Very Low Fertility in China in the 1990s: Reality or An Illusion Arising from Birth Underreporting?

Guangyu Zhang

Demography & Sociology Program, RSSS
The Australian National University
Canberra, ACT 0200, Australia
Tel: 61-2-61252376
Email: guangyu.zhang@anu.edu.au

Paper to be presented at the Very Low Fertility Session of the 2004 Annual Meeting of the Population Association of America, Boston, 1-3 April 2004.

Abstract

It was believed that all population statistics in China suffered serious underreporting of births in the 1990s. However, an extensive review has failed to find convincing evidence to support the claim of up to 20-30% concealment of births in surveys and censuses as generally believed, but rather much agreement between various sources of data over time. It appears that the official estimates are inflated and hence the generally accepted fertility estimate around 1.8 births per woman should be re-estimated downwards. Using data gathered at different points in time by different organizations, this research shows that fertility declined from around 2.0 to 1.70 in the first half of the 1990s, then further to 1.50-1.60 at the turn of this century. The available sources also show a decline in fertility preference. It is very likely that the combination of a government-enforced birth control program and rapid societal change quickly moved China into the group of very low-fertility countries earlier than that might have been anticipated, as almost all the others are developed countries.

Introduction

The path of China's fertility in the 1990s has been a matter of considerable debate. While the controversy in the early 1990s focused on whether China had reached below-replacement fertility, by the turn of the century the debate had shifted to how far below replacement the fertility level was (Feeney and Yuan 1994; Zeng 1996; Yu and Xie 2000). The annual population change survey from the State Statistical Bureau (SSB) (hereafter the SSB annual surveys) reported a continued decline of fertility with the total fertility rate (TFR) dropping dramatically from 1.98 in 1991 to 1.44 in 1999[1] (SSB 1991-2002) (Figure 1). Other sources, including retrospective surveys from the State Family Planning Commission (SFPC), the 1995 1% sample census and the 2000 census, revealed similar trends and roughly the same low level of fertility (Jiang et al. 1995; SFPC 2000; Zhang and Cui 2003). It appeared that China had already joined the very low-fertility group of countries as early as the mid-1990s, if these population statistics accurately recorded births.

However, fertility estimates in China were greatly affected by concerns about the possible underreporting of births. Underreporting is common in the population statistics of many developing countries, but the uniqueness of the Chinese case was that the strict one-child policy made numbers fraught with meaning and resulted in intentional manipulation from parties concerned of the birth control program. The tension between peasants' higher fertility preferences and the government's strict program of birth control provided both local cadres and rural couples with strong disincentives against accurately reporting reproductive behavior (Banister 1987; Smith et al. 1997). In addition, it was believed that the re-enforcement of the policy after 1991 resulted in a more serious underreporting of births, up to 25-28% in the early 1990s (Zeng 1996). Accordingly, the official birth figures, the crude birth rates (CBR) and the population totals, from the SSB annual surveys were upwardly adjusted after taking "sampling and enumeration errors" into account (Zhang, Yu, and Cui 1997). The actual adjustment factors ranged from 7% to 19%[2], much higher than the underreporting extent directly detected from the post-enumeration surveys[3], and amounting to more than 30 million births over the course of the 1990s (CPIRC Research Group 2003) (Appendix Table 1). During the intercensal period, most analyses employed fertility estimates from these adjusted results and obtained TFRs

around 1.8 from the mid-1990s onwards (Qiao 1998; Yu and Xie 2000). These estimates implied the endorsement of the SSB's estimated extent of the underreporting of births, but some authors suspected even more serious underreporting and argued that China's fertility could still be above the replacement level, e.g. TFR around 2.3 (Attane 2001; Ma 2002; Liang 2003).

When the 2000 census results were released in late 2002, the deterioration in census quality instigated much concern and speculation. According to the census post-enumeration survey, about 80% of the reported 1.81% undercount was explained by labor migrants, the "floating population" (Wu 2001). However, both the low fertility observed in the census year and the recorded low number of children aged below 10 gave rise to widespread suspicion that the younger cohorts constituted the majority of the census undercount. As official statistics, the SSB annual surveys were frequently used as a reference, and many analyses came to the conclusion that the census might have omitted more than 30 million, up to 37 million, children aged below 10 in 2000 (Wang 2003; Zhang and Cui 2003; Goodkind 2004). Consequently, a number of analyses still kept the estimate of TFR around 1.8 over the decade (CPIRC Research Group 2003; Wang 2003; Yuan et al. 2003; Zhang and Cui 2003). Given the increasing gap between the observed and adjusted fertility, these census-based estimates also implied an increasingly severe underreporting in the SSB series (Figure 1).

However, there are many reasons for doubting such a large scale underreporting of births. Even at a cursory glance, the claim that the 30-37 million younger children, about 20% of the age cohort, disappeared in the census count is too large to be true. The use of the inflated SSB annual series to evaluate the census completeness is also questionable. Several thorough analyses of the census data indicate a consistency in fertility which cannot be ignored. One analysis using the own-children method, for example, obtained an annual series of very low fertility over the decade, closely consistent with the unadjusted results of previous surveys (Guo 2004). Another analysis using the backward projection approach observed the same declining trends of fertility in a number of large minority ethnic groups, which are not sensitive to, but exempted from, the birth control program that applies to the Han majority (Attane 2003). Last, but not least, other factors affecting fertility could also prove significant. Given the rapid socio-economic development and the strengthening in the birth control program (Greenhalgh and Winckler 2001), it is possible that

China's fertility could drop as fast as shown in the unadjusted data.

Therefore, it is still too early to be confident about substantial undercount in the census and the SSB annual series. The continually observed low fertility figures over the decade may have resulted from serious under-enumeration, but it is at least equally likely that they reflect a real fertility drop. Looking backward, as argued in this paper, perhaps too much reliance has been placed on the data quality rather than upon fertility decline and its determinants. In-depth research with accurate fertility estimation certainly has both practical and theoretical importance. To achieve this end, it is important in the first place to make sure of the pattern and extent of the apparent underreporting of births.

Previous Research and Limitations on the Underreporting of Births

China's population statistics had a reputation of high quality in the early 1980s, but this pride diminished as a result of previous underreporting being shown by the 1990 census (Coale 1984; Zha, Zeng, and Guo 1996). In the early 1990s, most suspicions of under-enumeration arose from the low fertility reported by two large-scale surveys, i.e. the SFPC 1992 National Fertility Survey (hereafter the 1992 survey) and the 1995 SSB 1% sample census (Feeney and Yuan 1994; Zeng 1996). There were numerous papers and articles in the years following the 1990 census exploring the birth underreporting issue, mainly in Chinese, with many important findings: (1) most underreporting of births occurred in rural areas, as many peasants were determined to have more children, at least until they had one son; (2) consequently, those "unplanned" or "out-of-plan" births, e.g. female births, second and higher order births, were more likely to be underreported; (3) in most cases, those "missing" children in previous enumerations could be expected to show up in later ones, when they grew up to certain ages, i.e. aged 6-7, as they started to use education and other social services; and (4) accordingly, the closer to the enumeration time point, the more likely the "unplanned" births were to be unreported (Shao and Li 1993; Sun and Qing 1993; Zeng et al. 1993).

