Low Fertility in China: A Reassessment

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Introduction

Fertility in China has been very low over the last two decades. But there is considerable uncertainty of China's fertility level as a result of the decreasing completeness of population census and birth registration largely due to the rigid one-child policy and massive rural-urban migration. China's 2000 and 2010 census reported extremely low fertility-TFR of 1.22 and 1.18 respectively, and the annual population surveys since the late 1990s have also produced TFR of 1.1-1.4. Based on these results, many demographers claim that China has dropped into the low fertility trap since the late 1990s. But the widely established fact of varying degrees of birth and child under-reporting in censuses and surveys has also led to efforts in adjusting China's fertility level by assessing the under-reporting rate of births and children. With different adjustments of birth undercounting in census data, China's TFR around 2010 was estimated to be 1.42-1.75 (Li 2012, Yang 2013, Wang 2013, Zhai 2015). No consensus has been reached on how low China's fertility is, with enormous differences in various estimates. The purpose of this paper is to reassess China's recent fertility level using various analytical methods in census and fertility survey data. Since China has the largest population which is about 1.4 billion, China's fertility level has enormous implications for the global population trends.

Fertility Estimation Using Indirect Methods in 2000 and 2010 Censuses

Preston and Coale (1982) developed a variable-r method based on the generalized stable population model, which can offer a simple and robust estimate of the net reproduction rate (NRR). And estimation of the TFR corresponding to the NRR can be achieved by using a well-known approximation equation involving the NRR, sex ratio at birth and the probability of surviving to the mean age of the maternity function (Preston and Coale 1982). Conventional fertility estimation methods rely on birth data, while the variable-r method requires only the relative age distribution in two enumerations and the proportional birth distribution. This method assumes that pattern of age misreporting and completeness of coverage over the two censuses are largely the same. Applying to Swedish and Japanese data, the variable-r method produces results that are largely or exactly the same as those from the traditional method (Preston et al. 2001). Table 1 presents estimation of NRR in China for the 2000-2010 inter-censual period.

Table 1 Estimation of NRR for the 2000-2010 Inter-censual Period

Age Group	$v(a)$	$N(a)_{2000}$	$N(a)_{2010}$	$r(a)$	$\int_0^a r(x)dx$	$e^{\int_0^a r(x)dx}$	$v(a)e^{\int_0^a r(x)dx}$
（1）	（2）	（4）	（5）	（6）	（7）	（8）	（9）
0~4		31329680	34470044	0.0096			
5~9		41849379	32416884	-0.0255	-0.0161	0.9840	
10~14		60051894	34641185	-0.0550	-0.2175	0.8045	
15~19	0.0184	50170752	47987193	-0.0044	-0.3661	0.6934	0.0128
20~24	0.3481	46666004	63426563	0.0307	-0.3006	0.7404	0.2577
25~29	0.3600	57404984	50195097	-0.0134	-0.2574	0.7731	0.2783
30~34	0.1806	61972390	47637178	-0.0263	-0.3567	0.7000	0.1264
35~39	0.0645	53021514	57650515	0.0084	-0.4016	0.6693	0.0432
40~44	0.0192	39007731	61153229	0.0450	-0.2682	0.7647	0.0147
45~49	0.0092	41588890	51824489	0.0220	-0.1008	0.9041	0.0083
Total	1.0000						0.7414

Note: $v(a)$ is the proportional birth distribution over 2000-2010, $N(a)_{2000}$ and $N(a)_{2010}$ are census female population by age, and $r(a)$ is the age-specific rate of growth over 2000-2010.

The NRR estimated from the above table is 0.74. Using the conversion formula $TFR = (NRR(1 + SRB))/p(\bar{m})$, we arrive an estimated TFR of 1.68 (Table 2).

Table 2 Fertility Estimates for the Inter-censual Period over 2000-2010

Indexes	2000-2010
NRR	0.7414
SRB	1.1740
$p(\bar{m})$	0.9582
TFR	1.6821

In addition to the estimation of the 2000-2010 inter-censual fertility, we also use the Brass method to assess China's fertility in 2010. Brass (1968; 1983) developed an indirect estimation method, known as P/F ratio method, to correct the mis- or under-reporting occurred in period fertility using information from cohort fertility (number of children ever born). The idea is simple. The fertility level implied by the number of children ever born reported by women at younger reproductive ages is used to adjust the reported period fertility which tends to be lower biased because of either the reference time error or the case like China where intentional hiding of births exists. The important assumption underlying the method is the constant trends and patterns of fertility over the last 15-20 years. China's fertility over 1995-2010 was more or less stable under the below-replacement level. Table 3 presents the estimation results of the P/F ratio method.

Table 3 P/F Ratios Calculated from Cohort and Period Fertility from China's 2010 Census

i	Age group	$P(i)$	$f(i)$	$\phi(i)$	$F(i)$	P/F ratio
1	15-19	0.0125	0.0059	0.0296	-0.0002	
2	20-24	0.2596	0.0695	0.3770	0.1822	1.4252
3	25-29	0.8440	0.0841	0.7973	0.5975	1.4126
4	30-34	1.2928	0.0458	1.0265	0.9249	1.3978
5	35-39	1.5235	0.0187	1.1201	1.0777	1.4136
6	40-44	1.6871	0.0075	1.1576	1.1318	1.4907
7	45-49	1.8366	0.0047	1.1810	1.1739	1.5645

Note: $P(i)$ are average parity of women at ages 15-19, 20-24, …, 45-49; $f(i)$ are age-specific fertility; $\emptyset(i)$ are cumulative fertility; $F(i)$ are estimated from the equation $F(i) = \emptyset(i-1) + a(i)f(i) + b(i)f(i+1) + c(i)\emptyset(7)$, arriving fertility equivalents of $P(i)$. The coefficients a, b and c are derived from Coale-Trussell fertility models.

