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Patterns of Low Fertility in Hong Kong and Taiwan

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Abstract

This paper aims to study the patterns and causes of low fertility in Hong Kong and Taiwan from demographic perspective. Both period and cohort fertilities are examined. For period fertility, the effects of delayed childbearing and recuperation at later ages are inspected. Based on both Bonggarts-Feeney's (1998) and Kohler-Philipov's (2001) methods, tempo effects caused by delayed childbearing are examined for Hong Kong and Taiwan since 1976. Recuperation effects are derived from a simple model developed in present paper. For cohort fertility, postponement and recuperation effects are examined too. And the fertilities of cohorts born in the 1950s-1960s are estimated. The analyses reveal that, as in Europe, postponement of childbearing played a great role in the emergence of low fertility in Hong Kong and Taiwan. The pattern of low fertility in Taiwan is similar as that of Europe. However, low fertility of Hong Kong is not a simple echo of that of Europe and it has new features. With very low tempo effects, TFR of Hong Kong declined further in the 1990s. Lowest-low level of CTFR for cohorts born in the middle 1960s and period adjusted TFR in late 1990s displayed that postponement of childbearing in Hong Kong is accompanied by true decline in complete fertility. Without effective pronatalist policy, Hong Kong may continue to face low fertility in a long time and Taiwan may follow the pattern of low fertility Hong Kong, facing true lowest-low fertility in some near future.

Keywords: Low fertility, Pattern of fertility, postponement of fertility, recuperation of fertility

1. Introduction

How far fertility will decline is one of the most controversial issues in contemporary society. Traditional theories have implicitly assumed that replacement fertility of about 2.1 births per woman will prevail in the long run. With further decline in total fertility rate (TFR) at or below replacement level, that suggestion has been challenged and shattered. In the early 1990s fertility was below replacement in nearly all of the 46 countries in the developed world (Bongaarts 1998). The future fertility trend in the below-replacement fertility regimes has gained a tremendous attention. Two controversial schools of thought were developed. One school argued that the current low level of post-transitional fertility is a temporary phenomenon due to tempo effects caused by increasing mean age of childbearing (Le Bras 1991; Knodel et al. 1996). This perspective is supported by DFS (desired family size) data and the ongoing increasing mean age of childbearing. DFS has remained near or above two children in all societies with available measures. And increase in mean age of childbearing has depressed period fertility. In this view, once the trend of delayed childbearing ends, as it eventually must be, the corresponding tempo effect stops, thus bring fertility back up, presumably to near replacement level, i.e., desired fertility of most couples. By showing the adjusted tempo-free TFR in the developed world, 1.9-2.2 in late ***1980s***, and women's preferred number of children, 1.9-2.4 on average, Bongaarts (1999) concluded that current low fertility is unlikely to decline further and may even rise somewhat in the future in a number of countries. However, period fertility and adjusted period fertility without tempo effects didn't stop declining but decreased further in the developed world in the 1990s. The contrary school of thought argued that replacement fertility is a theoretical threshold that has little or no meaning for individual couples building their families, and below-replacement fertility is expected to be the norm and an intrinsic characteristic in post-transitional societies (Bumpass 1973; Demeny 1997). This argument is based on the empirical data that fertility has dropped below replacement in virtually all countries that have reached the end of the transition. This is the case in Europe and North America, where fertility has been below replacement since the mid-1970s, as well as in the most-developed areas in Asia, such as Hong Kong, North Korea, Singapore, Taiwan, and Thailand. Another strong evidence supporting this view is that complete cohort fertility for the birth cohorts of 1960s in low fertility regimes has decreased to well below-replacement level. It's about 1.5 for the mid-1960s cohorts in Western Germany, East Germany, Spain, and Italy (Golini 1998). Thus an era of below-replacement fertility is taking hold (Freijka and Ross 2001).

Recent fertility trends in the countries that have completed fertility transition have been remarkably diverged, ranging in the late 1990s from TFR close to 2.1 in the United States to lowest-low fertility, TFR lower than 1.3, in many European countries and some developing regions (Billari and Kohler 2003). At the end of the 1990s there were 14 lowest-low fertility countries in Southern, Central and Eastern Europe (Kohler et al. 2002). By the end of 2002, urban areas of Chinese mainland, Hong-Kong, Macao, and North Korea have entered into lowest-low fertility regime. The emergence of lowest-low fertility regime stimulates further research on the possible trends of fertility in post-transitional societies. The core issues include: What is the minimum level of fertility? What factors have caused lowest-low fertility? Is lowest-low fertility a tempo phenomenon?

There is no consensus over the above questions. For the minimum level of fertility, conventional theories have implicitly taken it as zero. Namboodiri and Wei (1998), surveying the range of theoretical frameworks developed by demographer to the study of reproductive behavior, found that most of the micro-level models implied a lower limit to fertility of zero. Similarly, Keyfitz (1987) found that all the explanations given for increasingly low fertility in modern societies imply that fertility is likely to continue to decline gradually toward zero. The possible minimum fertility of zero has been challenged from biological preposition, social and political reasons (Foster 2000, Golini 1998, Morgan 2001). It's argued that fertility has a fundamental role in the creation and perpetuation of families and kin groups, communities, and nation-states, the presence of zero fertility could be expected to receive strong cultural, social, and political reactions from policymakers, mass media, and the public at large. The reactions could lead to a change in the reproductive behavior of women and, therefore, to a recovery of fertility over zero (Golini 1998). And women have a biological predisposition toward nurturing or maternal behavior that interacts with environmental stimuli resulting, in most cases, in a conscious motivation for bearing at least one child (Foster 2000). Therefore the minimum level of fertility should be one. However, Golini (1998) argued that, considering the rate of childless, the minimum fertility is very likely close to and probably below the average of one child per woman.

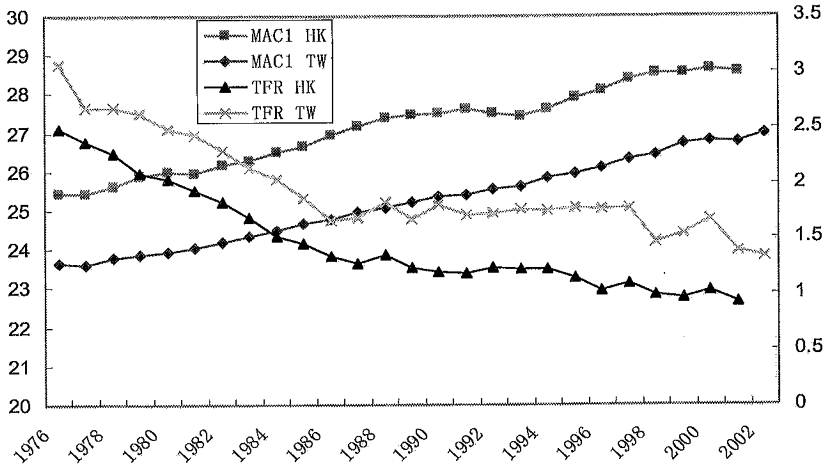
There are two controversial opinions about the future fertility trends in the lowest-low fertility regimes. From biological perspective, Foster (2000) and Morgan (2001) argued that low fertility in post-transitional societies is unlikely to fall any further. Morgan specified that although economic development and concomitant changes have eroded rationales for large families, strong rationales for low parity births remain and could be strengthened. Biological predispositions supported by a pronatalist context could result in a set of rational decisions that produce moderate levels of fertility (i.e., replacement level fertility). Based on empirical fertility data of Europe, Sobotka (2004) argued that the "lowest-low" fertility in Europe may be interpreted as a temporary consequence of the increasing age at motherhood. He showed that tempo-free TFR of Europe is above 1.4 in 1995-2000 for all 27 countries. On the contrary, Kohler et al. (2002) argued that lowest-low fertility is unlikely to be a short-term phenomenon that will quickly disappear from the demographic landscape, but likely to be a persistent pattern. They expect that it will prevail for a considerable period in the ECE (UN Economic Commission for Europe) countries with a TFR below 1.3 (Kohler et al. 2002). They proposed five factors contributed to the emergence of lowest-low fertility and may help maintain it in a long time: 1) tempo and compositional distortions that reduce the total fertility rate below the associated level of cohort fertility; 2) socioeconomic changes including increased returns to human capital and high economic uncertainty in early adulthood that made late childbearing a rational response for individuals and couples; 3) social interaction effects that reinforced this behavioral adjustment and contribute to large and persistent postponement in the mean age at birth; 4) institutional settings favoring an overall low quantum of fertility; 5) postponement and quantum interactions that amplified the consequences of this institutional setting when combined with ongoing delays of childbearing.

Most of the existing empirical and theoretical studies on low fertility are based on European experiences. Study on the non-European societies with lowest-low fertility could further strengthen our understanding of fertility behavior. In present paper, we choose Hong Kong and Taiwan as cases because of their forerunner of low fertility in developing world. Current demographic conditions in Hong Kong and Taiwan may be precursors of forthcoming social changes in other developing countries with relatively high economic development. The study on the patterns and causes of low fertility of Hong Kong and Taiwan may shed few more insights into fertility transition in the developing world.

Hong Kong and Taiwan have experienced marked fertility decline since the 1950s and they viewed replacement fertility in 1979 and 1983 respectively. Their fertility didn't stabilize at replacement level but declined further. The total fertility rates (TFR) of Hong Kong and Taiwan have declined to much lower than replacement level, even less than one in Hong Kong with 0.93 in 2001. In this paper, the patterns of fertility decline since the late 1970s, during which Hong Kong and Taiwan viewed fertility decline from about replacement level to very low level, will be studied.

Postponement of childbearing is viewed as an important characteristic of the second demographic transition, which is emphasized by all demographers observing the recent fertility trends in Central and Western Europe. Especially postponement of childbearing of parity one has emerged as a crucial determinant of differences in fertility levels among developed countries. In a similar way, Hong Kong and Taiwan shared the same experience. Postponement of mean age of childbearing for parity one (MAC1) has been intense in Hong Kong and Taiwan with annual increase 0.12 years since 1976, from 25.45 in 1976 to 28.68 in 2001 in Hong Kong and from 23.65 in 1976 to 26.99 in 2002 in Taiwan (see Figure 1). The mergence of low fertility since early 1970s has been associated with a substantial delay of childbearing in Hong Kong (Tu, 2003) and also in Taiwan. The correlation coefficient between TFR and MAC1 is -0.952 in Hong Kong and -0.875 in Taiwan. Postponement of childbearing deflates period fertility by shortening the reproductive years. In other words, postponement of childbearing might have played a role to some extent in decline of TFR in the two areas. Then what is the exact contribution of postponement of childbearing and decline in the quantum respectively to TFR decline? If such postponement stopped, would there be a recuperation of fertility? And to what a degree might the recuperation be? The answers to the above questions will help us clarify the issue whether the low fertility is a temporary phenomenon or not and project the general trends of fertility of Hong Kong and Taiwan in the near future.

