Another indicator in measuring the fertility situation of a place with very few births born outside wedlock

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Abstract

The Total Fertility Rate is the most common indicator in measuring the fertility situation of a place. It measures the total number of births born to the total female population, irrespective of whether they have married or not. In Hong Kong, very few births were born outside wedlock. The proportion of births born outside wedlock was about 7-14% in the past decade, much lower than some 40% for western economies such as US. This paper introduces another measure of the fertility rate for a place with very few births born outside wedlock on an empirical point of view for comparison. The proposed fertility indicator is a weighted sum of the age specific marital fertility rates which excludes the never married females in the compilation. The cumulative percentage of women marrying up to a specified age from a hypothetical cohort estimated based on the current first marriage schedule are used as the respective weights in the compilation. Data from Hong Kong reveal that the proposed indicator reflects in a timely manner the contrasting effect of the changing marriage rates over time on the evolving fertility situation.

Keywords: Average number of children, age specific fertility rates, total marital fertility rate, fertility projections

1. Introduction

The Total Fertility Rate (TFR) is the most common indicator in measuring the fertility situation of a place. TFR is defined as the sum of the age specific fertility rates (AFR). The idea behind TFR is that for a hypothetical cohort, if the cohort age specific fertility rates follow the current fertility schedule represented by AFR, TFR represents the average number of children born to a woman during her lifetime. TFR does not represent the fertility of any woman in reality since the current fertility schedule is experienced by women from different cohorts.

For places with very few births born outside wedlock, TFR, being the sum of AFR, can be written as the sum of the product between the proportion of now married women and the age specific marital fertility rates (AMFR). AMFR is the ratio of the number of births born to married women to the population of married women. Decomposition technique can be employed to breakdown the change in TFR into two components, one attributable to the marriage pattern and one attributable to marital fertility rates (Census and Statistics Department, Hong Kong, China, 2005).

There are also alternative indicators in measuring fertility, especially for places with most births born within wedlock. The Total Marital Fertility Rate (TMFR), being the sum of AMFR, has some theoretical merits but is not useful in practice. For a hypothetical cohort of women who were married at the beginning of childbearing period and remained married throughout the childbearing period, TMFR refers to the average number of children born to a married woman during her lifetime experiencing the current marital fertility schedule represented by AMFR. For places with very few births born outside wedlock, TMFR would be a more appropriate indicator than the TFR because never married women, who are very unlikely of

childbearing in such economies, are excluded in the calculation of TMFR.   However, TMFR has a very strong assumption that all women in the cohort have already been married at the start of the childbearing period.   In reality, this assumption is not valid in most places.   Hence, TMFR remains a textbook indicator.

This paper proposes another indicator that can capture the merits of TMFR without the deficiency of having the need of a strong assumption.   We call this the "Another Total Fertility Rate", or aTFR in short.   Data from Hong Kong are used to compile and compare the three different fertility indicators: TFR, TMFR and aTFR.

2. Method

Let $f(x)$, $f_m(x)$ and $p(x)$ be the age specific fertility rates, age specific marital fertility rates and proportion of now married women respectively at age x.   The childbearing period refers to the age group 15 to 49.   For a hypothetical cohort with the cohort age specific fertility rates following the current fertility schedule, TFR is the sum of the age specific fertility rates.   The formula for TFR is:

$$TFR = \sum_{x=15}^{49} f(x) = \sum_{x=15}^{49} p(x) \times f_m(x).$$

TFR can be written as the weighted sum of AMFR using the proportion of now married women as weight.

For a hypothetical cohort with the cohort age specific marital fertility rates following the current marital fertility schedule, TMFR is the sum of the age specific marital fertility rates.   The formula for TMFR is:

$$TMFR = \sum_{x=15}^{49} f_m(x).$$

TMFR can also be written as the weighted sum of AMFR with weight one. That is, the proportion of now married women at any age is 1, all married.   Because of the extremely small number of women aged 15 to 19 who are now married, the calculation for TMFR is confined to the age group 20 to 49.

For aTFR, firstly the nuptiality table is constructed.   Let $pm(x)$ be the probability of getting married for the first time.   It can be found using the usual life table formula:

$$pm(x) = \frac{2 \times n(x)}{2 + n(x)}$$

where $n(x)$ is the age specific first marriage rates of women, calculated as the ratio of the number of first marriages of women of a particular age x to the number of never married women of age x as at mid-year.   For a hypothetical cohort of size $l(0)$, let $l(x)$ be the number of never married women at age x.   Moreover, it is assumed that marriage is an absorbing state.   That is, once a woman is married, she remains married throughout her childbearing period and no divorce is assumed.   This is in line with the assumption of no divorce in TMFR.   Furthermore, no deaths are assumed.   This is in line with the definition of TFR that no deaths occurred. Analogous to the life table formula, $l(x)$ can be calculated as $l(x) = l(x-1) \times (1 - $

$pm(x-1)$) and the number of first marriages at age x in the cohort, $m(x)$, is $m(x) = l(x) \times pm(x)$.

