Analyzing the fluctuations in number of births in Korea by determining the magnitudes of tempo, quantum and the mean generation size effects of women in fertile age

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Introduction

The expression of 'lowest-low fertility' was coined by Kohler, Billari, and Ortega (2002) to indicate a period in which the Total Fertility Rate (TFR) stands at 1.3 or below. This terminology accurately represents the current situation in Korea and has triggered a substantial volume of research on fertility decline in Korea. Intensive studies are being carried out by demographers to find causes and solutions for fertility decline in the midst of rapid changes in institutional and socioeconomic conditions in Korea. There is a great deal of literature that explores links between the low levels of TFR and the postponement of childbearing (tempo distortions). In their 1978 paper, Donaldson and Nichols (1978) state that changes in fertility in Korea is limited to changes in period fertility and the timing of fertility has not received the attention it deserves. In addition, they further emphasize that it is vital to document the changes in tempo in conjunction with the decline in period fertility (Donaldson and Nichols, 1978)

Yet, there have not been serious efforts in addressing Korea's rapid fertility decline which considers the effects of tempo distortions on the period Total Fertility Rate (TFR) due to changes in the timing of childbearing. The observed TFR consists of 2 distinct components: (1) a quantum component (equals to the TFR without tempo distortions) that observes the level of fertility in the absence of tempo distortions and (2) a tempo component that is responsible for advancement or postponement of births (Bongaarts, 1999). Therefore, it is crucial to analyze both components in order to capture an accurate and a complete picture of future fertility trends in Korea.

The impact of tempo distortions on fertility has been investigated notably by Ryder (1964) and Bongaarts and Feeney (1998, 2006). Bongaarts and Feeney (1998) have suggested a simple method that removes such tempo effects from the TFR, so called the tempo-adjusted fertility. Since then, other researchers (Bongaarts and Sobotka 2010, Ortega and Kohler 2002, Schoen 2004) have attempted to improve methods that remove tempo distortions. Barkalov (2005) used 'age-parity-birth interval standardized indicators' to investigate the extent of tempo and quantum effects on the Russian fertility changes in the 1980s and 1990s. Sobotka, Lutz and Philipov (2005, hereafter referred to as SLP) used a simple method that decomposes changes in the total number of births into changes in the 'mean generation size' of potential mothers, changes in fertility level (quantum) and changes in the timing of childbearing (tempo).

The purpose of this paper is to apply SLP (2005)'s decomposition method to Korea's birth data to measure the magnitude of each component (tempo, quantum, and mean generation size of potential mothers) affecting the number of births in the context of the extremely low fertility in Korea. In particular, the period from 1997 to the 2000s is of special interest because Korea experienced the Asian Financial Crisis in 1997 which has presumably impacted the childbearing patterns in Korea as represented in which the TFR fell below 1.3 signaling the commencement of lowest-low fertility. The decomposition of Korea's fertility data into the 4 components mentioned above enable us to identify notable changes or patterns in these periods that might provide meaningful insights in explaining Korea's recent childbearing patterns.

SLP Decomposition Methods

This section briefly explains the main concepts of the SLP decomposition method. The main objective of this method is to separate the effects of fertility quantum, tempo and the mean generation size on the total number of births. SLP starts their decomposition method by linking the observed number of live births B in a year t with the period TFR based on the works of Calot (1984):

$$\text{Mean generation size (G)} = \frac{\text{Number of live births (B)}}{\text{TFR}} \qquad [1]$$

$$G = \frac{\Sigma_x(f_x * N_x)}{\Sigma_x(f_x)} = \frac{\Sigma_x(f_x * N_x)}{\text{TFR}} \qquad [2]$$