An intensive literature review has failed to find direct evidence to support the widely suspected substantial underreporting, e.g. up to 20-30%, in surveys and censuses in the 1990s[4] (Zhang 2003). For instance, some detailed examinations

suggested that the internal consistency of data was good both in the 1992 survey (SFPC 1995) and in the 1995 sample census (Scharping 2003). Recognizing the problem in data collection, both the SSB and the SFPC conducted more intensive post-enumeration surveys after the completion of each large-scale sample survey. The available results indicated that the extent of directly detected underreporting was not as serious as generally suspected, e.g. 6-7% birth underreporting in the SSB annual surveys in 1993 and 1994 (Jia and Sai 1995), and 6.47% in the 1997 SFPC survey (SFPC 2000). On the other hand, the most frequently referred to, and actually the primary evidence, came from the SFPC "special surveys" targeting the family planning statistics[5]. However, even in the late 1980s, the distortion in the family planning statistics, which was an upward self-reporting statistics by birth control cadres at the local level, was never a secret to the SFPC policy makers (People Daily 1988; Su 1989). Even so, one SFPC research found that the estimated fertility from the family planning statistics after adjusting to compensate for the astonishing number of unreported births, up to 37.5%, still did not exceed the SSB annual adjusted level (Cai and Zhang 2000).

It was further found that widespread concern about underreporting largely resulted from confusion and misunderstanding of different sources of data and the approaches to data collection employed (Zhang and Yuan 2004). There have been several population statistical systems under administrations of different government agencies since 1982[6]. While demographers utilize surveys and censuses to make demographic analyses, most under-enumeration evidence came from the registration-based statistics serving administrative purposes alone, in particular the family planning statistics. In general, births recorded in the surveys and censuses tended to be more complete than those in registration-based statistics, because the former enumerations were normally organized by the national or provincial government agencies downwards obtaining information through household interviews, while the latter statistics were self-reported by local cadres and reported up the administrative ladders. It needs to be appreciated that the extent of under-enumeration certainly differs considerably among sources of data gathered by different agencies using different approaches.

For the primary parties involved in birth statistics in rural areas, many studies suggested that both local cadres and rural couples that had "unplanned" births contributed to the statistical manipulation. However, the fact that local cadres and

those couples played different roles was often neglected. In China's birth control program, local cadres are both program performers and statistical reporters. Their superiors can use the birth figures they reported to evaluate the program performance and hence determine the reward or punishment. Naturally, statistical manipulation became a rational choice in areas where the pre-set birth control targets were hard to achieve (Smith et al. 1997). A number of empirical studies demonstrated that local cadres were quite clear about the fertility behaviors of their fellow villagers and intentionally manipulated reported birth figures when "necessary" (Xie 1990; Shao and Li 1993; Sun and Qing 1993; Chu 2001). It is important to avoid the interference from local cadres to obtain the true fertility, such as by using random checks or sample surveys rather than the self-reported family planning statistics.

The situation is different in surveys and censuses, because these investigations were carefully designed and gathered data by trained enumerators through face-to-face interviews. In this case, it was expected that most underreporting of births came from respondents directly, but local cadres could still play a part. One of the disadvantages for nationwide surveys and censuses is that the operations have to rely heavily on local cooperation. The larger the enumerations, the heavier they rely on local cadres. This was especially striking in the population census, because it mobilized 5-6 million enumerators across the country. According to some research, the approaches of manipulation from local cadres varied greatly, from coaching respondents who had "unplanned" births to prepare answers, to replacing ultimate sample units with higher than average births by units with low fertility women. (Li 1993; Tan 1998). However, it should kept in mind that making such manipulations might have a high cost, given the awareness of upper level officers of local falsification and the consequent measures targeting those responsible for the underreporting.

A useful counter-measure to reveal unreported births is to conduct post-enumeration surveys, because the much smaller sample size and single purpose enable organizers to control every aspect from drawing ultimate sampling units to sending trained statisticians to carry out intensive and in-depth household interviews. The practice of the SFPC "special surveys" in rural areas demonstrated well its effectiveness in China's context (Wang and Wang 1995; Zeng 1996). In addition, a number of field studies also suggested that peasants were actually very cooperative in answering questions (Zhang 1998; Chu 2001; Chen 2003). It appeared that the

intercensal post-enumeration survey, which targeted birth underreporting, was more effective in revealing birth concealment than censuses, which focused on the completeness of population counts and had a much bigger sample size.

Contrary to general belief, not all "unplanned" or "out-of-plan" births went unreported in every source of population statistics (Zhang and Yuan 2004). It is necessary to distinguish two concepts of birth underreporting in this research, or rather two underreporting patterns: the "consistent" underreporting and the "temporary" underreporting. The former refers to births that were concealed for some period, not appearing in previous enumerations but only in later investigations, or detected in the more intensive post-enumeration surveys (Jia and Sai 1995; Zha, Zeng, and Guo 1996; Zeng 1996). Normally, the majority of them were second or higher order births. On the other hand, "temporary" underreporting refers to those births that were enumerated in household data as family members, but were not reported by their birth mothers as "own" births in large-scale enumerations[7] (Johansson, Zhao, and Nygren 1991; Gao 1993; Tu and Liang 1994; Banister 1994). Some of these births may have been unplanned births but shortly afterward were recorded as in-migrants or adopted children, while some could be newborns of temporary female migrants. In addition, the deaths of some mothers also contributed to this phenomenon. Consequently, any proper adjustment based on original data should take these underreporting patterns into account.

In addition to the available evidence, the intensive review in this research suggests that the SSB over-inflated their surveyed fertility due to the great concern about the underreporting of births. Therefore, the unadjusted data of the SSB annual series are used in this paper to re-estimate China's fertility in the 1990s. Consistent with the above analyses supplemented by other sources, the probable extent of birth underreporting is determined. A population projection approach is applied to examine the completeness of births in the adjusted series in comparison with other available sources. Subsequently, several possible explanations of the fertility decline are also presented.

Data and Methodology

The primary data used in this research come from three differing sources: (1)

the unadjusted data of the SSB annual surveys from 1991 to 1994 and 1995 to 1999[8]; (2) data from the 1995 1% sample census and 1% long form of the 2000 census; and (3) the retrospective data from the SFPC 2001 Family Planning and Reproductive Health Survey (hereafter the 2001 survey). Also, data from three recent censuses (1982, 1990 and 2000) and one set of census-based life tables (1989-90) are utilized to adjust female age structure and to make population projections. In addition, the summary statistics from the household registration statistics and family planning statistics are referred to in order to make comparisons.