The P/F ratios across age groups 20-24 to 35-39 are rather constant at 1.4, implying relatively stable fertility in China over the past 15 years. The average of the four ratios stands at 1.41, suggesting an under-reporting rate of over 40% in the period fertility in China's 2010 census. Since the TFR reported from the 2010 census is 1.18, inflating it by 41% would yield a TFR of 1.66.

The above two indirect estimation methods produce almost the same result, suggesting the birth under-reporting over 2000-2010 is at a range of 20-40%.

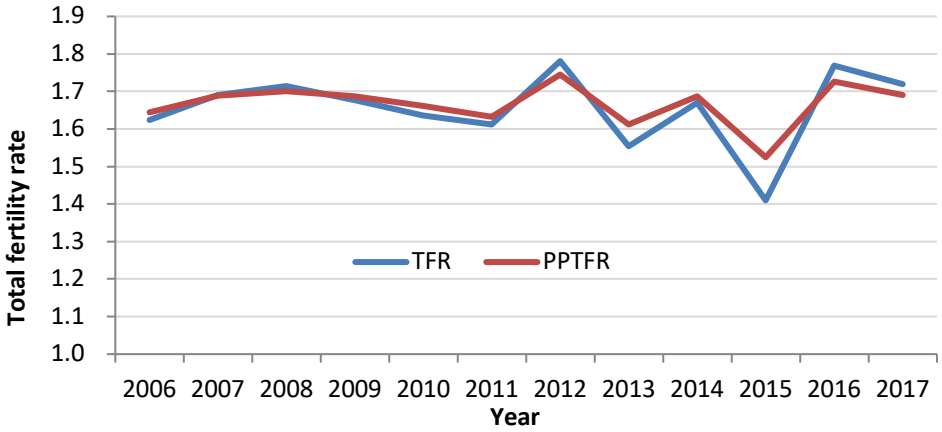
Fertility Rates Produced from the 2017 Fertility Survey

China conducted a national fertility survey in the middle of 2017 by the National Health and Family Planning Commission. The purpose of this survey is to collect information on women's fertility intention and behavior and the circumstances surrounding work-family balance in the context of the two-child policy. Quality of China's population survey data used to be affected by the one-child policy. With the transition to a two-child policy, as well as rather loose implementation of the policy, a fertility survey in this context could have improved data quality since most of the extra births which were illegal under the one-child policy are no longer need to be hidden. On the other hand, in conducting the survey, great efforts have been made by involving many experts and scholars on sampling scheme design, survey organization, data comparison, quality control and post hoc weighting, hoping to guarantee a high quality of the survey data.

This survey adopts a three-stage stratified PPS sampling method. Its sample covers China's all 31 provinces/municipalities, with a large sample size of 250,000 women aged from 15 to 60. A detailed history of pregnancy and childbearing of every woman is recoded in the survey, thus fertility rates over at least the last 10 years could be constructed.

The past decade seems to have witnessed a slightly rising trend but with large fluctuations of fertility in China, with TFR ranging from 1.41 to 1.78 (Figure 1). The average estimated TFR stood at 1.65. The TFRs obtained from this survey are largely consistent with the estimates in the previous section. Two additional observations could be made. One is that there is marked zodiac effect, the highest TFR occurred in 2012 which is a year of dragon, while the lowest TFR in 2015, a year of goat. This is typical of the pattern of zodiac preference in China. The other observation is that there is also considerable policy effect, the selective two-child policy in 2014 and the universal two-child policy in 2016 over which years TFR raised up a great deal. In fact in the last three years (2015-2017), fertility of the second births exceeded fertility of the first births.

Figure 1 Fertility Levels in China, 2006-2017



We have also produced fertility estimates based on parity progression ratio (PPTFR). Trends of PPTFR and TFR are largely similar except that PPTFRs are of less volatility. By controlling for age and parity, PPTFRs could partly eliminate tempo effect due to delayed marriage and childbearing or heaping effect either of the first births due to zodiac preference or of the second births due to the two-child policy. PPTFRs range from 1.53 to 1.75, with an average being 1.67.

The 2017 fertility survey also asked respondents the number of child ever born (CEB). The average CEB for women aged 45-59 is 1.7-1.8 which is completed fertility for this cohort. They were reaching ages of childbearing in the early 1990s when China enforced rigorously the one-child policy and fertility sharply fell to below-replacement level and stay very low since. TFRs reported from annual population surveys are lower than 1.5. Cohort fertility is also as high as 1.6-1.7 for women aged 35-44 who were entering ages of childbearing at late 1990s and early 2000s, when period fertility became even lower (1.3 or lower) from the census and annual surveys.

Highly consistent estimation results of recent fertility in China are produced in this research using different data and different methods, which could also be seen as a kind of mutual verification. With both period fertility and cohort fertility standing at over 1.6, it seems to suggest that in China most couples had two children even under the strong one-child policy over the early 1980s to the early 2010s.