where f_x is the age-specific fertility rate and N_x is the age-specific total population of women. As shown in equation [1] and [2], G is the number of women of childbearing age which are weighted at each age x by the relative contribution of fertility at this age to the total TFR. The index of tempo distortion $I_t =$ TFR/adjTFR is used to measure the degree of tempo distortion due to fertility postponement. SLP's adjusted fertility rates are calculated based on the method proposed by Kohler and Ortega (2002). Instead, this paper uses the tempo adjusted TFR of Bongaarts and Feeny (1998) which is also a tempo free indicator which essentially yields similar result to the method proposed by Kohler and Ortega (2002). As an illustration, if there is no fertility postponement, ideally the value of I_t equals 1. If the value of I_t falls below 1, then it is an indication that the fertility postponement is present since adjTFR exceeds the TFR in the numerator. Using the equations [1] and [2], SLP estimates the 'hypothetical number of births' which supposedly has no tempo effects and no number of births lost or gained due to tempo effects:

$$B^{\text{Hypothetical}} = \frac{B}{I_t} = \frac{G * \text{TFR}}{I_t} = G * \text{adjTFR} \qquad [3]$$

The further extension of equation [3] yields equation [4] below which expresses number of births B in the year t_1 as a function of the number of births in the year t_0 by introducing the indexes of change to capture the relative change between $[t_0,\ t_1]$.

$$B(t_1) = B(t_0) * I_G(t_1) * I_Q(t_1) * \left(\frac{I_t(t_1)}{I_t(t_0)}\right) \qquad [4]$$

where $I_G(t_1) = G(t_1)/G(t_0)$ represents the relative change in mean generation size of potential mothers between $[t_0,\ t_1]$ and $I_Q(t_1) = \text{adjTFR}(t_1)/\text{adjTFR}(t_0)$ represents the relative change in fertility quantum between $[t_0,\ t_1]$. Using the indexes of change mentioned above, the change in number of births between $[t_0,\ t_1]$ is expressed as below:

$$\Delta B(t_0, t_1) = \Delta B_T + \Delta B_Q + \Delta B_G + \Delta B_{TQG} \qquad [5]$$

and the changes in the magnitude of each factors between $[t_0,\ t_1]$ are computed as follows:

$$\Delta B_T(t_0,t_1) = B_0 * I_{T,t_1} - B_0 \quad [6]$$
$$\Delta B_Q(t_0,t_1) = B_0 * I_{Q,t_1} - B_0 \quad [7]$$
$$\Delta B_G(t_0,t_1) = B_0 * I_{T,t_1} - B_0 \quad [8]$$

where ΔB_T captures the change in the number of births due to tempo distortions; ΔB_Q computes the change in the number of births due to changes in fertility quantum; ΔB_G reflects the change in the number of births due to the changing mean generation size of potential mothers.

ΔB_{TQG} describes all interactions between $\Delta B_T, \Delta B_Q$ and ΔB_G. The two way and three way interactions can be computed as follows:

$$\Delta B_{TQ}(t_0,t_1) = (I_T - 1) * (I_Q - 1) * B_0 \quad [9]$$
$$\Delta B_{TG}(t_0,t_1) = (I_T - 1) * (I_G - 1) * B_0 \quad [10]$$
$$\Delta B_{QG}(t_0,t_1) = (I_Q - 1) * (I_G - 1) * B_0 \quad [11]$$
$$\Delta B_{TQG}(t_0,t_1) = (I_T - 1) * (I_Q - 1) * (I_G - 1) * B_0 \quad [12]$$

Determining the magnitudes of tempo, quantum and the mean generation size effects of women on the declining number of births in Korea from 1983-2009

The decomposition methods described in Section 2 is applied to Korea's fertility data (accessed and downloaded from Statistics Korea's homepage, Statistics Korea, 2011). Figure 1 shows the mean age of mother by birth order of 1st, 2nd and 3rd child. As shown in the figure 1, the mean age of mothers increased steadily from 1981 suggesting the postponement of childbearing and increase in tempo distortions. The mean age of mothers by birth order of 2nd and 3rd child stabilized briefly from 1981 to 1984 before displaying a steady rise signaling the onset of fertility postponement.