The SSB annual survey is a nationwide representative sample survey. The yearly-revolved sample size was about 1.2 million persons in the sampled households, covering approximately 330 thousand women of reproductive age (15-49). Given such a huge sample size, it was the non-sampling biases, especially the underreporting of births, rather than the sampling errors, which really worried the SSB statisticians (Hu 1994; Wu 1997) (Appendix 2). Therefore, since the early 1990s, a more intensive post-enumeration survey has been directly conducted by the SSB and provincial statistical agencies, which provided the basis for upward adjustment. Each year the adjusted key demographic figures appeared in the SSB *Statistical Communique of National Economy and Social Development*. Meanwhile, the unadjusted survey data were also released in the *China Population Statistics Yearbook*, which have been used in the analysis in this paper.

The 1995 sample census was the biggest intercensal enumeration with 12 million sampled people, 1% of the total population. The long form of the 2000 census sampled many more people, about 10% of the population. It was the first large-scale survey conducted together with a census. Given the huge sample sizes, the sampling errors did not constitute concerns for these two enumerations. Unlike the previous censuses, these two enumerations used a half-year duration of residence as the criterion to decide where the "floating population" should be enumerated. It has been suggested that such a classification could make more difficulties for the enumerators to either undercount or over-count the population (Zhang and Xu 2002).

The 2001 survey was the fifth of the SFPC nationwide surveys, following those held in 1982, 1988, 1992, 1997, respectively, which contained detailed histories of contraception and pregnancy of women of reproductive age (15-49). However, compared to the SSB annual series, its sample size was much smaller, about 0.18 million persons in sampled households, which means greater sampling variations

when examining changes at the provincial level. Using all the women of reproductive age in sample households as a new sampling frame, each province sampled women based on the proportion that women in the province made up of women in the whole country. Then at the end 39,586 women aged 15-49 in September 2001 were interviewed and formed the final dataset. A post-enumeration survey was also organized and the estimated underreporting rate was around 5% (Ding 2003).

Using these data, our analyses are applied at several stages employing a number of demographic techniques. First, a comparison of the key demographic figures is made between the SSB annual surveys and the 2001 survey to form an idea of the extent of underreporting in the various sources. Subsequently, we estimate the "possible" underreporting rates in the SSB annual series and then allocate the newly discovered additional births to different age groups of women to obtain adjusted age-specific fertility rates (ASFRs). The reverse survival method is applied to estimate the extent of "temporary" underreporting. The allocation coefficients among age groups are made by comparison with the retrospective survey. After obtaining the adjusted age-specific fertility rates, we use a population projection approach to estimate annual births and then compare births between different sources. For the analysis, a model female population age distribution is determined based on the three recent censuses and a life-table chosen to suit women aged 15-49 in each year.

Consistencies and Discrepancies between the SSB and SFPC Surveys

Due to data limitations, the comparison of key demographic figures between the SSB annual surveys and the 2001 survey can only be carried out at the national level. It is expected that the comparison would show systematic difference in patterns of birth reporting, because the two sources were gathered by two government agencies for different purposes at different time points.

Marriage for Chinese women is still universal. Presumably, the marriage data would be less sensitive to the birth control program and hence would suffer less underreporting or misreporting (Zeng 2000). It has also been demonstrated that the changing age of first marriage greatly contributed to the fertility variations in the 1970s and 1980s (Coale 1989). A comparison is made about the female mean age of first marriage (MAFM), and the mean age of first childbearing (MAFC) from the two

sources (Table 1). Both sources show an increasing trend toward of later marriage and later childbearing during the 1990s. More importantly, they agree closely with each other for both measures in each year. These figures indicate that women's reproductive behaviour in the 1990s was similar to the situation in the 1970s, and in contrast to the marriage heaping and birth bunching in the 1980s (Coale et al. 1991; Gu 1996).

Then the ASFRs from the two sources are compared, limited to women aged up to 35 because the 2001 survey only interviewed women aged 15-49 in 2001 (Table 2). As shown in the table, the SSB series generally reported slightly higher fertility rates than the 2001 survey, except in the years of the 1995 sample census and the 2000 census. A close agreement in the trends of fertility decline was evident. When looking further into the fertility rate of each age group, it was found that in two younger age groups, 15-19 and 20-24, mainly in the former age group, the retrospective survey reported more births than the "current status" survey. In the Chinese context, the legal age for marriage is 20 for women and all marriages and births before this age are considered as violation of the timing restriction imposed by the birth control program, though this is regarded as much less serious than exceeding the parity restriction. It makes sense that those women with early childbearing unreported or misreported their births or their ages in the annual survey, but reported them retrospectively when the issue had become less sensitive in later years. Curiously, the 2001 survey recorded fewer births than the annual series in the two older age groups, 25-29 and 30-34. There are two possible but opposite explanations: first, the retrospective survey failed to reveal some hidden births, which were normally higher-order births and were born to women in their late twenties or early thirties; or second, the annual series recorded some births with misreported birth orders, e.g. second or even higher order births reported as first-order births in the surveys, which actually were born several years ago. This shall be illustrated in the comparison of order-specific fertility rates.

This research further compares the fertility rate of first-order births from the two sources. In the retrospective survey, the declining trend of first order fertility rates is obvious, consistent with the increasing trend of the mean age of first marriage and of first childbearing. However, in the SSB surveys from 1996 to 1999, the TFR of first order births exceeded 1 (Attane 2001). This certainly contradicts the trend toward older ages of first marriage reported in the same source. It could be misreporting of ages at childbearing from those women with early childbearing, but this would further

inflate the mean age of first marriage and first birth. However, given the close agreement in these two measures, this possibility seems low. In addition, as the ASFRs at 15-19 is very much lower than at 20-24, the misreporting of a 15-19 year old as being 20-24 might not affect the fertility rate very much. An alternative explanation is that some women misreported their higher order births as first-order births, concealing their previous births. As the annual survey interviewed different women aged 15-49 each year, while the retrospective survey only interviewed one group of women aged 15-49 in 2001, it is possible that this kind of misreporting is would not occur in the retrospective survey.

The figures of the sex ratio at birth observed from two sources are also examined, which both reported an abnormal sex ratio at birth in each year. While the SSB annual surveys reported an abnormal but roughly stable sex ratio at birth, around 117 over the decade, the SFPC survey reported an abnormal but more fluctuating sex ratio at birth from year to year (SSB 1991-2002). In any case, the retrospective source reported more skewed figures. This may signal underreporting of female births. However, it could also be the outcome of the smaller sample size in the 2001 survey, which appeared more obvious in the urban population due to a much smaller sample size (not shown here). On the other hand, our calculations indicated in both sources the "missing" female births as, at the most, constituting 4-7% underreporting of births on the assumption of normal sex ratio at birth of 107. However, as many field studies suggested the practice of sex-selective abortions, this estimated extent proves to be an over-estimate (Chu 2001; Chen 2003).

