaarts-Feeney (1998) method, but the tempo adjustment is then applied to the whole set of parity-specific hazard rates. The TFRp* index is computed 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 & Sobotka 2012).

Measuring tempo distortions and decomposition analysis

Conventional indicators of period fertility, including the TFR, can change because of shifts in fertility level (*quantum*) or due to the effects of changes in fertility timing (*tempo effect*) or in the parity composition of the female population. Tempo effect and parity composition changes can be seen as "distortions" that could obscure the underlying fertility change and give false signals about increases and falls in fertility and about the actual fertility levels. The TFRp* aims to measure the period quantum of fertility that is free from tempo and parity-composition distortion. Therefore, the difference between the conventional TFR and the TFRp* provides estimate to what extent the TFR is affected by these distortions. Similarly, comparing TFR and TFRp* trends over time allows us to identify whether ups and downs in the TFR in the last decades were caused by a "real" change in fertility quantum or whether they were at least partly driven by changes in the timing of births or in the parity structure of the female population.

As our data are specified by birth order, we also investigate fertility trends by birth order. In addition, we perform a decomposition analysis, which aims to separate a change in the TFR into a quantum change and a change caused by tempo and parity composition effects (to simplify, we label these two effects as "tempo effect" below). Both quantum and tempo effect are decomposed by birth order as described below. In this way, the change in conventional TFR over any period of interest (here we use a 10-year period from t to *t+10*) can be seen as a product of a change in fertility quantum over that period (as measured by TFRp*) and of the change in the size of tempo effect between *t* and *t+10*:

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

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

5 Results

5.1 Fertility trends and tempo distortions, 1981-2014

Figure 1 summarizes fertility trends in Korea between 1981 and 2014, as measured by two period fertility measures—the conventional TFR and the tempo- and parity-adjusted TFR (TFRp*)—which are contrasted with the lagged completed cohort fertility, CTFR (the period indicators are also listed in Appendix Table A-1).[2] The conventional TFR fell from 2.57 in 1981 to a low of 1.10 in 2005—the lowest level on record—before recovering slightly. Overall, the TFR trajectory was far from smooth: periods when TFR declined rapidly, especially in the early- to mid-1980s, and between 1995 and 2005, alternated with the periods when it showed a broad stabilization with some fluctuations and minor rises, between the mid-1980s and the mid-1990s and, more recently, after 2005.

The TFRp* follows quite a different trajectory, depicting three main findings. First, it consistently shows higher levels throughout the analyzed period, indicating that the conventional TFR has been continuously affected by the ongoing shift towards later childbearing. This is illustrated in Figure 1 by an uninterrupted increase in the mean age at first birth, rising above 30 since the mid-2000s. Second, the TFRp* depicts much smoother trend than the conventional TFR, following three broad phases. Its steep fall in the early 1980s was followed by a broad stabilization at around 1.9 between 1984 and 2000, with a renewed, though gradual, decline thereafter. Third, the TFR and TFRp* trends diverged in the most recent period after 2005. While the TFR stabilized or slightly increased, the TFRp* continued declining gradually, indicating that the increase in conventional TFR was largely due to the reductions in tempo effect, while the underlying level of fertility (as measured by the TFRp*) declined further. As a result of the shrinking tempo effect, the difference between the two indicators narrowed: in 2014, the TFRp* fell for the first time below the 1.5 threshold, reaching 1.48, whereas the conventional TFR stood at 1.20. During the analyzed period the TFRp* also remained remarkably close to the lagged completed cohort fertility among women born until the late 1970s, confirming the earlier findings by Bongaarts & Sobotka (2012) on the close correspondence between these two indicators.