The idea of aTFR is that for a woman in the hypothetical cohort who is married at age x, the average number of children born to this woman during her lifetime is the sum of marital fertility rates from age x onwards. This follows the similar calculation method of TMFR. However, the sum of AMFR only starts at the age when the woman gets married, not at the beginning of the childbearing period. This removes the invalid assumption of requiring every woman married at the beginning of the childbearing period. Hence, aTFR can be written as:

$$aTFR = \frac{1}{l(0)} \sum_{x=15}^{49} m(x) \times \left(\frac{1}{2} f_m(x) + \sum_{i=x+1}^{49} f_m(i) \right).$$

Only half of the AMFR is counted at the age of marriage because the number of married-person-year of a woman married at age x is 0.5 (correction on continuity). An adjustment on the time lag between marriage and childbirth (given that gestation period of 9 months) can be added but omitted here for simplicity.

By re-arranging the inner summation, aTFR can also be written as follows:

$$aTFR = \sum_{x=15}^{49} \frac{1}{l(0)} \left(\sum_{i=15}^{x-1} m(i) + \frac{1}{2} m(x) \right) \times f_m(x).$$

Hence, aTFR is also a weighted sum of the AMFR, using the cumulative percentage of married women up to age x (with correction on continuity) from a hypothetical cohort based on the current first marriage schedule as weight.

3. Data

Age specific first marriage rates of Hong Kong were compiled from marriage data collected by the Immigration Department (ImmD) of the Hong Kong Special Administrative Region Government during marriage registrations. After the Marriage Reform Ordinance was enacted in 1971, all marriages are required to be registered with ImmD. The number of births by age of mother was compiled from birth data collected by ImmD during birth registrations. The population denominator used in calculating the age specific first marriage rates and AMFR was based on data on the marital status of the population obtained from various rounds of population censuses/by-censuses.

4. Results

The age specific first marriage rates are shown in Figure 1. The age specific first marriage rates declined in almost all age groups during 1976–2001. There were some increases in the first marriage rates for women aged 30 and over in 2011. This was likely attributable to the catch-up effect of marriage postponement. Women delay marriages until their thirties because of increasing education and career opportunities. This could also be revealed from the shift of the mode of the distribution to the right hand side.

Figure 1   Age specific first marriage rates, 1976–2011
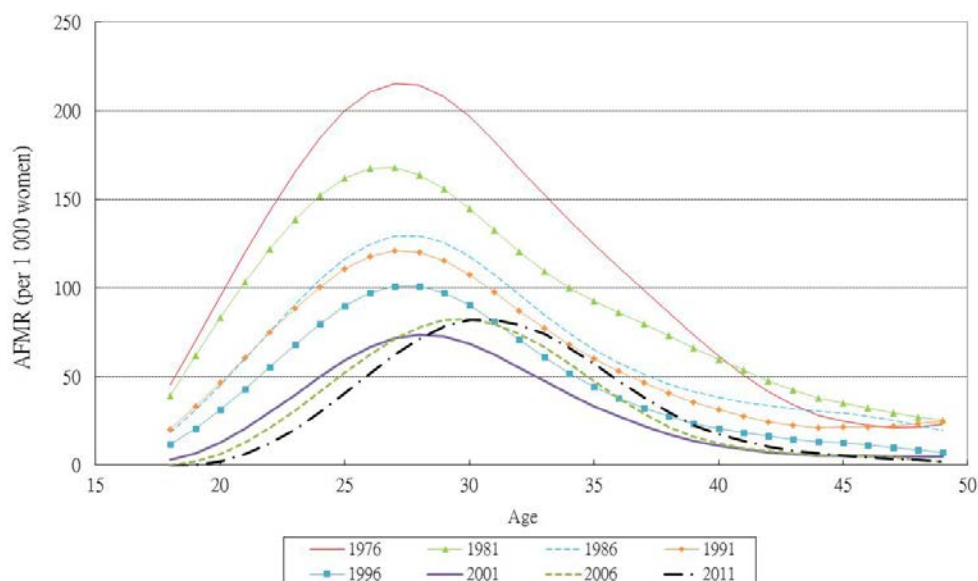
Based on the age specific first marriage rates, the proportion of never married women, $l(x)/l(0)$, in a hypothetical cohort by age is shown in Figure 2.   The proportion of never married women at the end of the childbearing period in a hypothetical cohort increased from 3% in 1976 to 36% in 2011.   That is, only 64% of women in the 2011 cohort were engaged in childbearing activities.   Moreover, the proportion of never married women at age 30 increased from 15% in 1976 to 69% in 2011.   This has a large negative impact on the fertility rates because ages 20 to 30 are regarded as prime childbearing ages.