In general, there were many consistencies between the annual surveys and the retrospective survey. But the systematic discrepancies were also evident, as these surveys were subject to different patterns of underreporting or misreporting, which provide useful clues when re-adjusting fertility rates. Because the SSB sources were the only annual series available and suffered a lesser underreporting compared to other sources, the fertility readjustment in this research will be based on the SSB unadjusted annual series.

Determining the Underreporting Extent in the SSB Annual Surveys

The data examination suggested that both the "consistent" and "temporary"

underreporting of births existed in our selected sources of data, though the latter mainly in the sample census and census. Once we can identify these rates and determine the extent of birth underreporting in each survey, we can proceed to re-estimate ASFRs and annual births.

It is suggested that a portion of "unplanned" births are hard to detect, concealment mostly from female respondents in surveys and censuses, in "current status" enumerations. These once "missing" births would appear in later years or could be detected by an intensive small-scale investigation. The three recent censuses did reveal the existence of many "unplanned" children in the preceding census, but the extent of such underreporting was not great. For example, the 1990 census suggested that the 1982 census underreported 5% of children aged 0-2 in 1982, which was confirmed again by the 2000 census. Meanwhile, the 2000 census indicated that the 1990 census undercounted 5% of children aged 0-7 in 1990, a finding which needs further confirmation by the future 2010 census (Zha, Zeng, and Guo 1996; Zhang and Cui 2003). During the 1990s, the SSB conducted a number of post-enumeration surveys shortly after each annual survey. According to their released results, the revealed underreporting rates were 6.9% in 1993 and 6.4% in 1994 respectively (Jia and Sai 1995). The outcomes in other years were not released, but the comparison between the released and the unadjusted CBR indicates that underreporting rates in surveys are roughly the same, or a bit higher, but no more than 10% (see note 3). Therefore, we assume that the "consistent" underreporting rates in the year of 1991 and 1992 were the same as that in 1993, while those in the years between 1995 and 2000 were the same as that in 1994.

The "temporary" underreporting of births tended to appear in the sample census and census. In both the 1990 and 2000 censuses and the 1995 sample census a common pattern of birth reporting was that the summation of survivals aged zero and reported infant deaths exceeded the number of "own" births reported by parents. More importantly, this pattern became even more striking in later enumerations, especially the 2000 census. The extent of "temporary" underreporting of births can be estimated through a comparison of reported births with expected births, obtained using a reverse survival method[9]. As shown in Table 3, this kind of birth underreporting increased from 3.03% in 1990 to 6.27% in 1995 and further to 11.6% in 2000. Given the roughly stable mortality of women of reproductive ages, this could indicate that more "unplanned" births went reported as in-migrants or adopted children, but the

alternative explanation cannot be ignored, namely that of increasing population mobility. In the census and sample census, the criterion of a half-year duration to distinguish where temporary migrants should be enumerated could result in the separate registrations of mothers and their children. It is quite likely that some young mothers had temporarily migrated to other places at the time of the census enumeration, given the huge number of temporary migrants in the late 1990s.

However, this pattern seemed very weak in the annual survey. The extent of "temporary" underreporting of births calculated using the same method was around 2-3‰ during the whole period, which was roughly equal to the yearly death rate of women of reproductive ages. It seems that population mobility had less impact on birth reporting in the annual surveys, perhaps because the survey was seldom bothered by the over-count or undercount problem as in the census. However, it is curious why no births were reported as in-migrants or adopted children. One possible explanation is that those births went "consistently" underreported in the sample survey, as parents may think it would be better to conceal them. On the other hand, everyone is expected to be enumerated in the census or sample census, and many births and younger children were probably reported but were placed in the category of non-own-births under such circumstances. Given the trough of fertility reported in the 1995 sample census and 2000 census compared to fertility rates in other years in the annual series, this explanation seems to be meaningful.

In addition to the "consistent" and "temporary" underreporting, we also consider the underreporting due to the underreporting of infant deaths. It was found that in some Asian countries, including China, newborns who died immediately after birth easily went unreported both in births and infant deaths (Coale and Banister 1994). In this case, the underreporting of infant deaths also meant the underreporting of births. In the absence of other strong evidence, we chose as the reference the surveillance data of infant deaths from the Ministry of Health, which was developed with help from the United Nations's Children's Fund (UNICEF) in the early 1990s (Ministry of Health 2000). It appears that the observed infant death rates in the SSB annual series are slightly lower, with a difference ranging from 1‰ in 1994 to 5‰ in 2000, which is our estimated extent of underreporting of births due to infant deaths. Consequently, we can obtain the estimated extent of underreporting of births in each year (Table 4). It is very likely that the actual underreporting rates could be higher, but our assumption seems to be a reasonable choice based on the available evidence and

data.

Readjustment of Fertility and Annual Births

Unlike many other efforts to adjust the TFR directly using obtained underreporting rates, we first estimate the concealed births and then allocate them to different age groups of women aged 15-49 to obtain the yearly ASFRs. The allocation coefficients of newly discovered additional births were decided with reference to the age distribution of fertility in the 2001 retrospective surveys.

As discussed in the previous section, the SSB series of ASFRs were lower in the two younger age groups, 15-19 and 20-24, while being higher in the two older age groups, 25-29 and 30-34 than those in the retrospective survey. It is suspected that early births in younger age groups could be intentionally concealed in the survey of current status in contrast with the situation in the retrospective survey, while higher order births in older age groups were difficult to detect both in the SSB and SFPC surveys. Because most Chinese women have births shortly after marriage and complete their childbearing career before their early thirties (Yu and Xie 2000), it is reasonable to suggest that most women have the first births in their early 20s and have the second or higher order births, if they have them at all, in their late 20s and early 30s. Obviously, these were "unplanned" or "out-of-plan" births, being second or higher order births, which violated the birth control program, and hence were more likely to go unreported. Consequently, we allocated the concealed births estimated from the underreporting extent as the following coefficients: 20%, 30%, 40% and 10% in the age groups of 15-19, 20-24, 25-29 and 30-34, respectively[10]. Then we obtained the readjusted ASFRs in the 1990s (Table 5). This adjustment clearly shows the continued declining trend of fertility and indicates that the TFRs in the late 1990s were very low.

This research proceeds to estimate the annual births based on our adjusted annual series of ASFRs. Since the variation of female age structure in each survey will affect estimates of birth numbers, we adjust the female age structure based on the three recent censuses. We believe that the lesser population mobility in the censuses in 1982 and 1990 means their age structure are more reliable than that of the 2000 census. Therefore, it is our decision to adjust the female population aged 5-48 in 1990 based on the 1982 and 1990 censuses, with reference to the 2000 census[11]. Then we

choose the 1989-1990 life table derived from the 1990 census to project women aged 15-49 in each year (Appendix Table 4). Subsequently, we multiply the number of women at each age group with adjusted ASFRs to obtain the annual births.