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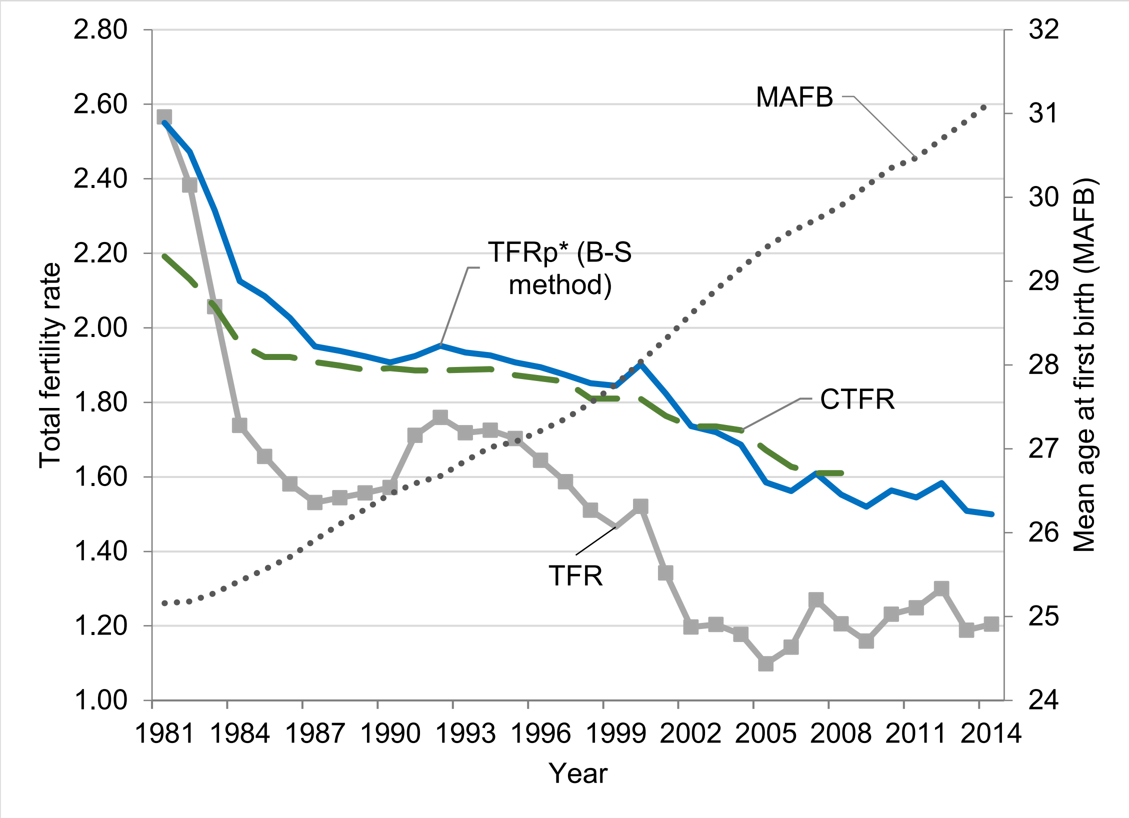
[2] Following previous studies (e.g., Sobotka 2003), we lagged the cohort fertility by the period mean age at childbearing observed in a given year. For instance, if the period mean age at childbearing is 30 in 2000, we compare the two indicators of period fertility observed in 2000 with the completed fertility rate of women born in 1970.

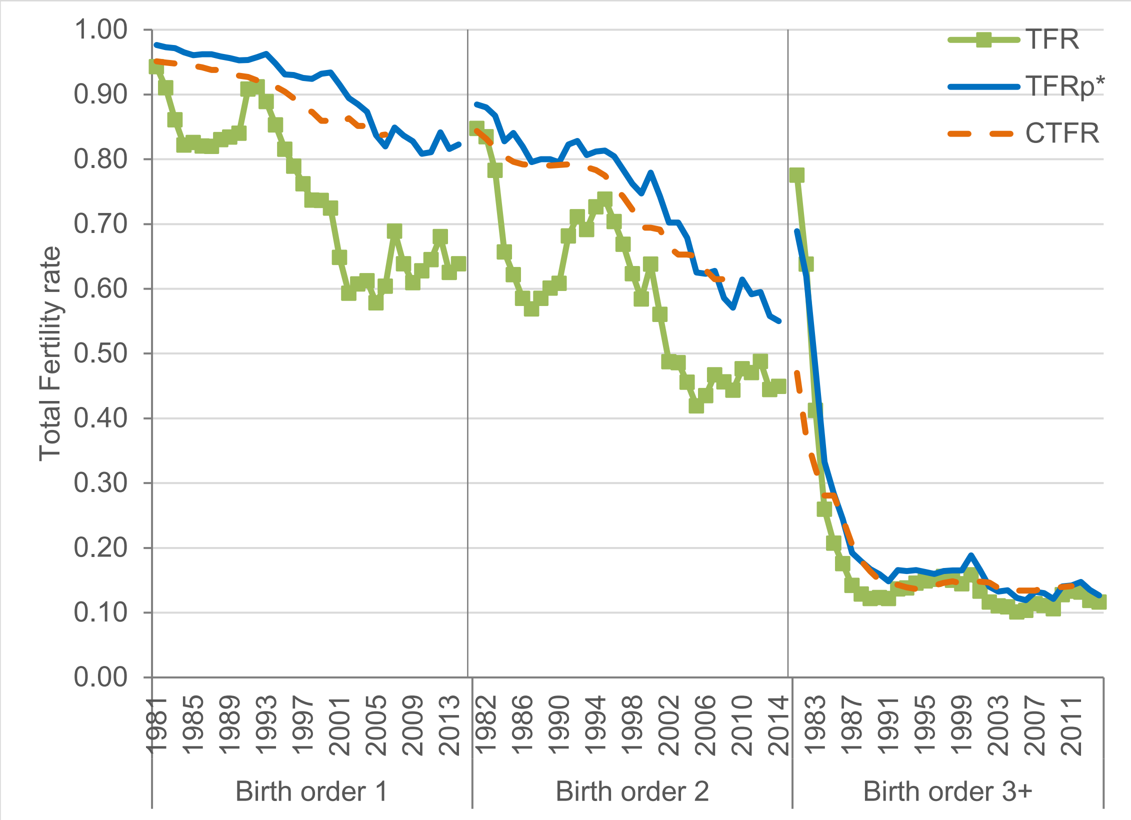
Figure 1. Fertility trends in South Korea, 1981-2014