Figure 1: Mean age of mother by birth order of 1st, 2nd and 3rd child

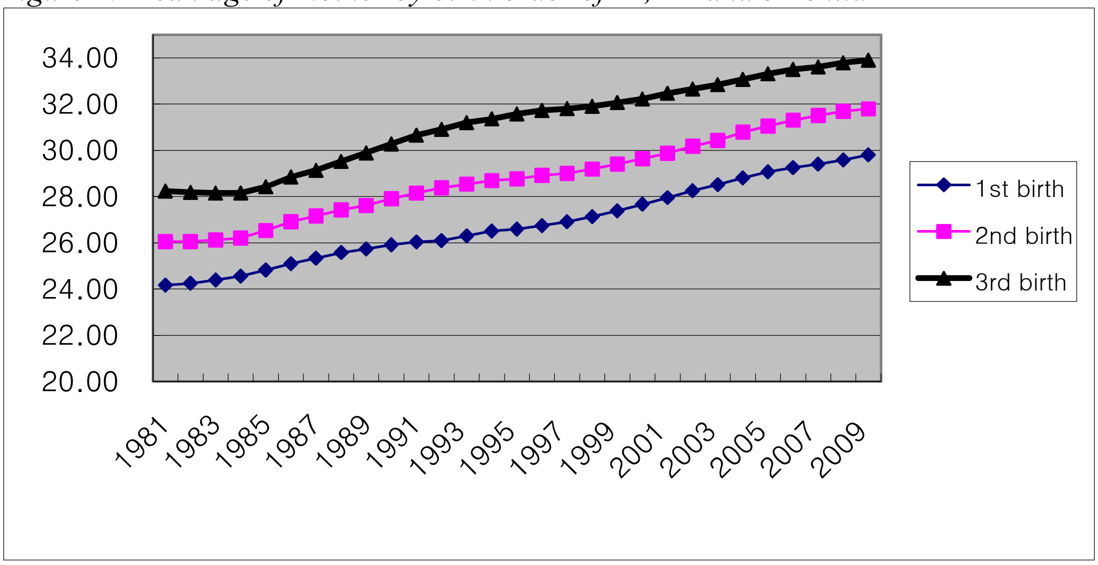
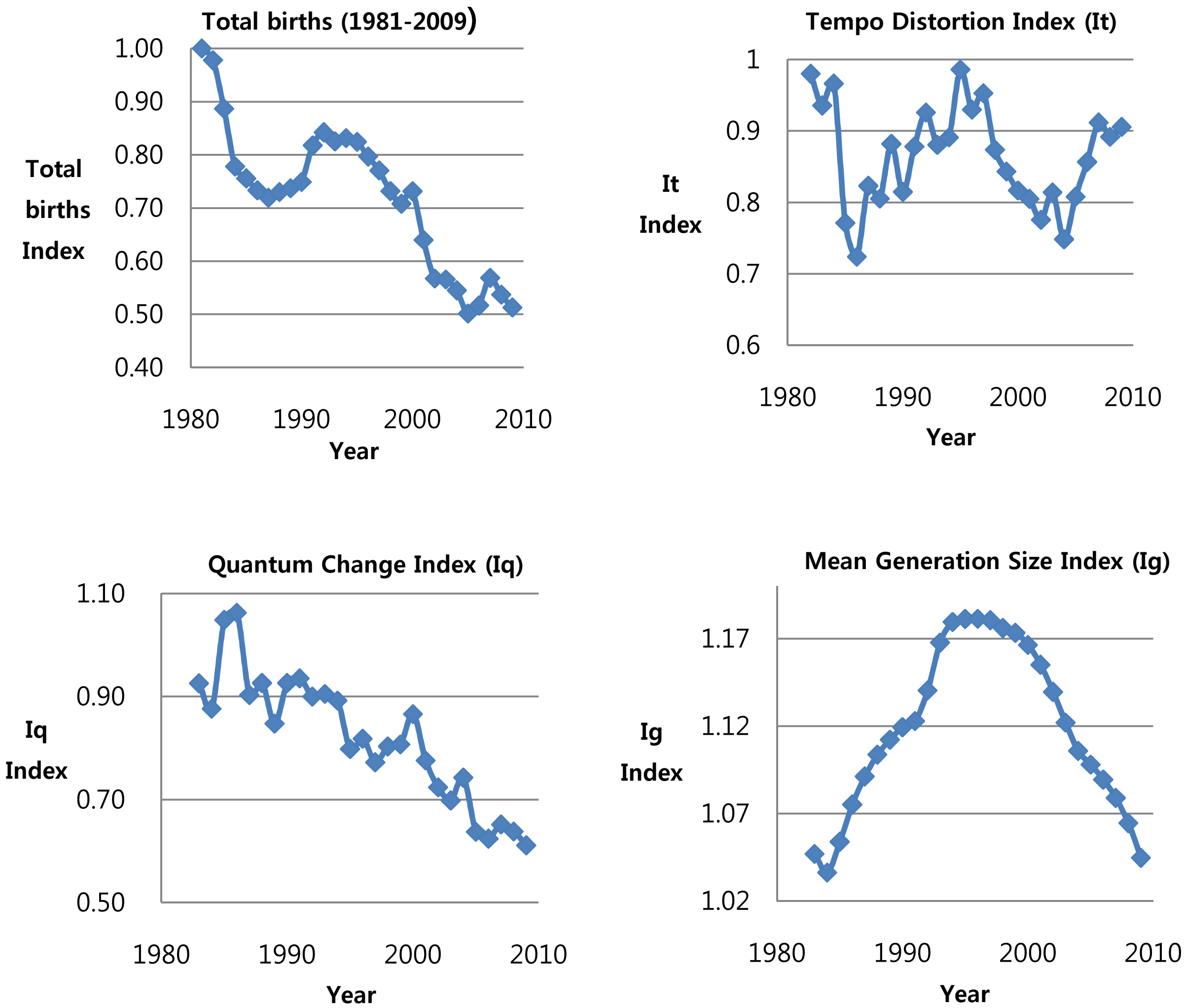