Figure 1 Trends of TFR and mean age of childbearing for parity 1 (MAC1), HK 1976-2001



The structure of the paper is centered on the above questions. In section 2, the methods measuring tempo effects caused by changes in timing of childbearing and the ones measuring recuperation effects at later ages are introduced; in section 3, the trends of period fertility are examined, including

the exact role of postponement of childbearing in the decline of fertility and the degree of recuperation; in section 4, cohort fertility trends are inspected; and finally, we give out the discussion and conclusions, including the characteristics and implications of low fertility in Hong Kong and Taiwan.

2. Methods

2.1 Measurement of the impact of changes in timing of childbearing on period fertility

The most widely used fertility index is the Total Fertility Rate (TFR). It is the average number of births of women through their reproductive lives (age 15-45) in a population. Traditionally, there are two perspectives to measure it, namely, period and cohort perspectives. The period TFR is defined as the average number of births a woman would have if she lives through her reproductive life and bears children following the age-specific fertility rates in a particular year or period. The cohort TFR is the average number of births 45-year-old women had through their reproductive lives. Period TFR measures the reproductive behaviors of a synthetic cohort and cohort TFR measures the actual reproductive experience of a real cohort. One disadvantage of cohort TFR is that the data won't be available until the end of the reproductive span for the cohorts studied. Thus period TFR is widely used to specify the current fertility level. However, period TFR is also subject to ongoing changes in the timing of births.

The general relation between timing changes and observed fertility rates, period TFR being temporarily inflated during periods when the mean age at childbearing is younger and deflated when childbearing is delayed, has been known for at least half a century and adjusted fertility measure was available

(Ryder, 1956). Recently this issue is re-vitalized and the adjustment methods have been further developed (Bongaarts and Feeney 1998; Kohler and Philipov 2001; Kohler and Ortega 2001).

Bongaarts and Feeney (B-F) developed a simple and relatively effective method to separate the tempo distortion from quantum in the observed period TFR. Quantum is defined as the total fertility rates that would have been observed in the absence of changes in the timing of childbearing during the period studied. The quantum component of the TFR is called 'tempo- free TFR'. And tempo effect is the distortion that occurs due to timing changes. The formulas of B-F adjustment are:

TFRi'=TFRi/(1-γi)............(1)

TFR'=□TFRi'.................(2).

Where TFR_i is the observed period total fertility rate of i^{th} birth order in any given year; γ_i denotes the change in mean of childbearing of parity i; TFR_i' is the adjusted tempo-free TFR of parity i; and TFR' stands for tempo-free TFR. B-F adjustment addresses tempo distortion based on mean age of childbearing and parity-specific birth rate.

B-F formula was based on a strong assumption that all female cohorts shift their timing of childbearing equally. Hence, B-F formula is exclusively valid for parallel shifts in the fertility schedule. Kohler and Philipov (2001) proposed a modification of involving the changes in the variance of the fertility schedule. K-P formula allows for the non-linear changes in mean age of childbearing and standard deviations of the fertility schedule. The observed variance and mean age are corrected from the biases caused by the presence of variance effects. Let

$$\hat{\gamma}_0 = \frac{1}{2}[\mu(t+1)-\mu(t-1)] \text{ and } \hat{s}_0^{\,2}(t) = \delta^2(t) \text{ ....(3)}$$

$$\hat{s}_n^{\,2}(t) = \delta^2(t) + \left[\frac{\hat{\delta}}{1-\hat{\gamma}_{n-1}(t)}\hat{s}^2(t)\right]^2 + \frac{\hat{\delta}(t)}{1-\hat{\gamma}_{n-1}(t)}\kappa(t) \text{ ...... (4)}$$

$$\hat{\alpha}_n(t) = \mu(t) + \frac{\hat{\delta}}{1-\hat{\gamma}_{n-1}(t)}\hat{s}^2(t) \text{ .... (5)}$$

$$\hat{\gamma}_n(t) = \frac{1}{2}[\hat{\alpha}_n(t+1)-\hat{\alpha}_n(t-1)] \text{ ....(6).}$$

Where 0 means the first step and n means nth step; μ(t) denotes mean age in year t for any parity; $\hat{\alpha}(t)$ is the adjusted mean age for year t; $\hat{s}^2$ (t) is adjusted variance for year t; $\kappa(t)$ is the centralized third moment of age specific fertility. The iteration of (4), (5) and (6) is repeated until the estimates for $\hat{\gamma}$ converge. Once $\hat{\gamma}$ is obtained, the adjusted total fertility rate TFR" is calculated based on: TFR"=TFR/(1-$\hat{\gamma}$).

Both B-F and K-P adjustments are probabilistic because their calculations are based on age- and parity-specific fertility rates. Kohler and Ortega (2002) extended B-F and K-P adjustment methods based on mean age of childbearing and parity-specific birth occurrence-exposure rates. Due to the strict requirements of the detailed data (age- and parity-specific births and age-specific number of women) to calculate parity-specific birth occurrence-exposure rates, such a method is difficult to be adopted widely, although it has a more deliberate calculation.

In this article, B-F and K-P methods are adopted. The difference between the observed and the adjusted TFR is tempo effect caused by changes in the timing of childbearing. It is calculated as:

TE=TFR'(or TFR")－TFR;

As a multi-dimension index, TFR is also subject to the birth-order composition. Therefore, tempo effects will be examined by parity.

2.2 Measurement of 'catching-up' effects at later ages

Theoretically, there are two possible effects of delayed childbearing. One is the shift of mean age of childbearing with little change in the completed cohort fertility. The other is the increased mean age accompanied by decreased quantum of fertility. If catching-up at older ages is perfect to offset the decline in fertility at younger ages, the quantum of cohort total fertility rates will not be affected by the changes in timing of births, that is 'pure postponement'. However, empirical evidences suggest a well-known negative relationship between the age at first births and completed fertility (Bumpass and Mburugu 1977; Marini and Hodsdon 1981; Morgan and Rindfuss 1999). Thus catching-up cannot offset the decline in fertility rates at younger ages completely at most times. In this paper, the exact degree of catching-up effects will be determined by the following methods.

2.2.1 Measurement of 'catching-up' effects of period TFR

No method to measure catching-up effect of period TFR is available so far. We attempt to develop one. To capture the trends of changes in fertility over time, first of all, we need to choose a reference time. The age-specific fertility during the reference period is treated as reference fertility schedule. And then we compare the age-specific fertility in the periods studied with that of the reference to pinpoint the exact age at which recuperation start, i.e., recuperation point. From that age on, fertility is supposed to be consistently higher than that of the reference. And at that age, the observed fertility schedule is supposed to be split into two components: postponement at ages younger than recuperation point and catching-up at ages older than that point. For example, in Figure 2 the recuperation point is age 29. Before 29, fertility of the studied period is lower than that of the reference because of postponement. Beyond age 29 the fertility level is consistently higher than that of the reference because of catching-up effects. The degree of catching-up effect is calculated as following:

$$D_t = TFR_t - TFR_b = \sum_{15}^{49}[f_t(x) - f_b(x)]$$
$$= \sum_{15}^{r}[f_t(x) - f_b(x)] + \sum_{r}^{49}[f_t(x) - f_b(x)]$$
$$= P_t + R_t \qquad \text{.................(1)}$$

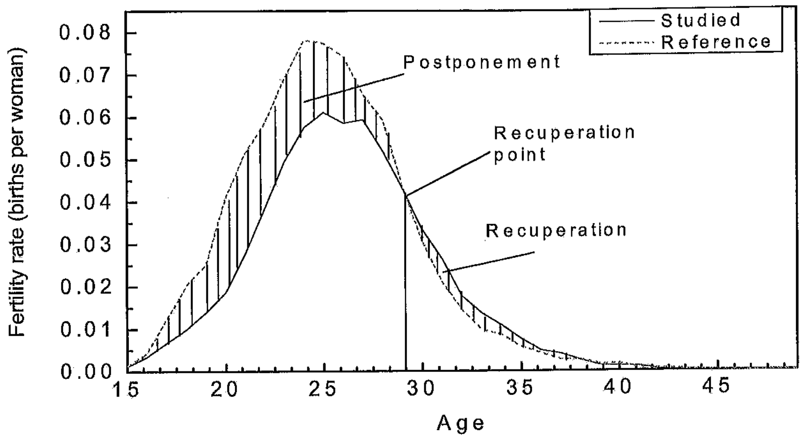
$$P_t = \sum_{r}^{49}[f_t(x) - f_b(x)] \qquad \text{.................................(2)}$$

$$R_t = \sum_{15}^{r}[f_t(x) - f_b(x)] \qquad \text{.................................(3)}$$

$$DR_t = 1 - \left|\frac{R_t}{P_t}\right| \times 100\% \qquad \text{................................(4)}$$

Where t is any studied year, b stands for the reference time; f(x) is fertility at age x; P_t is the deviation of cumulated fertility rates at ages younger than recuperation point in the studied year compared with the reference fertility schedule, called postponement effect; R_t is the deviation of cumulated fertility rates at older ages of year t compared with that of the reference, called catching-up effect or recuperation effect; DR_t is the degree of fertility recuperation.

Figure 2 Demonstration: measurement of 'catching up' effect



The method introduced above to measure period recuperation effects has three advantages: 1) pinpointing the precise ages at which recuperation begins; 2) graphically visualizing the trends of both postponement and recuperation effects; 3) quantifying the absolute and relative postponement and recuperation effects by decomposing the deviation of TFR between studied period and the reference into two parts, postponement and recuperation. This method provides us a tool to calculate the effects and degree of recuperation.

2.2.2 Measurement of 'catching-up' effects of CTFR

To depict the changes in the patterns of fertility schedule of different cohorts, a reference cohort needs to be selected. An ideal reference cohort is the one experiencing neither so much postponement nor catching-up. The widely used method to describe cohort patterns of fertility is to compare cumulated fertilities at reproductive ages. Cumulated fertility is the number of children that have been born to women at various ages up to the most

available calendar years. The degree of recuperation is calculated based on the difference in cumulated fertilities between the cohort studied and the reference. The formula is followed:

$$DR_c = \left(1 - \frac{FD_c}{MD_c}\right) \times 100\%$$

Where DR_c denotes the degree of fertility recuperation for cohort c; FDc means final cumulated difference of cohort c at age 45 comparing with that of the reference cohort; MDc is the maximum difference between the cumulated fertility of cohort c and the reference cohort. This method enables us to establish whether and to what degree recuperation effects catch up the decline of fertility at younger ages due to postponement of childbearing at older ages. The calculation of recuperation effect provides us a basis to predict the reproductive behavior of contemporary young cohorts as they grow older.