Source: own calculations based on census and vital statistics data

As the shift of childbearing to later ages differs by birth order, the importance of tempo effect in driving TFR declines and reversals is also likely to differ by birth order. Figure 2 compares trends in TFR, TFRp* and lagged CTFR separately for birth orders 1, 2, and 3+. This analysis indeed shows marked contrasts in fertility trends and tempo distortions by birth order. In the case of birth order 1, the TFR shows a downward shift from a relatively high level around 0.9 to a very low level around 0.6 within a decade starting in 1992. In contrast, the $TFRp_1$* remains high and very stable, at 0.94-0.95, until 2003, and depicts a long-lasting decline only in the subsequent period, when the TFR_1 broadly stabilized. This suggests that a fall in TFR_1 in the 1990s was largely fueled by tempo effect linked to very rapid first birth postponement. In the case of second births, the trajectories of TFR_2 and $TFRp_2$* differ as well, pointing out the important role of tempo effect. Following an earlier decline in the early 1980s, the $TFRp_2$* broadly stabilized at about 0.8 between the mid-1980s and 2000 and then depicted a continuous decline thereafter. In contrast, the TFR and TFRp* show very similar trends for third and higher-order births, converging in the 1990s. Whatever indicator is used, higher-order births fell sharply in the 1980s. Fourth and later births have since then became rare in Korea, contributing currently only 1% to Korean TFR. Third births have become rather uncommon as well, with both TFR_3 and $TFRp_3$* stabilizing at around 0.1 after the turn of the century, suggesting that only one in ten Korean women now give birth to a third child.

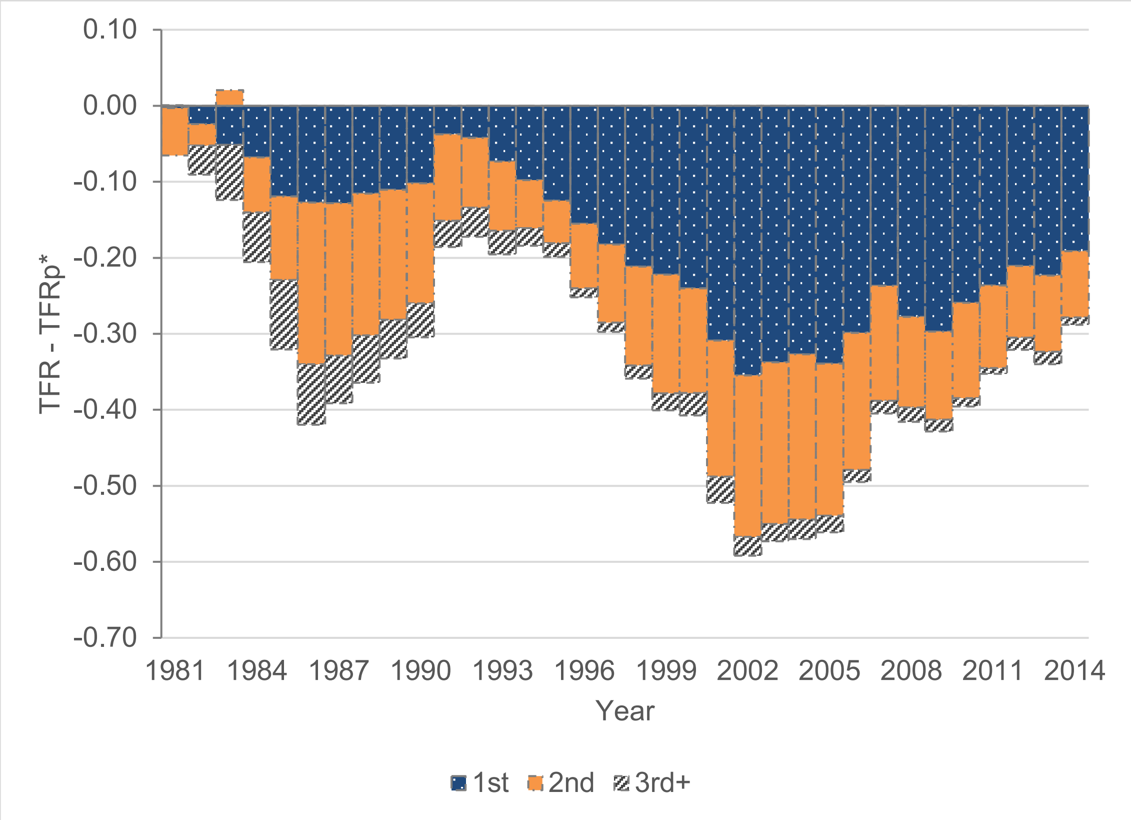
Figure 2. Order-specific trends in period fertility in Korea, 1981-2014