Figure 2   Proportion of never married women in a hypothetical cohort of women by age, 1976–2011
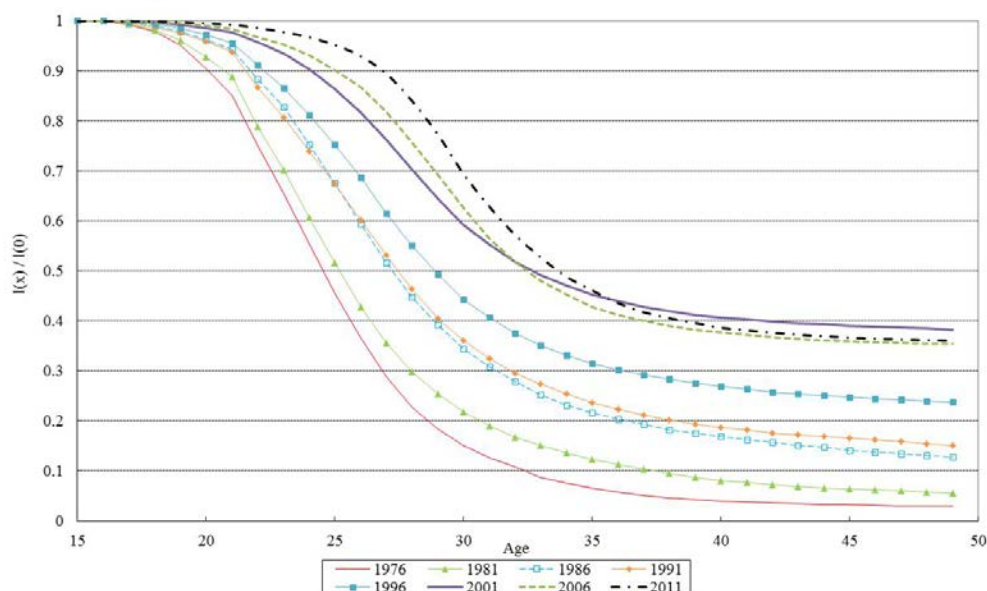

Figure 3 shows a comparison between the weights used in compiling TFR and aTFR.   The weight for TFR is the proportion of now married women at age x and the weight for aTFR is the cumulative percentage of married women up to age x from a hypothetical cohort based on the current first marriage schedule.   In general, the weight used in compiling TFR was about the same as the weight used in compiling

aTFR in 1976 and 1981. However, the two started to deviate from 1986, with the weight used in compiling TFR being consistently higher. The weight used in compiling TFR is the proportion of now married women at age x, which is based on these women's marriages in their earlier life. On the other hand, the weight used in compiling aTFR is based on the marriage rates of the current year. Hence, TFR will be slow in responding to rapid decline in marriage rates.

Figure 3   Comparison between the weights used in TFR and aTFR, 1976–2011
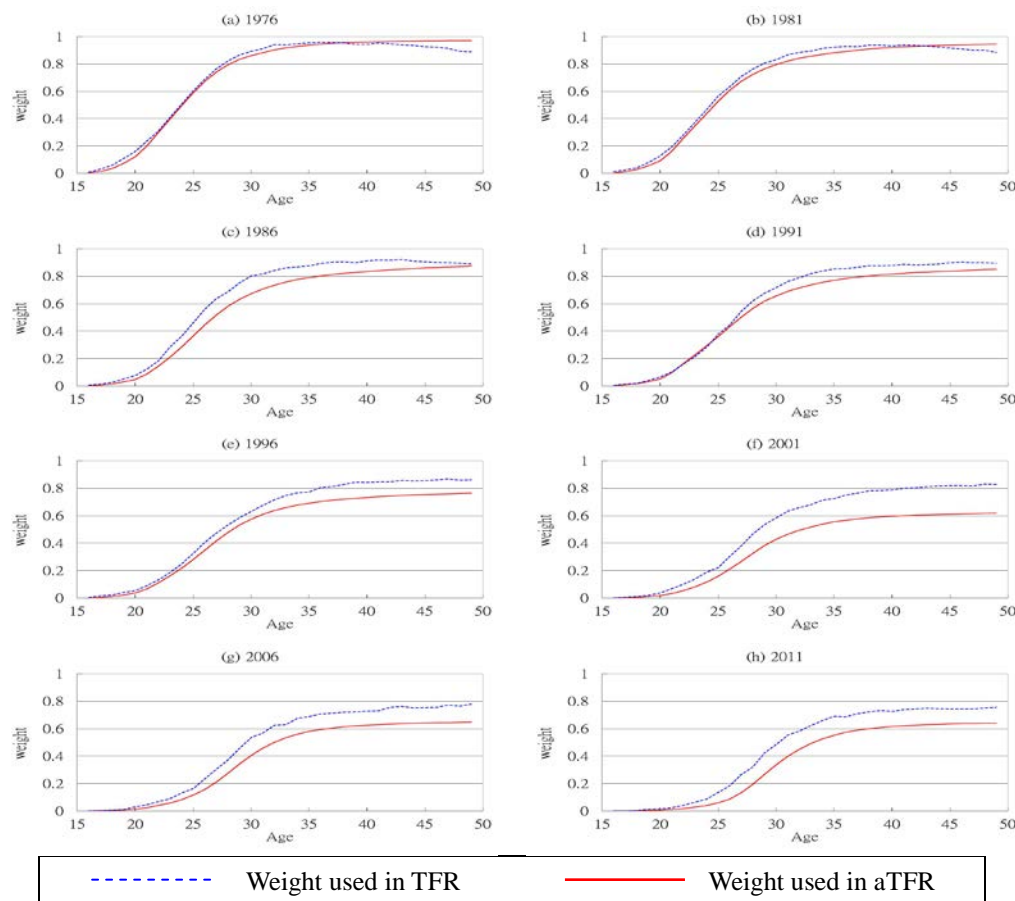
A comparison among TFR, TMFR and aTFR is shown in Table 1.