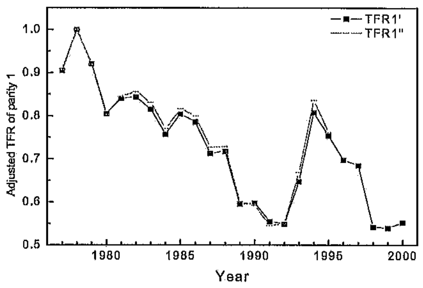
3. Trends of period fertility of Hong Kong and Taiwan since 1976

3.1 The adjusted fertility by B-F and K-P Methods

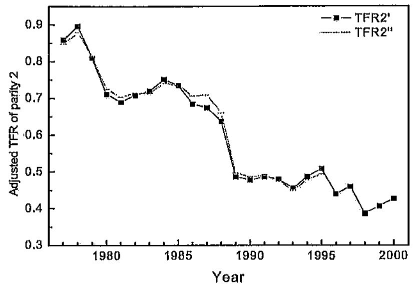
To eliminate the effects of changes in timing of childbearing (tempo effect) on period fertility, TFRs of Hong Kong and Taiwan are adjusted by both Bongaarts-Feeny's (1998) and Kohler-Philipov's (2001) methods based on the age-and parity-specific fertility rates. For Hong Kong, age- and parity-specific fertility rates are unavailable for years 1997-2001 while parity-specific mean age of births and total fertility rates are available. Due to the limitation of data, only B-F approach is to be adopted in that period.

In Hong Kong, parity three is very low and takes only very little part of TFR. Thus it is combined together with the other higher orders to be adjusted. In Taiwan, however, TFR of parity three was considerably high before 1980s, 0.63 in 1976 and 0.51 in 1980. To minimize bias during the adjustment, tempo effects of TFR3 are calculated independently and parity 4 and higher orders are combined as one order for their little percentage in TFR.

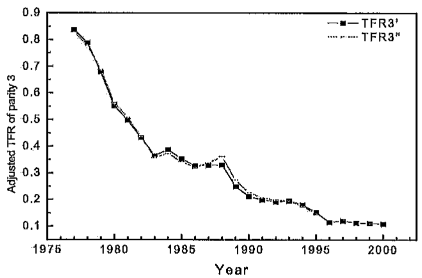
Figure 3 Adjusted TFR of parities one, two and three+, Hong Kong



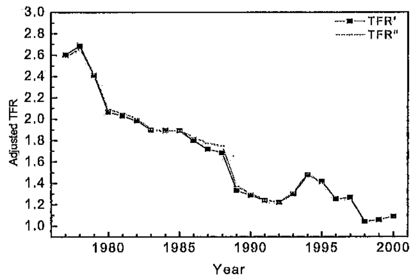
3.1 Adjusted TFR of parity one



3.2 Adjusted TFR of parity



3.3 Adjusted TFR of parity

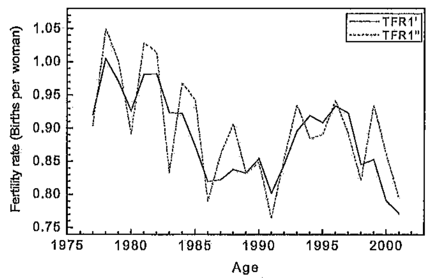


3.4 Adjusted TFR

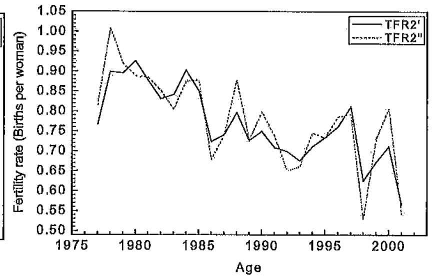
For every parity in Hong Kong, the adjusted fertility by K-P is little upward than the adjusted one by B-F method at most times. And the deviation between the two results is very small, 0.01-0.03 for parity one and two. For parity three, TFR_{3+}" and TFR_{3+}' are very close to each other (Figure 3.3). The deviation between the adjusted total fertility rates of Hong Kong

during 1977-1998 by B-F and K-P methods is insignificant (see Figure 3). Taiwan, however, faced a different condition. Adjusted fertility by K-P method fluctuated greatly around the adjusted fertility by B-F method (see Figure 4). And in some years, the parity specific fertilities are over-adjusted. For parity one, the adjusted TFR1 by B-F and K-P are greater than one in 1978, parity two by K-P method in 1978, and parity three by K-P in 1988 (see Figure 4). Over-adjusted fertilities may be caused by high speed of postponement of childbearing and great variance of the age of childbearing in Taiwan. It may also caused by the adjustment methods themselves, which contain some shortcomings. To overcome the above problems, we use our newly developed method to estimate the effects of postponement and catching-up too.

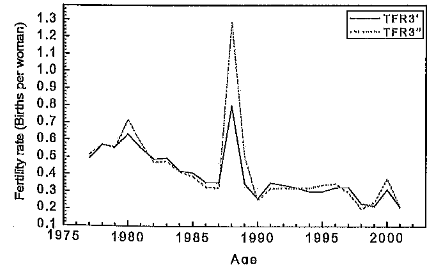
Figure 4 Adjusted TFR of parities one, two,
three and four+, Taiwan 1977-2001



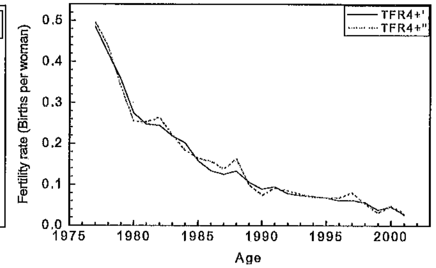
4.1 Adjusted TFR of parity



4.2 Adjusted TFR of parity



4.3 Adjusted TFR of parity three



4.4 Adjusted TFR of parity four

In the following analyses, for years 1976-1996, the adjusted fertility rates of Hong Kong are based on K-P method and the adjusted fertility rates for years 1997-2001 are calculated by B-F method because of data availability. And both methods jointly measure the tempo-free total fertility rates of Hong Kong 1976-2001 as AdjTFR. For Taiwan, the adjusted fertility rates by K-P from 1976-2001 will be adopted and labeled as AdjTFR too.

3.2 Tempo effects on TFR of Hong Kong and Taiwan after 1976

The parity-specific mean ages of childbearing, especially for parities one and two, have been rising substantially in Hong Kong (Figure 5). Mean age of childbearing for parity one (MAC1) has increased from 25.45 in 1976 to 28.68 in 2001 and MAC2 from 27.79 in 1976 to 31.39 in 2001. The changes in the mean age of childbearing for parity 3 and higher birth orders (MAC3) are much less than that of MAC1 and MAC2. MAC3 increased from 32.14 in 1976 to 33.24 in 2001 at rate of 0.04 years annually. In Taiwan, parities one and two together with parity three have experienced great increase in the mean ages of childbearing (see Figure 6).

Figure 5 Parity-specific mean age of childbearing, Hong Kong 1976-2001

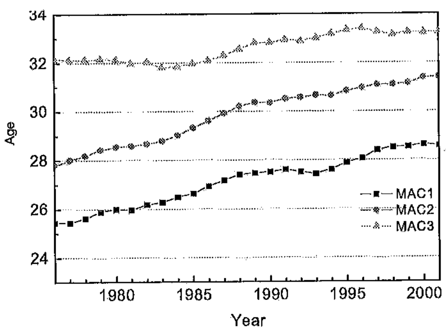
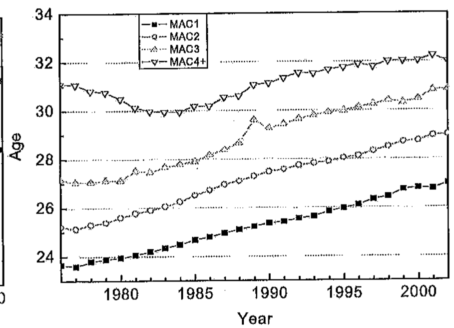


Figure 6 Parity-specific mean age of childbearing, Taiwan 1976-2002



Marked increase in parity-specific mean ages of childbearing implies that at least part of fertility decline during last 25 years could merely be a consequence of tempo effects. The adjusted fertility (AdjTFR) disentangles tempo distortion from the observed fertility trends (Bongaarts and Feeney 1998, Kohler and Philipove 2001). Due to tempo effects, the AdjTFR is generally greater than the observed TFR (see Figure 5). The tempo effect, however, is different over time. During the course to lowest-low fertility, 1976-1987, postponement of childbearing played a great role, especially in the mid-1980s (see Figure 5). The average contribution of tempo effect is 0.28 children per woman during 1976-1987, and greater than 0.4 in 1983-1987. If there had been no postponement of childbearing, the TFR of Hong Kong should have been much higher than 1.3 before 1987, 1.77 in 1987. The AdjTFR without tempo distortion reached below 1.3 in 1990 instead of 1987. Thus postponement of childbearing pushed Hong Kong into lowest-low fertility regime three years earlier. In the 1990s, tempo effect declined to a lower level, 0.13 on average. And since 1998, tempo effect has decreased to less than 0.1. If tempo effect is the only force that has caused period fertility decline in Hong Kong, with lower tempo effect, period fertility should have increased. However the fact is that period fertility in 1990s decreased. Therefore HK fertility decline in 1990s to lowest-low levels without substantial tempo effects has caused partially by decline in quantum of fertility. When tempo effect is removed, the average AdjTFR is lower than 1.3, 1.24, in the 1990s, and near 1.0 during 1998-2000. Therefore low levels of HK fertility do imply lowest-low fertility with decline in quantum.

Figure 7 TFR and AdjTFR of Hong Kong, 1976-2001

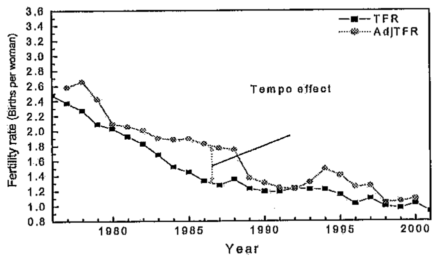
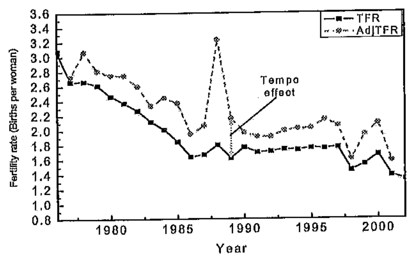


Figure 8 TFR and AdjTFR of TaiWan, 1976-2002



Since 1970s, AdjTFRs in Hong Kong and Taiwan have decreased on average, which means quantum of fertility has also declined and postponement of childbearing is not the exclusive cause of low fertility. As a multi-dimensional index composed by all parities, TFR is unable to indicate which parity has contributed to quantum decline, which parity has contributed to tempo effect, and to what a degree the tempo effect and quantum decline is. To overcome this shortcoming, the fertility trends will be analyzed by parity.