Source: own calculations based on census and vital statistics data

Figure 3 looks at the rises and falls of the tempo effect in the TFR and the contribution of each birth order to the overall tempo effect during the analysed period. A persistently negative value indicates that the TFR in Korea has been continuously depressed by the tempo and parity-composition effects during the last three decades. The overall size of tempo effect peaked in the early 2000s, reaching 0.58 in 2002. In that year, the very low TFR in Korea, at 1.2 was a product of a rapid shift towards later childbearing, as the corresponding TFRp* as well as lagged *CTFR* for the women born in the early 1970s stood much higher, between 1.7 and 1.8. The trend in tempo effect, measured by the gap between the TFR and TFRp*, shows two distinct waves, a smaller one in the mid-1980s, with tempo effect driven especially by postponed second births, and a larger one which was building up during the 1990s and early 2000s, and which was driven by the postponement of both first and second births. Since then, the gap between TFR and TFRp* has gradually reduced, but still stood at -0.27 in 2014.

Figure 3. Tempo effect and parity composition effect by birth order in Korea, 1981-2014



Source: own calculations based on census and vital statistics data

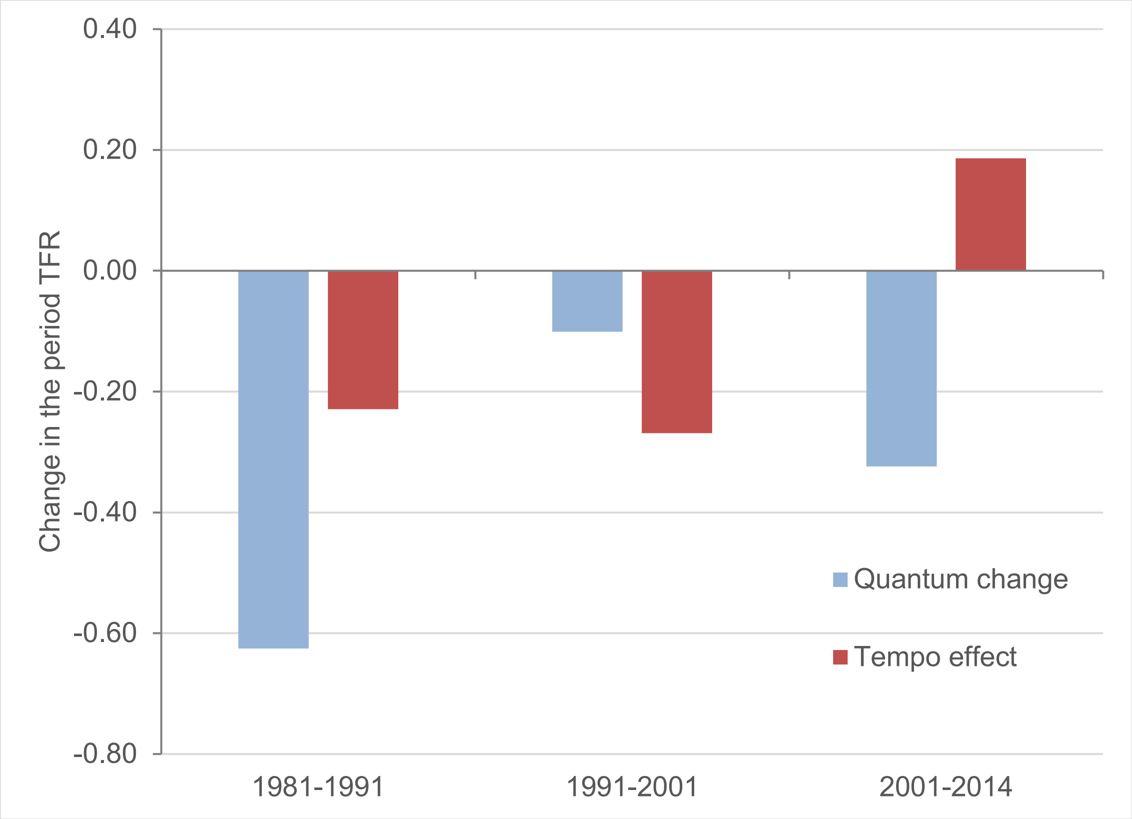
5.2 Three stages of fertility decline in Korea from low to ultra-low levels