As can be seen in Table 6, the adjusted birth figures are a little lower than the SSB adjusted series, but the estimated TFRs are much lower than those estimated from the SSB annual surveys. As a matter of fact, we do not need to upwardly adjust ASFRs on a large scale after taking many other factors into account, including the "temporary" underreporting, deaths of mothers, infant deaths and female age distribution, etc. It is evident that the SSB annual surveys may have underreported births to some extent, but they also had problems in estimating the population totals. This was particularly true in estimating births during the period from 1996 to 1999, because the adjusted female age structure based on censuses resulted in 4-6% additional births.

On the other hand, using our adjustments as a reference, the 2000 census may still have undercounted 27 million younger children aged below 10 in 2000. There is no dispute of the undercount in the census, but still there is a possibility of over-count in the SSB annual surveys. As a matter of fact, one SFPC research using the SSB unadjusted data indicated that the SSB surveys may over-count some births, e.g. enumerators' mistakenly registering children aged 1 as newborns, due to strong pressures from the above administrations to discover unreported children (Su 1996). On the other hand, our adjustments indicated there are causes other than the birth underreporting resulting in the loss of births in surveys and censuses. Considering the differe3nt approaches of data collections and different environments under which the surveys and census were conducted, it is suggested that a broader perspective is needed to re-consider the causes for the serious undercount of younger cohorts in the 2000 census.

Changing Fertility Preference and Reproductive Behaviours

During the past two decades, a number of domestic and foreign social studies documented in detail the declining fertility preference from "being content with one of each sex" in the 1980s to "two is best, one son is essential" in the 1990s (Greenhalgh and Winckler 2001). According to the 1985-1987 In-Depth Chinese

Fertility Survey, respondents interviewed in seven provinces, including Liaoning, Hebei, Shandong, Guangdong, Guizhou, Shannxi and Gansu, clearly reported their preference for at least 2, but at most to 3.6 children per family, though just 2 in Beijing and 1.8 in Shanghai (International Statistical Institute 1991). Fifteen years later, the SFPC 2001 survey observed that the ideal family size at the national level declined to 1.78 on average (urbanites 1.55 vs. peasants 1.88), and the decline in those provinces of the In-Depth Fertility Survey was also evident. Certainly, the wording of the questions was very important. An independent survey on fertility preference in 2002, in a careful manner similar to the In-Depth Fertility Survey, revealed that even on the assumption "without the current birth control program", the average fertility preference was 2.04 at the national level, in contrast to the figure of 1.78 under the condition "with the current birth control program" (Chen and Zhang 2003). The educated urbanites seemed to be happy with one child without gender preference, while peasants still preferred two children, and, if only one, a son preference was obvious. The rising sex ratio at birth in surveys and censuses and research on sex-selective abortion also provides evidence (SSB 1993, 1997, 2002; Chu 2001). The analysis of the 2001 survey data found an apparent inter-cohort shift in fertility preference: the younger the age cohorts, the fewer children they would prefer. Even for rural women, each 5-year younger age group recorded on average 0.1 fewer children in preferred family size. For the country as a whole, women aged below 30 in 2001, who actually experienced their peak reproductive period in the late 1990s, clearly showed the adoption of a small family size norm, the majority favoring only one child.

The examination of the SSB annual surveys and the SFPC retrospective surveys all confirmed the changes in women's reproductive behavior. As aforementioned, the 1990s witnessed the postponement in women's ages at first marriage and at first childbearing. The birth spacing between the first two parities increased from 1.7 years in 1991 to 3.5 years in 1999. The parity progression ratio from parity 1 to parity 2 declined and as did at higher parities. A number of studies demonstrated the "tempo" effects on the TFR measurement and the seemingly very low fertility figures (Feeney and Yuan 1994; Guo 2000; Ding 2003). In addition, due to the ageing of women at reproductive ages, the proportion of prime reproductive age women decreased from 7.8% of the population in 1991 to 5.9% in 2000, and this would also have contributed to decline of births in the whole society.

Discussion

The adjustments in this research illustrate that China's fertility declined dramatically during the 1990s and had reached a very low level at the end of the century. Given the fertility fluctuation above the replacement level over the course of the 1980s, this was certainly a surprise (Coale and Chen 1987; Gu 1996; SSB 1991) (Figure 1). As late as 1989 the TFR was still 2.35 as recorded by the 1990 census, an important question is: what factors contributed to such a remarkable fertility decline?

As it is the world's most systematically organized birth control program, the role played by the Chinese government has been extremely important. In contrast to the dramatic fertility decline in the 1970s, the implementation of the one-child policy in the 1980s still failed to reduce fertility to the low level that the government expected. The urban program was considered successful, but not so for the rural areas. It was concluded that the weakened state control over peasants in rural areas due to the de-collectivization reform in the early 1980s on the one hand, and the peasants' higher fertility preference for a large family size on the other, resulted in fluctuations of fertility during the 1980s (White 1991; Greenhalgh 1993, 1994). Nonetheless, in the following decade, the official control program was greatly strengthened, while peasants' fertility preferences also experienced important changes (Feng and Zhang 2002).

The 1990 census enabled the Chinese government to fully realize the problems being encountered in the birth control program, and hence began to take a series of measures for policy re-enforcement. The priority of the program was set in rural areas, in particular those populous agricultural provinces in middle China (Peng 1993). An important decision was issued in June 1991 to strengthen the birth control program, of which the most important content required that all sub-national political leaders at each administrative level assumed personal responsibility in the birth control program in the areas under their jurisdiction (CPC Central Committee and State Council 1991). The central government further required that government at each administrative level must greatly increase and ensure the funding of the birth control program, no matter how difficult the local financial position was. As a result, the program had been greatly improved in every aspect since the early 1990s, ranging

from funding, personnel and contraceptive facilities, to technical training and services, etc. (Kaufman et al. 1992; Thomas and Price 1996; Winckler 2002).

The program tightening exhibited its effectiveness in contraception and fertility change. The cases of birth control operations, including abortion, IUD insertion and sterilization, etc. soared in the early 1990s (Appendix Table 2 & 3). The contraception prevalence rate (CPR) of currently married women increased from 83.4% during the period of 1988-1992 to 85.3% in 1992-1996, and further to 86.9% in 1997-2000[12] (SFPC 2000). In the late 1980s many rural couples, though being entitled to have more than one birth, managed to have their births as soon as possible for fear of further policy change. This resulted in birth bunching in the late 1980s but a birth nadir in the early 1990s (Sun and Hu 1993; Gu 1996). And the year of 1991 happened to become the turning point for another round of fertility reductions. With hindsight, the measures taken by the Chinese government were really steadfast and powerful, and actually set the upper limit for almost all rural couples to have two children at the most, except for people in the minority ethnic groups.