3.3 Parity-specific tempo effects

3.3.1 Tempo effects on low birth orders: parities one and two

Parity one has experienced intensive postponement since 1976 in Hong Kong and Taiwan. Consequently they were affected greatly by tempo effects. In Hong Kong, tempo effect has contributed much to fertility decline before the end of 1980s. If there had been no postponement of childbearing, TFR_1 would have been greater than 0.8 during 1976-1986 in Hong Kong (Figure 9). However, after 1998, tempo effect decreased to a very low level, less than

0.03 on average. With very low level of tempo effect, TFR_1 didn't increase significantly and it fluctuated between 0.54 and 0.50 during 1998-2001. The $AdjTFR_1$ was about 0.63 on average in 1990s and 0.54-0.55 during 1998-2000. The decline in $AdjTFR_1$ implies that parity one experienced quantum decline in 1990s, especially after 1998 in Hong Kong. Taiwan faced higher TFR1 and AdjTFR1 than Hong Kong did. With tempo effect of 0.13 on average, although TFR1 followed a downward trend after 1976, from about 0.9 in the early 1970s to 0.67 in 2002, AdjTFR1 kept on a relatively high level, 0.91 during the 1980s and 0.87 on average from 1990 to 2001.

Figure 9 TFR1 and AdjTFR1, Hong Kong 1976-2001

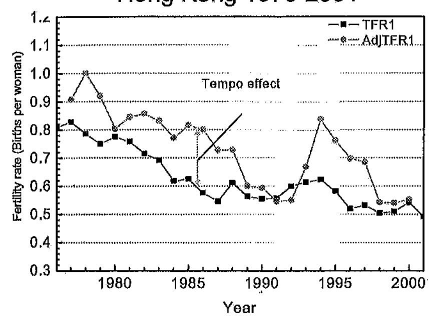


Figure 10 TFR1 and AdjTFR1, Taiwan 1976-2002

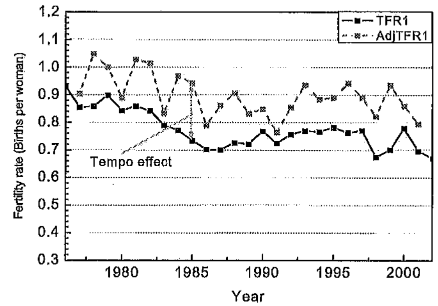


Figure 11 TFR2 and AdjTFR2, Hong Kong 1976-2001

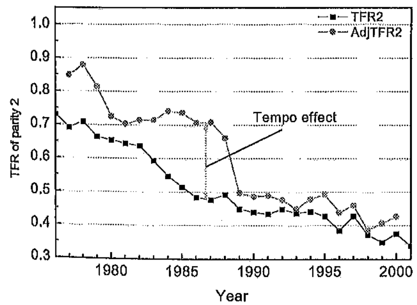
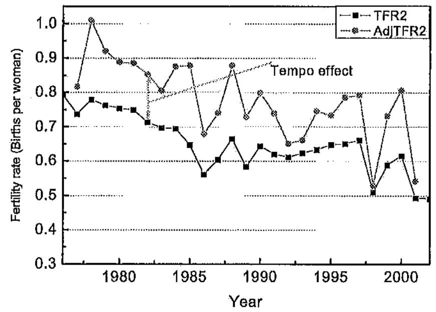


Figure 12 TFR2 and AdjTFR2, Taiwan 1976-2002



In Hong Kong, 1989 was the watershed for the role of tempo effect on decline in TFR_2. The average tempo effect before 1989 was 0.15. Without tempo effect, the $AdjTFR_2$ was higher than 0.7 in 1988 while TFR_2 was 0.5 in the same year. Therefore tempo effects have contributed to period fertility decline of parity two largely before 1989. However with further decline of TFR_2 after 1989, the role of such effect becomes not as great as before. The average tempo effect is only 0.05 in 1989-2000. Thus it is concluded that tempo effects mainly caused the initial decrease in TFR_2 during 1976-1989, and the further decline in 1990s was caused mainly by decline in quantum.

In Taiwan, tempo effect has not decreased much since 1976 and it was 0.12 on average with little fluctuation from 1976-2001. Both TFR2 and AdjTFR2 in experienced downward trend, but the pace of decline is not as great as that of Hong Kong. In the 1990s, TFR2 was greater than 0.6 and AdjTFR2 was greater than 0.7. In a word, TFR2 is still relatively high in Taiwan and tempo effect keeps to be an important factors of the level of TFR2.

For parity one and two, Hong Kong and Taiwan have followed different pattern of fertility decline. The pattern of parity one decline in Taiwan is similar with that of Europe caused by largely by tempo effect. In European countries with lowest-low fertility rate, $AdjTFR_1$ decreased little over time. It is relatively high for them, 0.83 on average during 1995-2000 (Sobotka, 2003). And AdjTFR1 is also high in Taiwan, 0.90 on average 1976-2001 and 0.88 in 1995-2000 with little decline of 0.02. However, for Hong Kong, $AdjTFR_1$ is only 0.63 on average in 1995-2000 and 0.55 in 1998-2000, much lower than that of Europe and Taiwan, and also lower than the lowest one in Europe, Spain with 0.7. For parity two, tempo effect is still an important

factor of fertility level in Taiwan but not in Hong Kong. That is to say, compared with Europe and Taiwan, fertility decline in parity one and two implies true decline in quantum in Hong Kong.

3.3.2 Tempo effects on higher birth orders: parity three and above

In Hong Kong, TFR of parity three and above (TFR_{3+}) is affected little by postponement of childbearing. The deviation between observed TFR_{3+} and the $AdjTFR_{3+}$ is very small, only 0.01 on average during 1977-2000. The highest tempo effect, about 0.07, concentrated in four years, 1986-1989. Before 1984 and after 1995, the tempo effect was near zero or slightly negative (Figure 13). Therefore with little tempo effect, the decline in fertility for parity 3 and higher orders is mainly caused by decline in quantum.

Figure 13 TFR3+ and AdjTFR3+, Hong Kong 1976-2001

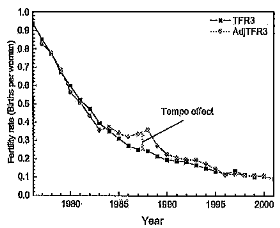


Figure 14 TFR3 and AdjTFR3, Taiwan 1976-2002

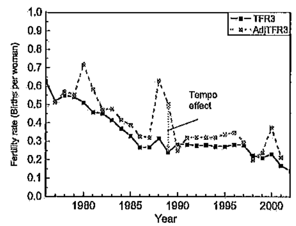
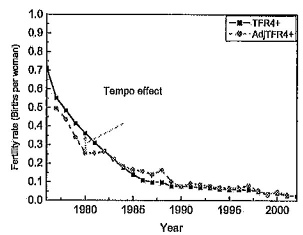


Figure 15 TFR4+ and AdjTFR4+, Taiwan 1976-2002



TFR3 in Taiwan is relatively high before 1990s. Therefore it is analyzed independently. Parity three has declined from 0.63 in 1976 to 0.14 in 2002. With the considerable drop in parity three, tempo effect has declined too, from 0.19 in on average in the 1980s to only 0.04 in the 1990s. Therefore, the decline in parity three in the 1990s is mainly caused by decline quantum. Parity 4 and higher orders in Taiwan experienced a similar pattern with Parity 3 and higher orders in Hong Kong, tempo effects near zero in the

1990s. Parity 4 and higher orders have experienced true decline in quantum and dropped to a very low level, lower than 0.1 since 1990.

3.4 Catching-up effects on period fertility

With postponement of childbearing, the peak of age-specific fertility of parity one has shifted from 20-30 years of age before 1991 to 25-35 in the 1990s in Hong Kong and from 20-24 to 25-29 in Taiwan. For the recent years, age-specific fertility at older ages is consistently greater than that of 1976 in both Hong Kong and Taiwan (Figure 16 and 17). Higher fertility at older ages since 1976 indicates some compensation for the postponement of childbearing of parity one. With dramatic decrease in fertility at age younger than 30 and relatively higher fertility at older ages since 1976 (Figure 18 and 19), parity two experienced both postponement and recuperation in Hong Kong and Taiwan.

For parity three and higher orders, the age-specific fertility tells us the same story as analysis of tempo effects that decline in TFR_{3+} is caused mainly by decreased quantum. Fertility of parity three and higher orders has decreased substantially at every age from 15 to 45 since 1976 in both Hong Kong and Taiwan (Figure 20 and 21). The shape of the fertility schedule of parity three and above did not change much, while the peaks of parities one and two shifted to the right. With little change in the timing of childbearing, little compensation exists for parity three and higher order.

Figure 16 Age-specific fertility rates of parity one, Hong Kong 1976-2001

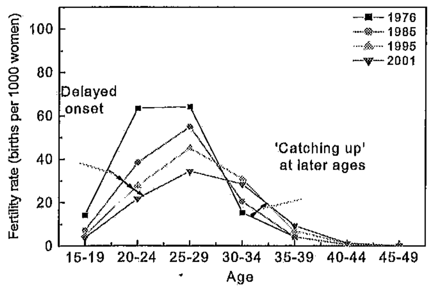


Figure 17 Age-specific fertility rates of parity one, Taiwan 1976-2001

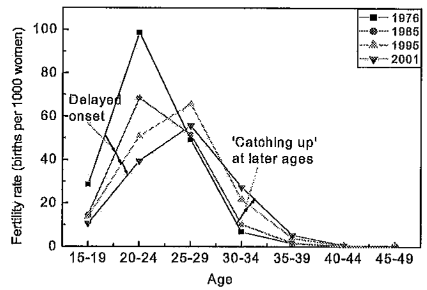


Figure 18 Age-specific fertility rates of parity two, Hong Kong 1976-2001

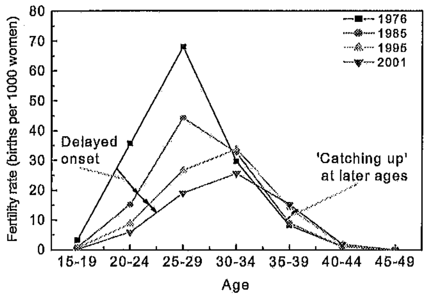


Figure 19 Age-specific fertility rates of parity two, Taiwan 1976-2001

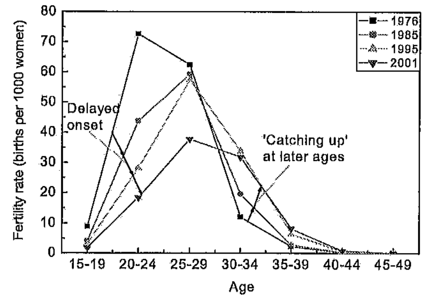


Figure 20 Age-specific fertility rates of parity three+, Hong Kong 1976-2001

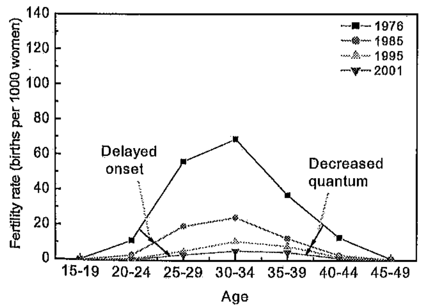
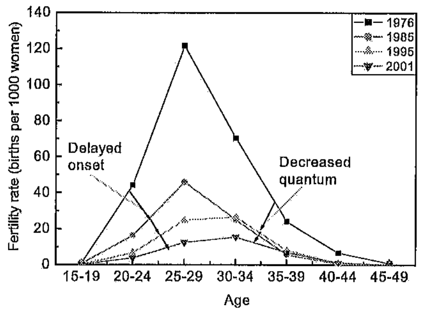


Figure 21 Age-specific fertility rates of parity three+, Taiwan 1976-2001



Analyses of tempo effects and the shape of age-specific fertility showed that the decline of period fertility of parity 3 and higher order is largely caused by decreased quantum and there is little postponement and recuperation for it. Thus we will focus on parities one and two only in analysis of recuperation effects.