In order to delineate the role of tempo effect and quantum decline in Korean fertility trends since the early 1980s we decompose an observed TFR change into its tempo and quantum components, analyzed separately by birth order (Figures 4 and 5; Appendix Table A-2). We distinguish three distinct periods, a) 1981-91, when Korean TFR fell rapidly below the replacement level, b) 1991-2001, when the TFR declined more gradually, but reached a very low level below 1.5 at the end of the period, and c) 2001-14 when the TFR first fell to the "ultra-low" levels around 1.2 and then broadly stabilized.

In the first period, 1981-1991, the TFR plunged by 0.86 in absolute terms, but this fall was almost entirely due to a "genuine" fall in fertility quantum, which was in turn largely concentrated at third and higher-order births. In other words, the fall in fertility in the 1980s to sub-replacement levels can be seen as the tail end of the fertility transition, marked by a virtual disappearance of large families with four or more children. In contrast, the TFR decline from 1.71 to 1.34 in the next period, 1991-2001, was dominantly (by 88%, or by 0.32 in absolute terms) driven by tempo and parity composition effects, linked especially to the postponement of first births, with quantum decline having a small role in the case of the second births. This means that the shift to very low TFR level in

Korea was initially brought about by an intensive trend towards later family formation in the late 1990s and early 2000s.

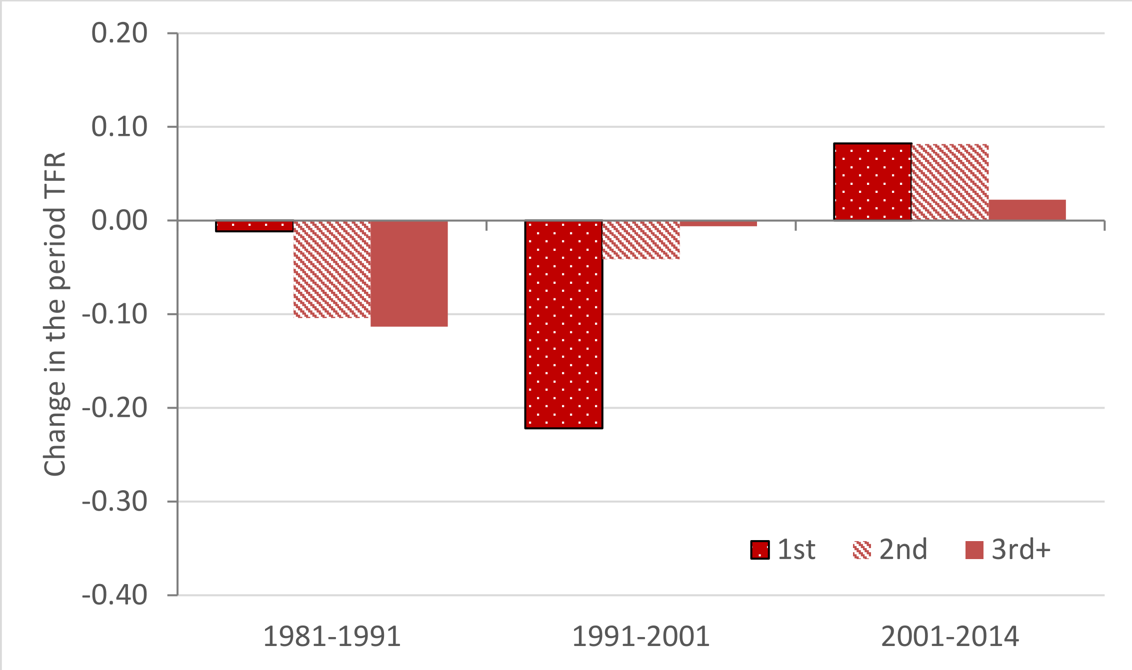
Figure 4. Decomposition analysis of changes in period TFR in three distinct periods, 1981-2014