In addition, China experienced an accelerated socio-economic development with the increase of per capita GNP at an average yearly rate of 7-8% over the course of the 1990s. The urban proportion rose from 20.6% in 1982 to 26.23% in 1990, and further to 36.1% in 2000. Meanwhile, the illiteracy rate of people aged above 15 dropped from 22.81% in 1982 to 15.88% in 1990 and further to 6.72% in 2000 (SSB 2002). The regional disparities in socio-economic development were still obvious in the 1990s, but the country as a whole had gained real progress. For example, although the eastern coastal provinces benefited more from the rapid development, the level of per capita GNP for middle China in 2000 exceeded the level of eastern areas in 1990. It was found that the developed areas had below-replacement fertility for a decade as observed in the 1982 and 1990 census, respectively (Poston and Gu 1987; Tu 2000). In addition to the economic development, the Chinese government put great effort into reducing fertility in the populous agricultural provinces of middle China in the 1990s. While most of the developed eastern provinces experienced a far below replacement fertility, there seem to be few reasons to doubt that most of those middle provinces could achieved a below-replacement fertility during the 1990s.

Certainly, development did not bring prosperity and wealth for everyone, especially in rural areas. Although rural reform increased peasant income initially in the early 1980s, the rapid development and increasing urban-rural disparity soon

ended such a honeymoon, producing a much lesser favourable position for peasants. For example, although peasant income increased 12 times from 1980 to 2000, the household income ratio between urbanites and peasants, after first declining from 2.5 in 1980 to 1.83 in 1984, then reversed increasing to 2.2 in 1990 and further to 2.8 in 2000 (SSB 1991-2002). As a result, the growing rural-urban disparity and the declining agricultural income brought about huge rural-urban migration, from 6 million in 1982 to 70 million in 1990 and further to 140 million in 2000 (Li 1986; SSB 1993, 2002). For the first time, huge number of young and middle-aged peasants left their traditional villages but witnessed a double contrast of life: they lived a better life than they previously had, but, at the same time, had a worse life than their urban counterparts. What such a development had brought to peasants, in particular rising expectation and aspiration, deserves further research.

In the 1990s, many rural socio-economic policies, in addition to the birth control program, greatly helped to alter peasants' higher fertility demands. For example, since the late 1980s, the Chinese government has gradually changed the rural land allocation system, which stipulates that the portion of land allocated is fixed with family members at the original allocation time, and can no longer be changed even if families have new members. This means that an addition of a family member no longer brings more benefits (Shao 2000). Meanwhile, the application of the Compulsory Education Law since 1986 and the increasingly rising educational costs also reversed higher fertility demands (Cai and Du 2001). More importantly, it is hard to deny the impact on peasant fertility preference from the decade-long strongly enforced family planning program. In particular, the younger cohorts who entered into childbearing ages in the 1990s actually grew up in an environment of a fairly strong birth control campaign in the 1980s and most had internalised the concepts of birth control and a small family size.

The low level of development, educational achievement and household income was often used as an excuse to reject the possibility of low fertility, let alone the "surprisingly" very low fertility. However, the accelerated tempo of China's development over the past two decades was second to none. For many developed countries or regions at the early developing stage, such as Japan and Taiwan, the fertility decline was well advanced before the actual economic take-off (Freedman 1979; Caldwell 2002). From an historic perspective, the Chinese people displayed the characteristics of craving upward mobility and the ability of adaptation to changing

environments (Whyte and Gu 1987; Greenhalgh 1988). If the goals of life are too remote or too difficult to be achieved, no one would be bothered even to imagine it. But during the 1990s, for the first time both urbanites and peasants witnessed a different lifestyle as a result of the rapid development, which can be achieved but need more strenuous efforts. This could generate real difference in people's attitudes, ideas and aspirations. It is necessary to reiterate what Freedman (1979: 4) described 25 years ago: "it is crucial that increasing numbers of people have become aware of alternatives to their traditional lifestyles and aspire to something different, even though these aspirations often are poorly defined ".

Therefore, when young urbanites are eager to enjoy a middle class life, e.g. owing a car, buying a big house, or going overseas, etc., it will not be a big surprise that the three municipalities of Beijing, Tianjin and Shanghai experienced a further fertility decline, as low as an observed TFR of 0.7–0.9 in the 2000 census (SSB 2002). Indeed, one research found that the reproductive behaviour for young urbanites, especially in big cities, had exhibited the characteristics of their counterparts in developed countries, e.g. pre-marriage cohabitation, later marriage or no marriage, choosing no children when younger, etc. (Jiang 2002). By the same token, the young peasants who migrated to cities and witnessed the urban prosperity, also desire the lifestyle their urban counterparts have already had. It is expected that this expectation and aspiration could dampen the strong demands of young peasants for having more than two children, or at least one son, perhaps just one child. The combined effects between the development and the enforced birth control program greatly quickened the pace of transformation in fertility preference and behaviour.

Therefore, we have obtained a rather complicated picture, while the powerful birth control program prevented urbanites from having more than one births and peasants from having more than two, a number of young urbanites and peasants began to have fewer children than being allowed, or postponed to have children in response to the changing environment. The real decline in marital fertility and "tempo" effects jointly brought the fertility down as observed in surveys and censuses.

Concluding Remarks

It was widely suspected that births in all population statistics suffered serious

underreporting in the 1990s. Accordingly, the birth figures in official statistics were intentionally inflated, which were further used as a reference to demonstrate the substantial undercount in the 2000 census. However, an intensive review has failed to find convincing evidence of the claimed substantial underreporting, up to 20-30% concealment of births, but rather agreement among different sources of data over time. The widespread concerns of the underreporting of births, in the absence of robust evidence, did not necessarily justify the SSB over-inflation of the surveyed figures. More importantly, this over-concern distracted the attention of demographers to other potential causes leading to the under-enumeration in surveys and censuses.

Consequently, the most accepted estimate of TFR around 1.8 births per woman, employing on the officially adjusted results, needs to be re-adjusted downwards. It was revealed that not all "unplanned" births went unreported in surveys and censuses. Using the data of the unadjusted SSB annual series and the SFPC 2001 survey, this research has managed to determine the extent of birth underreporting and, further, to construct an estimate of annual fertility series. The results clearly show a continued fertility decline with a very low fertility in the late 1990s. The readjustments illustrate that low birth figures in the SSB annual series did not necessarily result from the underreporting of births alone. It was also suggested that the undercount in the 2000 census could arise from such processes as the rapidly increasing population mobility and the census-taking approach.

The birth control program after 1991 has been greatly strengthened since 1991. Unlike the situations in the 1970s and 1980s, China enjoyed a rapid socio-economic development, which was beneficial to transforming people's fertility preference and behavior in addition to the enforced birth control program. This research illustrate that the total fertility in China first declined from around 2.0 to 1.70 during the first half the 1990s, then further dropped to 1.50-1.60 at the turn of the century. Without any doubt, the combined effects of a government enforced program with rapid societal changes quickly moved China into the group of very low fertility countries earlier than that might have been anticipated, as almost all the rest being developed.