Although the figures of age-specific fertility provide us some qualitative information about postponement and catching-up, they are unable to estimate the exact degree of catching-up effects, while quantitative description of catching-up effect is closely related to the future trends of fertility.

To estimate 'catching up' effect quantitatively, first of all, we need to find a fertility schedule as reference. For period fertility, Hong Kong didn't experience much postponement of childbearing before late 1970s. And there is little change in the shape of parity-specific fertility schedules before 1976. Therefore year 1976 is chosen as the reference period. In Taiwan, fertility schedule changed little before 1977. Therefore, 1977 is chosen as reference period.

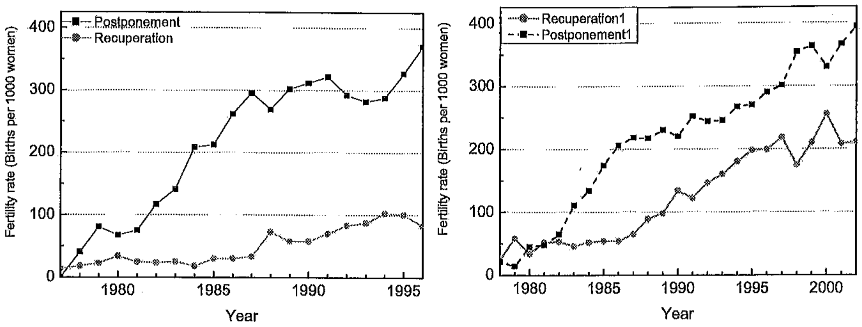
It's often assumed that recuperation of fertility for parity one starts at age 30 (e.g. Lesthaeghe et al 1999). This assumption is somewhat arbitrary because the age at which recuperation starts for different cohorts or different periods is divergent. In present study, the age of recuperation is not fixed, rather the one from which the age-specific fertility of the studied years begins to be consistently higher than that of the reference. Such a definition catches the true starting point of recuperation and allows it to change according to the shape of fertility schedule of the studied period. Recuperation of parity one starts at age about 28-29 in Hong Kong and 25-26 in Taiwan. If we assume the recuperation begins at age 30, part of that recuperation would be taken as postponement, which deflates both

postponement and recuperation effects.

At the ages younger than the recuperation point, the age-specific fertility of the studied years is lower than that of the reference period, which is caused by postponement of childbearing, namely postponement effect. At the ages older than recuperation point, the age-specific fertility of studied years is consistently higher than that of the reference due to catching-up at older ages. The cumulated deviation of fertility caused by catching-up is catching-up effect or recuperation effect.

For parity one, both Hong Kong and Taiwan experienced increasing postponement effect with little fluctuation. At the same time, catching-up effect at later ages increased too. In Hong Kong, the pace of increase in catching-up effect is much lower than that of postponement. Postponement effect rose from 0.04 children per woman in 1978 to 0.37 in 1996, while recuperation effect increased from 0.01 in 1978 to only 0.08 in 1996. As a consequence of higher postponement effect and relatively much lower recuperation, the gap between TFR_1 of 1976 and the later years becomes wider and wider (Figure 22). The degree of recuperation for parity one is about 10-20% in 1980s and 20-30% in 1990s on average. In another word, only 10-30% of fertility decline at younger ages caused by delayed childbearing can be compensated at older ages. Or equivalently, 70-90% of fertility decline caused by delayed childbearing contributed to decline of period TFR_1 in Hong Kong. The uncompensated postponement effect is a pure decline in period total fertility rate compared with that of the reference year. Thus the more postponement effect occurs, the lower period fertility will be. That is to say further postponement of parity one may cause lower period TFR_1 with more women without children in a particular year in Hong Kong.

Figure 22 Trends of postponement and recuperation of parity one compared with 1976, Hong Kong 1977-1996



Compared with Hong Kong, Taiwan experienced lower postponement effect and relatively higher recuperation of parity one (Figures 22 and 23). While the postponement effect increased from zero in 1976 to 0.37 in 1996 in Hong Kong, it increased from zero in 1977 to 0.29 in 1996. And recuperation effect is 0.08 in Hong Kong in 1996, while Taiwan had a higher one, 0.2 in 1996. Relatively lower postponement effect and higher recuperation at older age brought Taiwan a higher TFR_1 than Hong Kong and the level of TFR1 in Taiwan didn't decrease too much in the 1990s.

For parity 2, the recuperation point is around age 30-31 in Hong Kong and age 27-28 in Taiwan. Similar as parity one Taiwan had a lower postponement and greater recuperation effect on parity two than Hong Kong. Postponement effect increased from 0.04 children per woman in 1977 to 0.39 in 1996 in Hong Kong, while it increased from 0.04 in 1978 to 0.28 in 1996 in Taiwan, 0.11 lower than that of Hong Kong (Figures 24 and 25). While childbearing was continuously delayed, fertility at older ages did not change much in Hong Kong, but it increased considerably in Taiwan. Recuperation effect in Hong Kong fluctuated between 0.02-0.06 and the degree of

recuperation is only about 10-20% (Figure 24). Consequently 80-90% of fertility decline at younger ages caused by postponement couldn't be compensated and led to the decline in period TFR_2. In Taiwan, recuperation effect increased largely to 0.2 in 1996 and decreased a little since the late of 1990s (Figure 25). With higher recuperation effect TFR_2 in Taiwan didn't decrease too much before 1997 and began to decrease markedly after that due to higher postponement and lower recuperation. Compared with parity one, parity two faced greater postponement effect and smaller recuperation effect in both Hong Kong and Taiwan. Further postponement of childbearing will cause greater decline in period TFR_2.

Figure 24 Trends of postponement and recuperation of parity 2 compared with 1976, Hong Kong 1977-1996

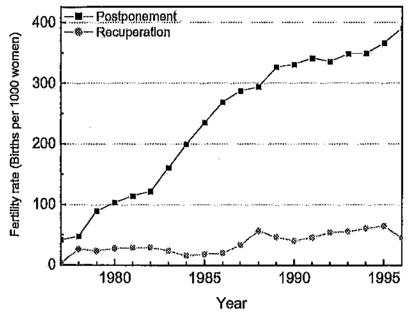
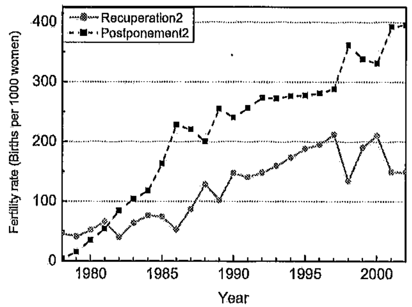


Figure 25 Trends of postponement and recuperation of parity 2 compared with 1977, Taiwan 1978-2002



With decrease in the percentage of parity three and higher order to TFR, changes in parity one and two are playing more and more important role in the trends of fertility. Parities one and two take up near 90% of TFR since the 1990s in Hong Kong and higher than 80% in Taiwan. Future changes in fertility level will largely depend on the possible changes in parities one and two, the main composition of TFR. Moreover, the changes of parities one and two are affected greatly by the timing of childbearing. Therefore, if childbearing will be delayed further, period TFR of Hong Kong and Taiwan will decrease further at low level due to imperfect recuperation.

4. Trends of cohort fertility of Hong Kong and Taiwan

4.1Trends of complete cohort fertility of all birth orders

To gain a more complete picture of fertility trends, changes in cohort fertility need to be examined, especially fertility trends of the most recent cohorts. To depict the changes in timing of childbearing and to estimate catching-up effects, birth cohorts of 1946 in Hong Kong and 1940 in Taiwan are taken as reference cohorts respectively because they are the latest ones that didn't experience much postponement or catching-up in the two areas.

Whether lowest-low fertility is a temporary phenomenon is determined by the changes in cohort fertility patterns. If the cohorts postpone childbearing without any change in the complete cohort fertility, period fertility is merely affected by tempo effects. Thus lowest-low fertility is a temporary phenomenon caused by postponement of childbearing, and once such postponement stops period fertility will rise up. However, if cohort fertility faces true decline in quantum, in other words, lowest-low fertility is caused by quantum decline instead of tempo effect, low fertility may last for a long time. Analyses of cohort fertility trends will help to describe the changes in fertilities of Hong Kong and Taiwan more clearly.

In Hong Kong, the patterns of age-specific fertility have changed

greatly since cohort 1946 (Figure 26). The younger cohorts have much lower fertility at their younger adulthood, i.e., before age 30. With significant postponement, little recuperation is observed. At late 30s, the younger cohorts still have lower fertility than that of cohort 1946 and they have similar fertilities at age 40s with that of cohort 1946. Taiwan also experienced significant postponement for the cohorts born after 1940. The younger cohorts have lower and lower fertilities at their younger adulthoods. Similar as Hong Kong, Taiwan didn't see any recuperation at older ages but some decline in quantum (Figure 27).