Figure 2 shows that Korea experienced a rapid decline in the number of births where the number of births decreased by half in just the past 20 years. There was a sharp fall in the number of births in the early 1980's and this fall corresponds to the sharp increase of tempo distortions which is reflected in index I_t. Shortly after the steep fall, I_t rebounded and peaked in 1995 reducing the size of tempo distortions. However, it decreased again with the outbreak of the economic crisis in 1997.

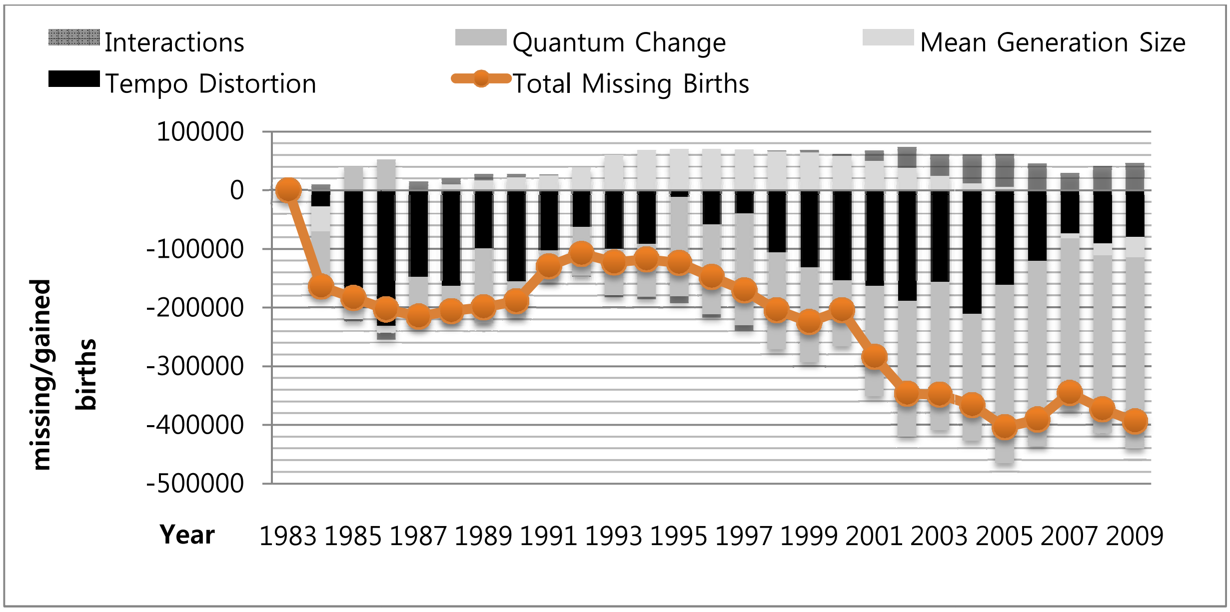
Figure 2: Fluctuations in the total number of births in respect to the reference year (1983) and the relative tempo effects, quantum change, and the mean generation size of potential mothers in Korea