Notes:

This paper has greatly benefited from the comments of Prof Jack Caldwell, Prof Peter McDonald, Dr Zhongwei Zhao, Dr Heather Booth and Prof Terry Hull. Earlier discussions with Prof Susan

Greenhalgh, Prof John Hobcraft, Dr Daniel Goodkind, Prof Yuan Xin and Prof Zhu Yu have also been appreciated. Many thanks to Julian Robert's helpful polishing. The author, of course, takes full responsibility for the final draft.

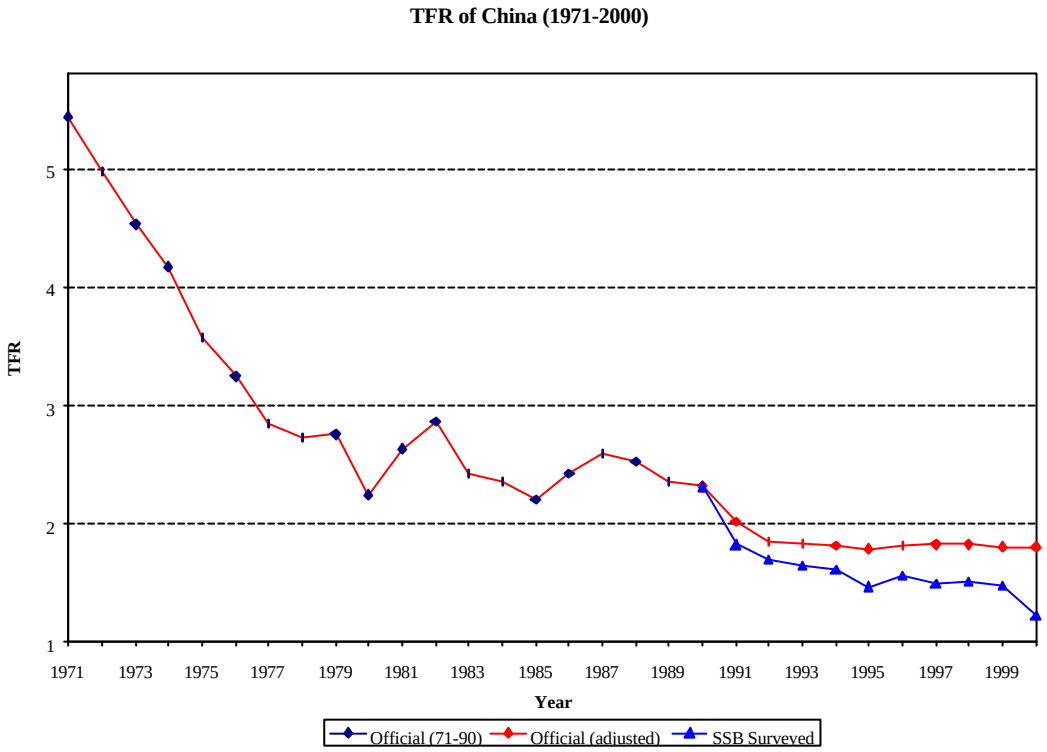
1. The SSB once published official figures of the annual TFR based on their annual population change survey, census or sample census, but, during the 1990s, it provided only age-specific fertility rates (ASFR) from unadjusted survey data without any comment. In some years, e.g. from 1991 to 1993, no ASFRs were formally released, the figures appearing in this paper being derived from a paper of the SSB statisticians (Sun and Hu 1993).
2. The adjustment factors are my own calculations based on the ratios of the weighted average of CBRs from the unadjusted SSB figures and their publicly released adjusted figures (see Appendix Table 1). The unadjusted SSB figures are from an internal report (CPIRC Research Group 2003).
3. In one paper from the SSB statisticians (Jia and Sai 1995), they reported that the post-enumeration survey revealed 6.9% underreporting in 1993, equal to 1.12‰ error in CBR, and 6.4% in 1994, about 0.98‰ missing births in CBR, but they made a 2.51‰ upward adjustment in 1993 and 2.38‰ in 1994 respectively, amounting to 5.83 million births in these two years. But in this paper they managed to defend themselves for having done enough in upward adjustment, as many still suspected the SSB adjustment could undercount births.
4. In another papers, the author and his colleague carefully examined the operations, inherited problems, outside constraints and the underreporting of births in particular in each population statistics. It appeared that each source of data had its own problem in completeness of births, though all of them had been affected by the birth control program. The data comparison suggested that the SSB annual surveys had comparatively complete birth records than any other sources (Zhang 2003; Zhang and Yuan 2004).
5. Recognizing the substantial birth underreporting in the family planning statistics, on average 32.5% from 1982 to 1990, as revealed in the 1990 census, the SFPC decided to directly organize small sample surveys through household interviews in rural villages, unknown to provincial officials and local cadres, in two provinces each year from 1993 to 1999 (SFPC 1993-2000). Such unnoticed random checks discovered about 35% underreporting of births in the family planning statistics in some populous agricultural provinces in middle China, but no more than 5% in developed areas in eastern coastal provinces. It was demonstrated that rural couples were cooperative while most underreporting came from the manipulation of local cadres (Wang and Wang 1995).
6. After the 1982 census, China upgraded one and established two additional population statistical systems under different administrations: (1) the *hukou* statistics based on the household registration (*hukou*) system, administered by the Ministry of Public Security (MPS); (2) the SFPC family planning statistics hailing from local routine registration, and the quinquennial retrospective survey; and (3) the SSB annual sample survey for population change, decennial population census and the sample census taken at the midpoint of the

intercensal period.

7. In the questionnaires of the surveys and censuses, there are questions about family composition, which recorded every family member, while the question on births was answered only by women of reproductive ages. The difference between younger children in the household and reported "own births" by parents had been found since the SFPC 1988 2‰ National Fertility and Contraception Survey until the recent 2000 census.
8. In the year of sample census in 1995 and census in 2000, no results of the annual survey were released.
9. The method of reverse survival used was taken from Zeng and his colleagues research about the causes for abnormal sex ratio at birth (Zeng et al. 1993). This approach just adds the enumerated children aged 0 in the household data with the reported infant deaths to obtain an expected number of births. Then the minimum extent of birth underreporting can be obtained through the comparison between the reported "own" births by parents and the expected births.
10. Due to the different patterns of ASFRs in the 1995 sample census and the 2000 census, we use different allocation coefficients. The adjustment coefficients of 30% were evenly distributed among the age groups 20-34 while 10% was employed for age group 15-19 in 1995. Meanwhile, the coefficients allocated in the 2000 census long form were 10%, 50%, 40% and 10% in the four age groups, respectively.
11. We take several steps to construct the female population aged 5-48 in 1990. As the younger cohorts aged 5-9 in the 1990 census were very likely to be underreported with an apparent intercensal survival ratio of 1.0462, and women aged 15-19 in 2000 had already joined labour migration with a possibility of being over-counted, we make a compromise and use 0.023 as the coefficient to estimate women aged 5-9 in 1990. By the same token, we employ the 1990 census to decide the number of women aged 10-18 in 1990, as these women aged 2-10 in 1982 were very likely to be underreported. For women in other age groups, we primarily rely on the 1982 and 1990 census.
12. According to the SFPC 1992, 1997 and 2001 survey, the rest 13-17% of currently married women who were not using contraceptives included those being pregnant or waiting for pregnancy, being ill, and having no sex life, etc. And the actual proportion of women not practicing contraception, with the reasons of fear of side effects, quality of sex life, unavailability and lack of knowledge, etc., were 2.97% in 1992, 2.73% in 1997 and 2.25% in 2001, respectively.