Figure 26 Age-specific fertility rates of cohorts 1946-1971 (all birth orders), Hong Kong

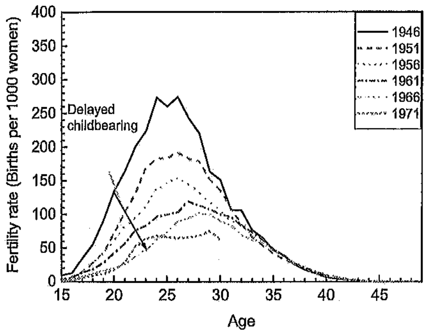
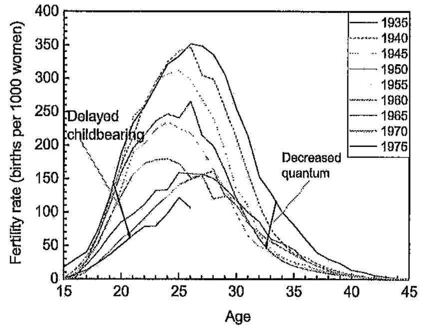


Figure 27 Age-specific fertility rates of cohorts 1935-1975 (all birth orders), Taiwan

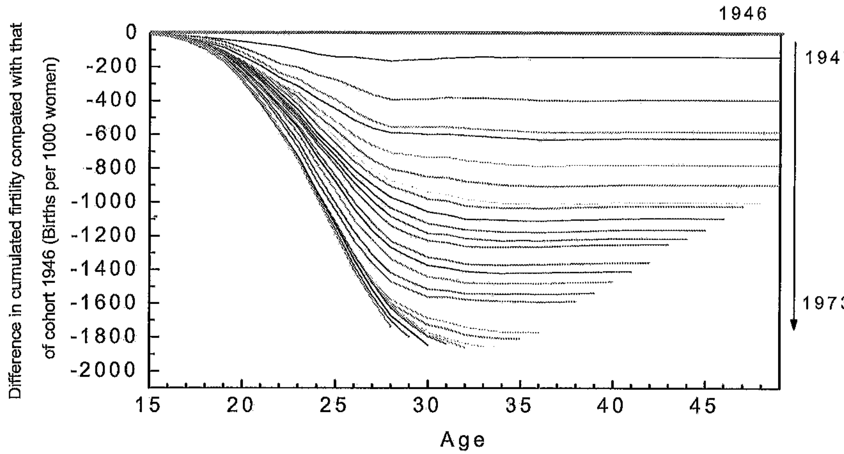


With great postponement and little recuperation, complete cohort fertilities of Hong Kong and Taiwan have decreased markedly. Cohort TFR (CTFR) of Hong Kong dropped from more than three children of the cohort born in 1946 to 2.02, a little below replacement level, of the cohort born in 1953. CTFR of Taiwan decreased from 4.4 of the cohort born in 1935 to 2.6 of cohort 1953. The women born in 1940s and early 1950s spent their reproductive ages in about. Thus decline in CTFR of these women have contributed to the decline in period fertility in the 1970s-1980s.

Due to the characteristic of CTFR, data not available until the end of childbearing ages of the studied cohorts, the CTFR of cohorts born after 1953 cannot be obtained directly. To estimate CTFR of the most recent cohorts, the catching-up effect of cohort fertility will be analyzed. This analysis will help find out the difference between the cumulated fertility of the studied cohorts and that of the reference one at various ages up to the most recent available calendar years.

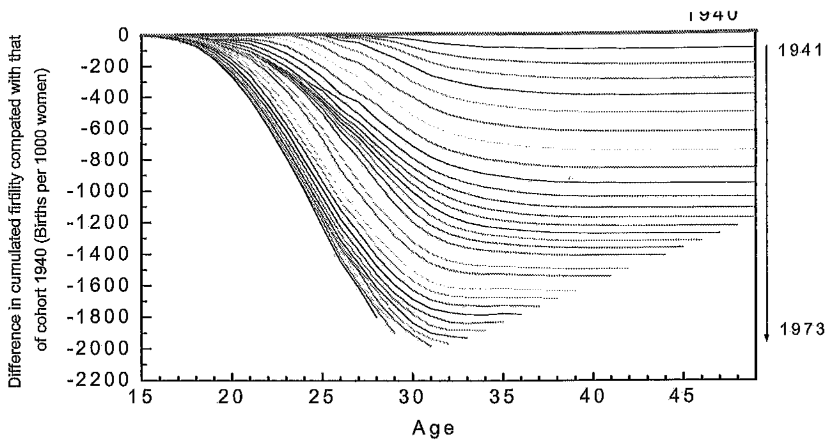
In Figures 28 and 29, the lines represent the deviation of cumulated fertility of the studied cohorts from that of the reference cohorts, cohort 1946 in Hong Kong and 1940 in Taiwan. Longer distance from the top horizontal axis means lower cumulated fertility of the studied years in comparison with that of reference cohort. In Hong Kong, gradually increased distance over cohorts 1947-1973 from cumulated fertilities of cohort 1946 implies decreased complete cohort fertility since cohort 1946 (Figure 28). The deviation in cumulated fertility to the reference cohort gradually increases from age 15 to early 30s, where first-birth childbearing has traditionally been concentrated. If there is recuperation, the difference should decrease gradually at the older ages. For all cohorts born after 1950, the difference reaches its maximum at early 30s and then levels off with little recuperation (Figure 28). The lines representing the difference in cumulated fertility from cohort 1946 are nearly parallel with the top horizontal axis after age 35. Thus there is little change in age-specific fertility at ages older than late 30s for all the following cohorts compared with that of cohort 1946.

Figure 28 Postponement and recuperation of CTFR compared with cohort 1946, Hong Kong 1947-1973



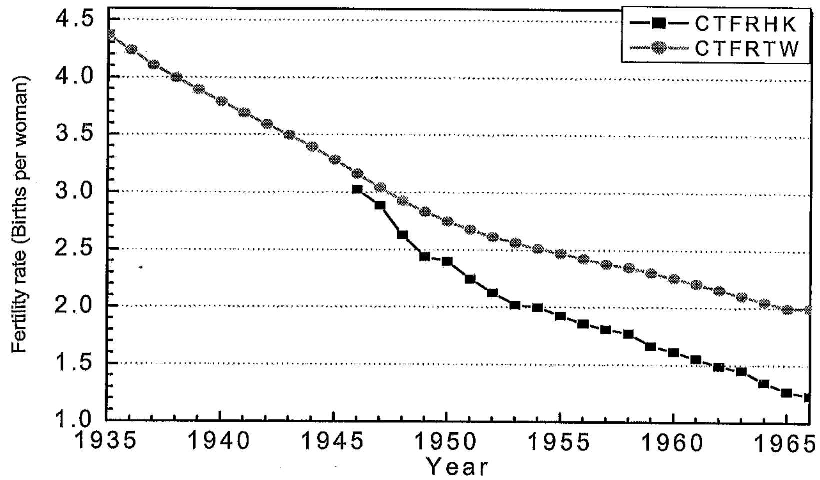
The younger cohorts in Taiwan have a similar pattern as those in Hong Kong, greater and greater deviation from reference cumulated fertility ages 15 to early 30s . While the younger cohorts in Hong Kong reach their maximum deviation from the preference one at early 30s and then levels off with little recuperation, the ones in Taiwan experienced continue to deviate from that of the preference cohort until age 40s and then level off (Figure 29). Thus the younger cohorts didn't have any recuperation at old ages but small quantum decline. The lines representing the difference in cumulated fertility from cohort 1941 are nearly parallel with the top horizontal axis after age 40 instead of 35 in Hong Kong. Therefore there is little change in age-specific fertility at ages older than early 40s for all the following cohorts compared with that of cohort 1940.

Figure 29 Postponement and recuperation of CTFR compared with cohort 1940, Taiwan 1941-1973



Both in Hong Kong and Taiwan, the accumulated fertility at age 40s parallel with each other, which means the age-specific cohort fertility at age 40s changed little for all the cohorts studied. To estimate the proximate CTFR of the cohorts born after 1953, the cumulated fertility at their ages 40-45 or 35-45 will be estimated by the average cumulated fertility of cohorts 1946-1952 at the same ages.

Figure 30 CTFR (cohorts 1935-1952) and estimated CTFR (cohorts 1953-1966) of Hong Kong and Taiwan

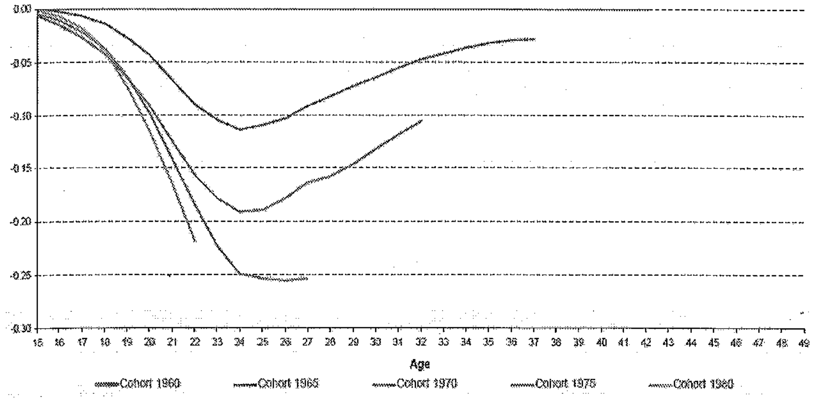


With little recuperation at late age 30s, the declines in fertility at younger ages for the cohorts born after 1946 in Hong Kong and after 1940 in Taiwan imply true decline in their complete fertility. The estimated cohort TFR, based on the assumption that there is little recuperation after age 37, is shown in Figure 17. CTFR in Hong Kong has decreased largely, from more than 3.0 for cohort 1946 to about 1.23 for cohort 1966 (Figure 30). Cohorts 1964-1966 have experienced lowest-low fertility with an average cohort TFR 1.28. The large decline and absolute low levels of CTFR for the cohorts born in the late 1950s and early 1960s have contributed to the decline in period fertility in 1990s. And the low level of cohort TFR for recent cohorts also confirms the finding that fertility decline in 1990s of Hong Kong was caused mainly by decline in quantum. CTFR in Taiwan decreased near linearly from 3.2 for cohort 1946 to 2.0, lower than replacement level, for cohort 1966 (Figure 30). The space of decline in CTFR in Taiwan is slower than that of Hong Kong because parity two is still popular in Taiwan. The declines in CTFR for cohorts born in later 1940s to early 1960s have contributed to the quantum decline in period fertility of years 1980s-1990s.

4.2 Trends of complete cohort fertility of parity one

In Taiwan, cohort age-specific fertility rates of parity one is incomplete and only five years, 1960, 1965, 1970, 1975 and 1980, are available. Based on the limited data, we can see that the shape of deviation in cumulated fertility over ages 15-49 is 'U' shape for the younger cohorts compared with cohort 1960 (Figure 31). By a U-shaped pattern, the line representing the cumulated fertility of a cohort initially declines as the difference to the reference cohort grows, then reaches a trough, and reverses itself and moves towards zero as the difference to the reference cohort diminishes. If there is `perfect' recuperation, the difference will diminish completely, and partial recuperation implies a persistent difference also at the end of childbearing ages. Recuperation of parity one in Taiwan is near perfect for cohort 1965, only 0.03 lower than that of cohort 1960 at age 37. And cohort 1970 tend to continue the 'catch-up' trend at age 30s. Strong recuperation ensured that parity one didn't decrease too much in Taiwan and the decline in period of parity one is mainly caused by postponement of childbearing.