Additionally Figure 2 shows that the index of quantum change displays a steady pattern of decline pushing the number of births downward. Index I_G shows that the mean generation size of potential mothers steadily increased and peaked in the mid 1990s, then started to decline thereafter. This decline suggests that the mothers born in the baby boom period have passed their active reproductive ages and the generation size of potential mothers is not being sufficiently replenished with new potential mothers to reverse such a decrease in the number of potential mothers.

Figure 3 suggests that the tempo effects were a significant factor in driving the decline in total number of births until the early 1990s. The increase in the mean generation size of potential mothers in the 1990s was not strong enough to provide any significant impact in which to offset the decline in the number of births. However, since the mid 1990s to date, the decline in the number of births has been strongly influenced by the fall in fertility quantum combined with declining number of potential mothers.

Figure 3: Decomposition of changes in the total number of births due to tempo, quantum, mean generation size of mothers and interactions among these factors.



Possible explanations for the dominance of fertility quantum decline

A close examination of Figure 3 reveals that since the mid 1990s to date, the decline in fertility quantum has significantly influenced the fall in the number of births in Korea relative to other factors mentioned in this paper. As previously hypothesized a pattern is observable from the period of 1997 to the 2000s. The magnitude of tempo distortions that drives the decline of total number of births steadily increases from 1997 and reaches a peak in 2004. Then it steadily decreases from 2004 to date. It is important to provide some possible explanations to such variations in tempo distortions from 1997 to the 2000s. Furthermore, a detailed investigation is necessary as for what has happened that induced a gradual decrease in tempo distortions since 2004.

Economic conditions

One possible explanation is that the Asian Financial Crisis in 1997 caused the postponement of childbearing in Korea. High unemployment induced the postponement of marriage among young people. Orsal and Goldstein (2010) constructed statistical models to demonstrate the effects of economic conditions on the TFR using the panel dataset for 22 OECD countries (this dataset excludes Korea and includes Japan). The purpose of their model was mainly to investigate the "explanation of short term variations in fertility". They observed that good economic conditions are associated with a higher TFR which bad economic conditions contribute to a lower TFR. Furthermore, the status of economic conditions does not only lead to the postponement of childbearing but it also effects fertility quantum (Orsal and Goldstein, 2010). In light of Orsal and Goldstein's reasoning, postponements due to bad economic conditions are reflected in the increase of the magnitude of tempo distortions from

1997 to 2004. However increase in tempo distortions halt in 2004 although economic conditions did not improve significantly. This divergence suggests that other than fertility response to economic conditions are required to explain such a change in the magnitude of tempo distortions after 2004. Possible explanations are briefly discussed below.

Recuperation of delayed births

Recuperation of delayed births from the Asian Financial Crisis in 1997 offers a possible explanation for the decreasing trend of tempo distortions from 2004, in which people started to recuperate from delayed births and marriage due to the dire economic conditions brought by the Crisis. Frejka et al (2010) devise a "recuperation index" that measures the degree of recuperation of all postponed births. Using the "recuperation index", they show that there was an "appreciable recuperation among Korean women born in the 1960s and 1970s" (Frejka et al, 2010).