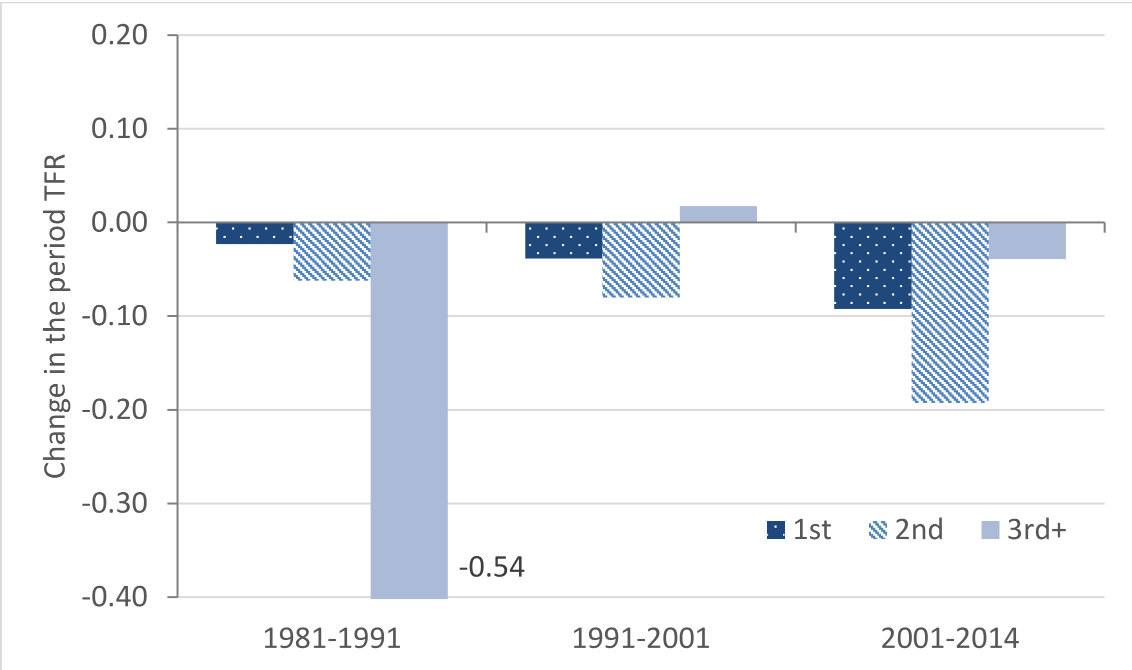
Source: own calculations based on census and vital statistics

In the last period of the ultra-low fertility between 2001 and 2014, period quantum and tempo changes had contrasting influences on the TFR. Falling first and especially second birth rates had a negative effect on fertility quantum, as measured by the TFRp* which fell by 0.38 children per woman in that period. In contrast, the diminishing tempo effect pushed the TFR upwards by 0.24 children per woman. The net balance of these two contrasting trends was a minor TFR decline, by 0.14. It is noteworthy that the importance of higher-order births in Korea diminished to the extent that they now have very little influence on fertility trends. After the turn of the century changes in both period quantum and tempo effects have therefore become concentrated in lower-order births, at birth orders 1 and 2.

Figure 5. Decomposition of changes in period TFR by birth order



a. Change in period TFRs attributable to order-specific tempo effects



b. Change in period TFRs attributable to order-specific quantum effects

Source: own calculations based on census and vital statistics

6 Discussion

The rapid shift from very high to "ultra-low" fertility in Korea has attracted attention of demographers, sociologists, journalists, and policy-makers. Most of their analyses, conclusions and policy plans were based on conventional indicators of period fertility, which are strongly affected by the shift to later family formation. Our study is the first one to provide a comprehensive analysis of the role of the ongoing shift in the timing of births and in the parity distribution of the female population in fueling Korean fertility decline. Our analysis reveals that tempo effect has had a strong and persistent negative influence on period TFRs in Korea since the early 1980s. On average the TFRs were depressed by -0.34 in absolute terms between 1981 and 2014. This tempo effect was most intensive in the early 2000s, when Korea experienced for the first time the "ultra-low" or "lowest-low" TFR levels at 1.2-1.3. Tempo effect has been a decisive force in pushing Korean fertility to such low levels: without the shift to later childbearing, period fertility rates in Korea would consistently stay higher and would decline more gradually, falling below a threshold of very low fertility, 1.5, only in 2014. This conclusion is supported not only by our indicator of choice to measure period fertility, the tempo- and parity-adjusted total fertility rate, TFRp*, but also by the trends in completed fertility rates. Women born in 1974, who were in peak childbearing ages at the time the TFR in Korea reached a trough of 1.1 in 2005 have given birth to 1.68 children on average. This vast difference between period TFR and cohort CTFR further shows the extent to which the period TFR trends in Korea in the last decades have been affected by tempo distortions.