Figure 31 Postponement and recuperation of CTFR1 compared with cohort 1960, Taiwan 1965-1980



Data source: TU Jow-ching and Wang Jianping, 2004, Patterns of lowest-low fertility in Hong Kong and Taiwan, http://ccms.ntu.edu.tw/~psc/C2004paper/1-2.pdf

Hong Kong has a different experience of changes in parity one from Taiwan. In Hong Kong, women of younger cohorts have postponed their onset of motherhood. The peak of age-specific fertility of parity one shifts from early 20s for the cohort born in 1946 to late 20s for the cohorts born in the 1960s. And at age 30s, fertility of the younger cohorts is higher than that of the cohort 1946 (Figure 31). Thus there is some recuperation at age early 30s for the decline in fertility at early adulthood.

Figure 31 Age-specific fertility rates of parity one, cohorts 1946-1971, Hong Kong

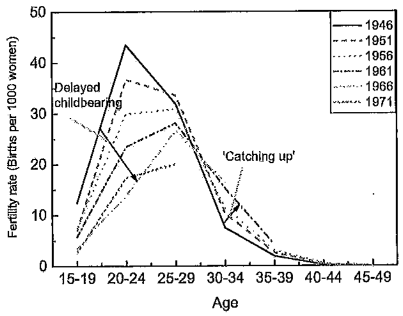
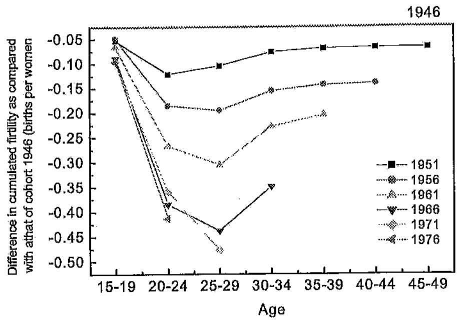


Figure 32 Cohort patterns of postponement and recuperation of first births compared with cohort 1946, Hong Kong 1951-1976



Due to recuperation at older ages, the pattern of the difference in cumulated fertility of parity one to the reference is in 'U' shape in Hong Kong. As 'U' shape, it is different from that of the CTFR parallel with the top horizontal axis and also different from 'U' shape of parity one in Taiwan. In Hong Kong, the right part of 'U' is much shorter than that of Taiwan. Thus, the degree of recuperation of parity one in Hong Kong is less complete than that of Taiwan (Figures 31 and 32). With detailed data, the exact degree of recuperation in Hong Kong can be calculated based on the formula, $DR_c = \left(1-\frac{FD_c}{MD_c}\right)\times 100\%$. The maximum deviation for cohort 1951 is 0.121 at age 20-25 and it is 0.067 at the end of childbearing. Thus the degree of recuperation for cohort 1951 is 44.63%. For cohorts born in 1936, 1941, 1946 and 1951, the fertility at ages 45-49 is zero, which means that very few women deliver their first child in late 40s. Therefore it is reasonable to assume that women complete their first childbearing before 45. If so, the recuperation rate for cohort 1956 is 28.8%. If cohort 1961 follows the recuperation rate of cohort 1951, its final fertility rate would be 0.805.

Table 1 Mean age of childbearing for parity one (AMC1) and ultimate childless rate for cohorts 1946-1961, Hong Kong

Year	MAC1 (year)	Childless rate (%)
1946	24.61	2.6
1951	25.62	9.3
1956	25.96	16.6
1961	27.49	19.5

Complete cohort fertility rate of parity one is of interest because it can be used to measure the ultimate percentage of childless. The childless rate equals one minus cohort TFR_1. For cohorts 1946, 1951 and 1956, the rates were 2.6%, 9.3%, and 16.6% respectively in Hong Kong (Table 1). The estimated childless rate for cohort 1961 is 19.5%. The mean age of childbearing of parity one (MAC1) increased from 24.6 for cohort 1946 to 27.5 for cohort 1961 (Table 1). In fact, a significant increase in rates of childless over cohorts accompanied by increase in MAC1 reveals that fertility recuperation at older ages is not strong enough to offset the decline at younger ages. It also indicates that postponement of childbearing in Hong Kong implied a real reduction in completed fertility of parity one with a considerable percentage of childless, up to 19.5% for cohort 1961. The low cohort TFR_1 of the cohorts born in the late 1950s and early 1960s have contributed to the low level of period TFR_1 in 1990s. Lowest-low complete cohort fertility for the cohorts born in mid-1960s implies that lowest-low fertility in Hong Kong is a true decline in complete fertility.

5. Conclusion

There are common characteristics and also differences between the patterns of low fertility in Hong Kong and Taiwan. In terms of decline in parity one and the role of postponement of childbearing in decline of period TFR, Taiwan has a similar pattern as that of Europe but different from Hong Kong in the 1990s. Low fertility of Hong Kong is not a simple echo of European countries, where lowest-low fertility is viewed as temporary phenomenon caused by tempo effect (Sobotka, 2004). While Hong Kong has shared the same characteristic with Taiwan and other low-fertility areas, tempo effects caused by increasing mean age of childbearing, it goes further in fertility decline and displays new features.

As one of the main characteristics of second fertility transition, postponement of childbearing has played an important role in the decline of fertility at low level in both Hong Kong and Taiwan. Tempo effect caused by delayed childbearing contributed greatly to the emergence of lowest-low fertility, TFR lower than 1.3, of Hong Kong. The average contribution of tempo effect is 0.28 children per woman during 1976-1987, and greater than 0.4 in 1983-1987. Tempo effect has pushed Hong Kong into lowest-low fertility regime three years earlier, in 1987 instead of 1990. The tempo effects in Taiwan didn't change too much, except year 1988 with higher than one. In the 1980s, TFR is 1.74, much lower than replacement level. However, when tempo effect is eliminated, the adjusted TFR is much near replacement level with 2.07. Without tempo effect, total fertility of Taiwan in the 1990s is also near replacement level with1.97 instead of the observed level of 1.69.

While tempo effects caused decline in period TFR of parities one and two, stopping childbearing of higher orders is another important factor of

lower fertility in Hong Kong and Taiwan. Our analysis on parity specific tempo showed that the decline in parity three and higher orders was mainly caused by quantum decline without little tempo effects.

Taiwan and Hong Kong shared another common phenomenon, incomplete recuperation for all parities of period fertility and non-recuperation for CTFR. Therefore further postponement of childbearing will cause both lower cohort and period fertility in Hong Kong and Taiwan.

In the 1990s, demographic causes of fertility decline in Hong Kong changed, the role of tempo effects decreased with true decline in parities one and two. Hong Kong goes further in fertility decline than Taiwan and European countries. The major difference of low fertility in the 1990s' Hong Kong between Taiwan and Europe are as follows:

First, while complete cohort fertility of parity one is relatively stable in Taiwan and Europe, it has declined steadily in Hong Kong. Hong Kong experienced quantum decline in all parities, including parity one in 1990s, especially after 1998. Decline in the $AdjTFR_1$ without tempo effect, from about 0.9 in late 1970s to 0.63 on average in 1990s and 0.54-0.58 during 1998-2000, implies a quantum decline in parity one. Analysis of cohort data substantiated the above argument. Childless rate has increased significantly in the younger cohorts, from 2.6% for cohort born in 1946 to 19.5% for cohort born in 1961. The low cohort TFR_1 of the cohorts born in the late 1950s and early 1960s have contributed to the low level of period TFR_1 in 1990s. Thus postponement of childbearing in Hong Kong implies a true reduction in complete fertility of parity one with a considerable percentage of childless.

Second, while lowest-low fertility in Europe and low fertility in Taiwan may be viewed as temporary phenomenon caused by tempo effects, it is caused by true decline in complete cohort fertility in Hong Kong in the 1990s. Hong Kong fertility decreased further at lowest-low level in 1990s without substantial tempo effect. If tempo effect is removed, the average AdjTFR is still lower than 1.3. It was 1.24 in 1990s, and near 1.0 during 1998-2000. Complete cohort fertility decline of cohorts born in the 1950s and 1960s has contributed to the further decline of period fertility in 1990s. The cohorts born in the mid-1960s have experienced lowest-low fertility around 1.28 on average. Thus, low levels of fertility in Hong Kong did imply lowest-low fertility regime, and it cannot be explained as temporary phenomenon caused by tempo effects.

The new characteristics of patterns of low fertility in Hong Kong have their theoretical implications. Decline in cohort TFR_1 accompanied by postponement of childbearing in Hong Kong supports the argument that women who postpone childbearing indeed take some risk of secondary sterility, either they or their partners will prevent them from having children. Increased percentage of childless also signifies that the minimum fertility level may be below one. The biological predisposition toward nurturing is taken as the reasons that in most cases women would have at least one child and low fertility may have reached its limit (Foster, 2000). However, Foster also acknowledged that there is no inevitable link between genetic predispositions and behavior. Therefore it is logically possible that the predisposition towards nurturing could be suppressed, resulting in decline in complete fertility of parity one. The low level of cohort TFR_1 of cohorts born in the early 1960s supports the above logic. Biological predisposition is a necessary but not sufficient precondition preventing lowest-low fertility from further decline. The expression of biological predisposition is affected by the context of existing institutions. Only if pronatalist institutions are set up,

biological predisposition cannot prevent lowest-low fertility from further decline. And the fact that lowest-low fertility of Hong Kong in the 1990s is mainly caused by true decline in complete cohort fertility signifies that European experience is not the only path to lowest-low fertility. Cohorts born in the mid-1960s in Hong Kong have lowest-low complete fertility and they contributed to the period fertility decline in the 1990s.

One of the reasons that decline in parity one and fertility decline in the 1990s' Hong Kong is mainly caused by quantum decline is mean ages of childbearing have been compressed to a relatively high level, 28 on average in the 1990s and 28.6 in 2001 for parity one. Timing of childbearing is affected biologically. Conventionally, most of the first child is delivered before early 30s. With high age of childbearing, near 30, there is less and less room for postponement of childbearing. Thus tempo effect was squeezed out and heavy postponement of childbearing caused involuntary childless. Consequently, quantum decline takes over the important role in fertility decline.

In conclusion, our analyses reveal that, while the patterns of low fertility in Hong Kong share the same characteristics with from those of Taiwan and Europe, they are different from two aspects. As in Europe, postponement of childbearing played a great role in the emergence of low fertility in Hong Kong and Taiwan. And both Hong Kong and Taiwan have incomplete recuperation on every parity. Thus further postponement of childbearing may lower fertility in the two areas. The pattern of low fertility in Taiwan is similar as that of Europe. However, low fertility of Hong Kong is not a simple echo of that of Europe and it has new features. With very low tempo effects, TFR of Hong Kong declined further in the 1990s. Lowest-low level of CTFR for cohorts born in the middle 1960s and period adjusted TFR in late 1990s displayed that fertility decline in the 1990s' Hong Kong is mainly caused by true decline in complete fertility. Hong Kong also experienced decline in parity one, while Taiwan and Europe faced a relative stable level of parity one. The patterns of low fertility caused mainly by true decline in the 1990s' Hong Kong may be precursor of fertility patterns of other developed countries without efficient pronatalist policies.