Diffusion

In 2009, Korea's TFR was 1.15 which is one of the lowest in the world. Rapid economic and social developments in the last 50 years have decreased the level of fertility in Korea. The demographic transition theory fits rather well in explaining the very low fertility occurring in Korea. In other words, the theory suggests that the "increase in child survival together with rising costs and declining economic value of children is considered to be the fundamental driving force of the fertility transition" (Bongaarts, 2006). Yet, the persistence of the lowest-low fertility phenomenon combined with the steadily decreasing temporal distortions since 2004 suggest that the fertility response to economic conditions or the demographic transition theory alone is not sufficient to explain the recent trends of fertility decline in Korea.

As an alternative, theory of diffusion is applicable in explaining the recent changes in fertility in Korea. Pollak and Watkins (1993) provide a comprehensive discussion on the diffusion of preferences regarding "fertility regulation and family size". Chung and Das Gupta (2007) observe that Korea's small and homogenous population characteristics are optimal for rapid diffusion of ideas or preferences. They also note that recent decline in the preference for sons, initiated among educated urban elites, is due to the swift "diffusion of new information and snowballing of adoption" across the Korean population. In Figure 3 of this paper, the magnitudes of both tempo distortions and quantum effects in 2007 were the lowest for the observation periods of 1997~2009. The TFR of 2007 (1.24) increased from 2006 (1.11) then fell again in 2008 (1.18). Such a temporary hike in TFR in 2007 is thought to be due to the effects of zodiacal preferences on the childbearing behavior in Korea. For example, 2007 was the Year of the Golden Pig where there is a belief that babies born in these years will live a happy and fortunate life. Lee and Paik (2006) elaborate such effects on the fertility and sex ratio at birth in Korea. However, as Chung and Das Gupta (2007) demonstrate, parents are becoming less concerned in making childbearing decisions based on the animals of the zodiac. Even though the impact of such effects has decreased over the examined periods, the cultural belief might still significantly affect fertility decisions.

According to the "2009 National Survey on Marriage and Fertility Trends" conducted by the Korea Institute for Health and Social Affairs, there is a decline in the ideal number of children to bear. The ideal number of children decreased from 2.06 in 2005 to 1.87 in 2009 for single male respondents. For female respondents, that figures decreased from 2.05 in 2005 to 1.79 in 2009 suggesting women feel more pressured in balancing work and household chores. Such results support our findings that changes in fertility preferences have played a significant role in recent fertility decline in Korea.

The phenomenon of persistent lowest-low fertility coupled with steadily decreasing tempo distortions in Korea since 2004 suggest that the recent low fertility trends in Korea is mainly due to changes in people's preference for small family size (reducing the quantum level) rather than the change in tempo distortions. This observation deserves careful considerations because if the decline in fertility is not attributable to temporal aspects and such trends continue in the future due to changes in preferences concerning fertility as previously mentioned, then there is a concern that such a decline in fertility quantum could lead to permanent reductions in fertility quantum.

Conclusion

Since the mid-1990s the declining fertility quantum effect has been influencing the decline in the number of births in Korea. The postponement of childbearing intensified due to dire economic conditions, as reflected in the increase in the magnitude of tempo distortions from 1997 to 2004. Recuperation of delayed births from the Asian Financial Crisis in 1997 is a possible explanation for the decreasing trend of tempo distortions from 2004. The persistent lowest-low fertility coupled with steadily decreasing tempo distortions in Korea since 2004 suggest that the recent low fertility trend in Korea is mainly due to rapid diffusion of preference for small family size rather than a change in tempo distortions.

Many highly educated women in Korea are eager to continue their work after marriage but the patriarchal social environment makes it difficult for women to balance work and raise their children. Such incompatibility and the effects of gender equity on fertility are explained by MacDonald (2000). According to the OECD, in 2009, Korean workers on average worked the longest hours among OECD countries (2,243 hours/year) which exceed the OECD average (1,766 hours/year). Until more policies that focus on fostering a family-friendly environment are established, it is likely that the diffusion of low fertility preferences will continue at its accelerated rate which is a sign that Korea has already fallen into the "Low Fertility Trap" (Lutz et al, 2006).

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