We found that Korean fertility change since the early 1980s can be divided into three distinct phases. First, the shift to sub-replacement fertility in the 1980s was driven by a massive reduction in third and higher-order births. At that period, having four or more children became rare in Korea. Second, further decline to "lowest-low" fertility in the 1990s and early 2000s was largely fueled by tempo effect, connected with an intensive postponement of first and second birth. Third, the tempo effect has gradually declined after the turn of the century, but, at the same time, Korea has seen a decline in first birth rates from initially high levels, and a faster decline in second birth rates, as measured by TFRp*. This latest trend marks a break with the previous pattern prevalent until the 1990s and among women born until around 1970, when first birth rates were almost universal, and a large majority of women also had a second child.

Our findings based on the TFRp* index also offer a reinterpretation of Korean fertility decline. Until around 2000, the decline was largely driven by the postponement of childbearing, which itself was driven by expanding education, new work and career opportunities for women, delayed marriages and difficulties for women to combine their family commitments and labor market participation. However, net of the postponement of childbearing, fertility levels had not declined much below two births per woman. The situation changed soon after 2000, when a gradual shift towards higher childlessness and even a more pronounced trend towards a rising share of women with only one child can be detected in the data. Also the completed fertility of women who were in prime childbearing ages in the early 2000s shows a clear decline, falling from 1.7 among those born in 1973 to an estimated level below 1.5 among those born in 1979. This estimate ranks Korea, alongside Japan, Italy and Spain, among countries with the lowest cohort fertility globally (Myrskylä et al. 2013). This change in fertility behavior proceeded in parallel with a shift away from universal marriage, with a rising share of women born in the 1970s never marrying into their late 30s (Yoo 2016; Kim & Yoo 2016).

Why did these shifts in marriage and fertility take off soon after the onset of the Asian financial crisis in 1997? The crisis itself had a strong impact in Korea, leading to a spike in unemployment in the late 1990s, but this factor alone cannot explain the observed long-term changes in fertility. Similarly, the financial crisis did not lead to a long-term increase in the vulnerability of families with children: rather, the initially very limited government spending on families and social protection has expanded since the late 1990s (e.g, León et al. 2016; Sacchi & Roth 2016). These reforms included an extension of maternity leave, establishment of parental leave since 2001 and a vast expansion of public childcare provision, which is now fully financed by the government. However, there is evidence that the labor market opportunities of younger people, especially among women, deteriorated after 1997, and this trend occurred in tandem with a stronger attachment of married women to employment. Korean labor market has long been characterized by very long working hours, male-oriented work culture, huge gender pay gap—with women's average earnings amounting to 62% of male wages in 2014 (OECD 2017)—but also very high share of female labor force in self-employment and high rates of "non-regular" (temporary and non-standard) work contracts (León et al. 2016; Grubb et al. 2007; Ma 2013, 2014).

All these factors have made de the combination of employment and childrearing difficult for women. In the past, the prevailing adaptation to these labor market constraints among women was to withdraw from the labor market during pregnancy to focus on family responsibilities (Ma 2016). However, this model has been changing since the late 1990s. Four interrelated factors have made the decision among women to form a family or to have a second child more difficult. First, the share of irregular workers, who are not guaranteed employment, has further increased after the onset of Asian financial crisis, between 1997 and 2003. Moreover, irregular and part-time jobs in Korea are not most common among young adults as in most other rich countries, but especially among women in their 40s and 50s who return to the labor market after a "gap" when they focused on family and childrearing (Grubb et al. 2007). Second, Ma (2014) shows that while labor market conditions have deteriorated after 1997, women's attachment to the labor market strengthened. She argues that the economic crisis both increased the need for additional income in uncertain times, and thus a higher appreciation of women's employment and earnings by their male partners, but it also fostered a stronger attachment of women to the labor market. As a result, more women returned to employment without interruption soon after giving a childbirth. Third, mothers returning to labor market in the decade since 1997 experienced marked downward mobility, typically taking jobs with lower occupational status after their return (Ma 2014). Fourth, the 2000s also saw changes in women's attitudes to family and marriage. Younger generations of women have gradually rethought the rigid patriarchal prescription of women's role in the family and in assisting their husband's career (Chang & Song 2010). Moreover, the view that people should have a child once they marry weakened substantially after 1997, as the data for married women analyzed by Kim & Yoo (2016) indicate.