Reference:

ARCHIVES (2001), "R. F. Harrod on reviving the birth rate", Population and Development Review, 27, 1, December.

Bettio, F. and P. Villa (1998), "A Mediterranean perspective on the breakdown of the relationship between participation and fertility". Cambridge Journal of Economics 22 (2): 137-171.

Billari, F. C. and Kohler H.-P. (2003), "Patterns of low and lowest-low fertility in Europe." PAA 2004 annual meeting program, (Available at: http://paa2004.princeton.edu/download.asp?submissionId=41843)

Bongaarts, J. (1998), "Fertility and Reproductive Preferences in Post-Transitional Societies." *Conference on Global Fertility Transition, Bellagio, Italy* May 1998 No.114.

Bongaarts, John and Griffith Feeney (1998), "On the quantum and tempo of fertility". *Population and Development Review* 24(2): 271-291.

Bongaarts, J. (1999), "Fertility Decline in the Developed Word: Where Will It End?" *American Economic Review* **89**(2): 256-260.

Brown, Judith M. ed. *Hong Kong's transitions, 1984-1997*. Oxford: Macmillan Press. 1997

Buckley, Roger. *Hong Kong: The road to 1997*. Cambridge: Cambridge UP. 1997

Bumpass, L. L. (1973), "Is low fertility here to stay?" *Family* Planning *Perspectives* **5**(2): 67-79.

Bumpass, L. L. and E. K. Mburugu (1977), "Age at marriage and completed family size," *Social Biology* 24(1): 31–37.

Carrasco, C. and A. Rodriguez (2000), "Women, Families, and Work in Spain: Structural Changes and New Demands," Feminist Economics, Vol. 6 Issue 1.

Chan, Natalia Sui Hung (2001), City on the edge of time: Hong Kong culture and the 1997 issue. Ph.D. Dissertation. UMI Microform 3027045

Chesnais, J.-C. (1996), "Fertility, family, and social policy in contemporary Western Europe." *Population and Development Review* **22**(4): 729-739.

Chesnais, J.-C. (2001), "Comment: a march toward population recession." *Population and Development Review* **27**(Supplement: Global Fertility Transition): 255-259.

Demeny, Paul (1997), "Replacement-level fertility: The implausible endpoint of the demographic transition," in Gavin W. Jones, Robert M. Douglas, John C. Caldwell, and Rennie M. D'Souza (eds.), *The Continuing Demographic Transition*. Oxford: Clarendon Press.

Del Boca, D. (2002), "The Effect of Childcare and Part Time Opportunities on Participation and Fertility Decisions in Italy", Discussion Paper No. 427, IZA.

Delgado Perez, Margarita, and Massimo Livi-Bacci (1992), "Fertility in Italy and Spain: The Lowest in the World," *Family Planning Perspectives* 24: 162-171.

Di Tommaso, M.L. (1999), "A Trivariate Model of Participation, Fertility and Wages: The Italian Case", Cambridge Journal of Economics, 23, 5: 623-

EUROSTAT (2002), *Statistical Yearbook, data 1999-2000.* Luxembourg: Office for Official
Publications of the European Communities.

Foster, C. (2000), "The limits to low fertility: a biosocial approach." *Population* and *Development Review* **26**(2): 209-234.

Freedman R. and Blanc A. K. (1992), "Fertility transitions: an update". *International Family Planning Perspectives*. 18: 44-50&72.

Frejka T. and Calot G. (2001), Cohort Reproductive Patterns in Low-Fertility Countries. *Population and Development Review* 27(1): 103-32

Freijka T. and Ross J. (2001), "Paths to subreplacement fertility: the empirical evidence." *Population and Development Review* **27**(Supplement): 213-254.

Giraldo, Anna; Mazzuco, Stefano and Michielin, Francesca. (2004), "Compatibility of children and work preferences: two European cases" paper presented at PAA meeting, Boston, MA.

Golini A. (1998), "How low can fertility be? An empirical exploration." Population *and Development Review* **24**(1): 59-73.

Hobcraft L. (1953), "Data need for fertility analysis in the 1990's". In A. Blum and J. Rallu (Eds), *European Population*, Volume 2: Demographic Dynamics (pp. 447-460). Montrouge, France:John Libbey Eurotext

Keyfitz, N. (1987), "The family that does not reproduce itself" *Population and* Development *Review* 12(supplement): 139-154

Kohler, H.-P. and Ortega J. A. (2002), "Tempo-adjusted period parity progression measures: Assessing the implications of delayed childbearing for fertility in Sweden, the Netherlands and Spain". *Demographic Research* 6(7):145–190.

Kohler, H.-P., Billari F. C. and Ortega J. A. (2002), "The Emergence of Lowest-Low Fertility in Europe During the 1990s." *Population and Development Review* **28**(4): 641-680.

Kohler, H.-P. and Philipove D. (2001), "Variance effects in Bongaarts-Feeney formula". *Demography* 38(1): 1-16

Knodel, John Vipan Prachuabmoh Ruffolo, Pakamas Ratanalangkarn, and Kua Wongboonsin. (1996), "Reproductive preferences and fertility trends in posttransition Thailand," *Studies in Family Planning* 27(6):307–318.

Le Bras, Hervé. (1991), *Marianne et les lapins: l'obsession demographique*. Paris: Olivier Orban.

Lesthaeghe, Ron and Paul Willems. (1999), "Is low fertility a temporary phenomenon in the European Union?". *Population and Development Review* 25(2): 211-228

Letabelier M.-T. (2003), "Fertility and family policies in France", Supplement to Journal of
Population and Social Security: Population, Vol.1, N.1, pp. 245-261.

Livi-Bacci, M. (2001), "Comment: desired family size and the future course of fertility." *Population and Development Review* **27** (Supplement: Global Fertility Transition): 282-289.

Livi-Bacci, M. (2004), "A Fund for the Neborn. A Proposal for Italy", papere presented at PAA meeting, Boston, MA.

Meulders D., Plasman O. and R. Plasman. (1994), "Atypical Employment in Europe", Dartmouth, Ashbury.Mincer, J.(1985), "Intercountry Comparisons of Labor Force Trends and of Related Developments: An Overview", Journal of Labor Economics, v.3, Issue 1:1-32.

Morgan, S. P. and King R. B. (2001), "Why Have Children in the 21st Century? Biological Predisposition, Social Coercion, Rational Choice." European Journal of Population 17: 3-20.

Morgan, S Philip. (2003), "Is Low Fertility a Twenty-First-Century Demographic Crisis?" Demography 40: 589-603.

Marini, M. M. and P. J. Hodsdon. (1981), "Effects of the timing of marriage and first birth on the spacing of subsequent births." Demography 18(4): 529–548.

Mauldin, W. P. and Ross J. A. (1991), "Family planning programs: effort and results, 1982-1989". Studies in Family Planning 22: 350-367

Morgan, P. S. and R. R. Rindfuss. (1999), "Reexamining the link of early childbearing to marriage and to subsequent fertility" Demography 36(1): 59–75.

Namboodiri, K. and L. Wei. (1999), "Fertility theories and their implications regarding how low fertility can be" Genus 48(2): 37-55

Pinnelli, Antonella. (1995), "Women's Condition, Low Fertility, and Emerging Union Patterns in Europe," in Karen Oppenheim Mason and An-Magritt Jensen (Eds.), Gender and Family Change in Industrialized Countries. Oxford: Clarendon Press.

Presser, H. B. (2001), "Comment: a gender perspective for understanding low fertility in post-transitional societies." Population and Development Review 27(Supplement: Global fertility transition): 177-183.

Prioux, France (1990), "Fertility and family size in Western Europe". Population: An English Selection 2: 141-161

Rubery et al. (1994), Changing Patterns from Work and Working Time in the European Union and the Impact on Gender Divisions, European Network of Experts on the Situation of Women in the Labor Market, Report for the Equal Opportunities Unit, DGV, Brussels, European Comission.

Sobotka, T. (2003), "Postponement of childbearing and the future fertility recuperation in Europe". Presentation on the conference "The Second Demographic transition in Europe" in Spain, Belgium, 19-24 June 2003

Sobotka, T. (2004), "Is Lowest-Low Fertility in Europe Explained by the Postponement of Childbearing?" Population and Development Review 30(2): 195-220.

Tu, Edward Jow-Ching (2003), "Patterns of Lowest-Low Fertility in Hong Kong". Journal of Population and Social Security (Population), Supplement to 1: 629-642.

TU Jow-ching and Wang Jianping, (2004), "Patterns of lowest-low fertility in Hong Kong and Taiwan". http://ccms.ntu.edu.tw/~psc/C2004paper/1-2.pdf

Wang Jianping (2003), Household Trends and projections in Hong Kong: A macro-simulation model, Ph.D. Dissertation, UMI Microform 3094776: p.95

Zing Yi and Land Kenneth, C. (2001), "A sensitivity analysis of the Bongaarts-Feeney method for adjustment bias in observed period total fertility rates". Demography 38:7-28

Patterns of low fertility in Hong Kong and Taiwan

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摘要

本文主要從人口學視角探討香港和台灣的低生育率的模式及其成因。為了全面了解生育率的變化模式，我們同時研究了時期生育率和終身生育率的變化趨勢。我們設計了一種簡潔的方法來測度補償性生育對生育率的影響，並採用了 Bonggarts-Feeney' s (1998) 和 Kohler-Philipov' s (2001) 兩種方法分離出自 1976 年後生育延遲對於時期生育率的影響。在分析終身生育率走向的基礎上，我們推測了 1950 至 1960 年代出生的婦女的終身生育率。我們的分析顯示，與歐洲類似，生育延遲在香港和台灣的生育率下降過程中扮演著很重要的角色。香港和台灣的低生育率模式雖然類似，但也有很大的差異。台灣的低生育率模式與歐洲的極其相似，但是香港有著自己的特點而不僅僅是歐洲模式的延續。在生育延遲的影響已經下降到很低的情況下，香港的生育率在 1990 年代進一步下降。1960 年代出生的婦女的終身生育率和調整後的 1990 年代的時期生育率都處於超低水準，這

說明香港的生育率是真正的低生育率而不僅僅是生育延遲的伴生現象。如果沒有有效的促進生育的政策，香港有望在長期內面臨低生育率現象；在不久的將來，台灣可能會步香港的後塵而面臨香港現時的生育模式。

關鍵詞：低生育率　生育率模式　生育延遲　補償性生育