Table 1   Total Fertility Rate, Total Marital Fertility Rate and Another Total Fertility Rate, 1976–2011

Year	TFR	TMFR	aTFR
	(per 1 000 women)		
1976	2 480	4 096	2 390
1981	1 933	3 483	1 815
1986	1 367	2 820	1 126
1991	1 281	2 936	1 177
1996	1 191	2 841	974
2001	931	2 665	595
2006	984	3 231	671
2011	1 204	4 316	731

5. Discussions

Another fertility indicator called aTFR is proposed. It is built on the following definition: for a hypothetical cohort of women experiencing the age specific first marriage rates and age specific marital fertility rates of the current year, aTFR is the average number of children born to a woman throughout her childbearing age. The proposed aTFR assumes the current schedule of marriage rates whereas TFR assumes that the current age specific proportions of now married women in the population. For a hypothetical cohort, it may not be preferable to assume the current level of proportion of now married women in the population because such proportion is the outcome of the marriage rates of the past years.

TFR of Hong Kong experienced a decline from 2 480 (per 1 000 women) in 1976 to 931 in 2001 and then increased to 1 204 in 2011. TMFR decreased from 4 096 (per 1 000 women) in 1976 to 2 665 in 2001 and then increased to 4 316 in 2011. TMFR is larger than TFR because the coverage of female in the denominator for TMFR is married women only whereas for TFR is all women.

During the period between 1976 and 1981, aTFR in Hong Kong was only about 4-6% lower than TFR. This indicated that the period marriage rates during the period more or less reproduced the cohort effect seen in the proportion of now married women. The marriage postponement phenomenon was not observed. A large drop in both aTFR and TFR was observed during the period from 1986 to 1996. The marriage rates during the period dropped substantially in all age groups. The aTFR was 8-18% smaller than TFR, illustrating the effect of marriage postponement phenomenon. The widening ratio between aTFR and TFR indicated that the marriage postponement phenomenon was the dominating factor in the drop of fertility rate. This was further quantified by using the Kitagawa method (Census and Statistics Department, Hong Kong, China, 2005). During the period between 2001 and 2011, TFR increased by 29% from 931 in 2001 to 1 204 in 2011, as a result of the catch-up effect for women in the thirties. The aTFR only increased by 23% from 595 in 2001 to 731 in 2011, partly counterbalanced by the continual marriage postponement for women in their twenties. Combined, aTFR was 32-39% smaller than TFR during the period.

Though the proposed aTFR can overcome the limitations of TFR, aTFR has its own drawback too. The main assumption of aTFR is that marriage and giving births are two sequential events. While this is true for many Eastern societies, aTFR cannot be applied to Western societies such as US and France that have high proportions of births born outside wedlock. Moreover, one might argue that age specific first marriage rates are still being affected by past marriage schedule. Leftovers (those still being unmarried at high ages) are subject to lower chance of getting married. Nevertheless, the impact to aTFR is likely small because the age specific marital fertility rates for women in the late 30s and 40s are relatively small. Finally, aTFR can be further enhanced by adding the components on divorces and gestation period of women in the calculation. Having said that, by assuming constant marriage rates and marital fertility rates, aTFR is the projected TFR when all the current women of childbearing ages (aged 15-49) have exited their childbearing period some 35 years later. This provides another useful indicator in fertility projections.

References

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