In sum, after 1997 attitudes among women to marriage, family responsibilities, and to having children within marriage have slowly shifted away from the traditional familialistic norms based on the strict division of gender roles and responsibilities. At the same time, married women with children got more attached to the labor market, while a considerable share of women have "non-regular" jobs which usually lack the protection the regular employment entails, including unemployment benefits as well as maternity and parental leave. Not surprisingly, Ma's (2016) analysis shows that women's continuing employment after first birth "acts as a deterrent against more children" (p. 189). Her conclusions complement our findings on the falling quantum of fertility rates at second birth order. Our analysis also indicates a very limited scope for future increase in fertility rates in Korea, especially because larger families have almost vanished in Korea. While the conventional TFRs continue being moderately distorted by the shift to a late timing of family formation, the trends in tempo- and parity-adjusted TFRp* and in completed fertility point out that it is unlikely to recover much above the 1.4 threshold. The low fertility will be sustained by a combination of unfavorable labor market conditions for women with families and the persistence of traditional gender roles and expectations regarding their family roles, household tasks, caring for dependent members and childrearing (Kim & Cheung 2015).

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Appendixes

Table A1. TFR, TFRp*, tempo effect, and women's mean age at first birth (MAFB), 1981-2014

Year	TFR	TFRp*	Tempo effect (TFR-TFRp*)	MAFB
1981	2.566	2.550	0.016	25.16
1982	2.383	2.472	-0.089	25.18
1983	2.057	2.315	-0.259	25.28
1984	1.738	2.125	-0.387	25.43
1985	1.654	2.085	-0.431	25.56
1986	1.581	2.026	-0.445	25.71
1987	1.531	1.950	-0.419	25.91
1988	1.544	1.938	-0.394	26.10
1989	1.557	1.924	-0.367	26.28
1990	1.571	1.907	-0.335	26.46
1991	1.712	1.925	-0.213	26.59
1992	1.759	1.952	-0.192	26.68
1993	1.718	1.934	-0.215	26.86
1994	1.725	1.926	-0.201	27.02
1995	1.703	1.907	-0.204	27.09
1996	1.645	1.894	-0.249	27.21
1997	1.587	1.873	-0.286	27.36
1998	1.510	1.851	-0.341	27.55
1999	1.465	1.844	-0.379	27.77
2000	1.521	1.902	-0.381	28.04
2001	1.342	1.823	-0.482	28.31
2002	1.197	1.737	-0.540	28.61
2003	1.204	1.720	-0.517	28.90
2004	1.177	1.686	-0.509	29.15
2005	1.099	1.585	-0.486	29.40
2006	1.143	1.562	-0.419	29.59
2007	1.270	1.609	-0.339	29.73
2008	1.206	1.552	-0.346	29.90
2009	1.159	1.520	-0.361	30.13
2010	1.232	1.563	-0.332	30.35
2011	1.249	1.544	-0.296	30.47
2012	1.300	1.584	-0.284	30.70
2013	1.188	1.509	-0.320	30.91
2014	1.204	1.500	-0.295	31.15

Table A2. Contribution of tempo and quantum components of period fertility to changes in period TFR in Korea by birth order in three periods (1981-1991, 1991-2001, & 2001-2014)

Period	TFR at the start of the period	TFR at the end of the period	Difference		Birth order			Total birth orders
					1st	2nd	3rd+	
1981-1991	2.566	1.712	-0.854	Tempo	-0.012	-0.104	-0.113	-0.229
					1%	12%	13%	27%
				Quantum	-0.023	-0.062	-0.540	-0.625
					3%	7%	63%	73%
1991-2001	1.712	1.342	-0.370	Tempo	-0.222	-0.041	-0.006	-0.269
					60%	11%	2%	73%
				Quantum	-0.038	-0.080	0.017	-0.101
					10%	22%	-5%	27%
2001-2014	1.342	1.204	-0.137	Tempo	0.082	0.082	0.022	0.186
					-60%	-59%	-16%	-136%
				Quantum	-0.092	-0.193	-0.039	-0.324
					67%	140%	29%	236%