    According to the 1997 DRHS survey, though only 8.3% women practiced contraception before the first childbearing, 56.5% women used contraceptive after the first childbearing, while 34.1% after the second childbirth. For women practicing contraceptives after the first births, 59% of women used IUDs, and 33.3% were sterilized, including vasectomy of their husbands. For those using contraceptives after having the second child, 81.5% women were sterilized while 16.3% chose the IUDs.

Figures and Tables:



Source: the TFR series from 1971 to 1982 from Coale and Chen, from 1983 to 1990 from Yao and Yin, the official series from 1991 to 2000 from the SFPC, the unadjusted series from the *China Population Statistics Yearbook* (Coale and Chen 1987; Yao and Yin 1994; SSB 1991-2002).

Table 1: Female Mean Age for First Marriage and First Childbearing (1990-2000)

Year	SSB MAFM	SFPC MAFM	SSB MAFC	SFPC MAFC
1990	22.05	22.35	23.28	23.76
1991	22.21	22.52	23.42	23.65
1992	22.47	22.94	23.58	24.02
1993	22.67	22.87	23.70	24.27
1994	22.73	23.09	23.87	24.17
1995	22.93	23.33	24.04	24.44
1996	23.20	23.55	24.24	24.67
1997	23.39	23.58	24.48	25.00
1998	23.57	23.54	n.a.	25.00
1999	23.67	23.71	n.a.	25.07
2000	23.80	23.53	n.a.	25.13

Source: 1. the SSB series from the *China Population Statistics Yearbook*, 2002.
2. the SFPC series own calculation based on the 2001 SFPC survey dataset.

Table 2: Comparison of Truncated Age-Specific Fertility Rates between the SSB Annual Surveys and the 2001 Survey (1991-2000)

Year	Source	Age group				Total
		15-19	20-24	25-29	30-35	
1991	SSB 1991	**0.0089**	**0.1712**	**0.1236**	**0.0414**	**1.73**
	SFPC 2001	0.0248	0.1800	0.1018	0.0360	1.71
1992	SSB 1992	**0.0074**	**0.1600**	**0.1114**	**0.0406**	**1.60**
	SFPC 2001	0.0184	0.1592	0.0962	0.0346	1.54
1993	SSB 1993	**0.0077**	**0.1525**	**0.1166**	**0.0370**	**1.57**
	SFPC 2001	0.0178	0.1554	0.0924	0.0226	1.44
1994	SSB 1994	**0.0045**	**0.1389**	**0.1238**	**0.0405**	**1.54**
	SFPC 2001	0.0148	0.1430	0.0904	0.0258	1.37
1995	SSB 1995	**0.0109**	**0.1541**	**0.0918**	**0.0265**	**1.42**
	SFPC 2001	0.0138	0.1498	0.0916	0.0280	1.42
1996	SSB 1996	**0.0073**	**0.1515**	**0.1095**	**0.0314**	**1.50**
	SFPC 2001	0.0120	0.1418	0.0862	0.0254	1.33
1997	SSB 1997	**0.0027**	**0.1293**	**0.1218**	**0.0349**	**1.44**
	SFPC 2001	0.0080	0.1260	0.0826	0.0266	1.22
1998	SSB 1998	**0.0026**	**0.1267**	**0.1193**	**0.0376**	**1.43**
	SFPC 2001	0.0096	0.1394	0.0882	0.0262	1.32
1999	SSB 1999	**0.0026**	**0.1220**	**0.1188**	**0.0400**	**1.42**
	SFPC 2001	0.0084	0.1312	0.0850	0.0282	1.26
2000	SSB 2000	**0.0060**	**0.1145**	**0.0870**	**0.0286**	**1.18**
	SFPC 2001	0.0080	0.1470	0.0994	0.0296	1.42

Source: 1. the SSB series calculated based on unadjusted data from the *China Population Statistics Yearbook* 1995-2001, 1995 and 2000 data from the sample census and census, respectively.

2. the SFPC 2001 series own calculations based on the 2001 survey dataset.

Table 3. "Temporary" Underreporting Rates in Censuses and Sample Census

	Reported births	Enumerated children aged 0	Infant deaths	Expected births	Underreporting rates
	(1)	(2)	(3)[4]	(4)=(2)+(3)	(5)=((4)-(1))/(4)
1990 census (1% sample)[1]	248, 120	250, 343	5, 531	255, 874	0.0303
1995 sample census[2]	166, 772	172, 308	5, 628	177, 936	0.0627
2000 census (long form)[3]	1, 181, 952	1, 304, 731	32, 308	1, 337, 039	0.1160

Source: 1. taken from Gao Lin, 1993, *Population Research* 1: 1-6 [in Chinese].

2 & 3. from the *China Population Statistics Yearbook* 1997 & 2002.

Note: 4. infant deaths are obtained by multiplying total infant deaths with 9.5% sample ratio of long form.

Table 4. Estimated Extent of Underreporting of Births in the SSB Annual Series (1991-2000)

Year	"Consistent" underreporting rate[1] (%)	"Temporary" underreporting rate (%)	Underreporting rate due to mothers' deaths (%)	Underreporting rate due to infant deaths[2] (%)	Estimated underreporting extent (%)
1991	6.9		0.3	0.40	7.60
1992	6.9		0.3	0.45	7.65
1993	6.9		0.3	0.20	7.40
1994	6.4		0.3	0.20	6.90
1995	6.4	6.27		0.11	12.78
1996	6.4		0.3	0.20	6.90
1997	6.4		0.3	0.00	6.70
1998	6.4		0.3	0.00	6.70
1999	6.4		0.3	0.67	7.37
2000	6.4	11.6		0.59	18.59

Note: 1. except the 1993 and 1994 "consistent" underreporting rates directly surveyed, other years interpolated

2. the underreporting rate due to infant deaths in 1991 and 1996 interpolated with reference figures in neighboring years.

Table 5. Adjusted Age-Specific Fertility Rates and Total Fertility Rates (1991-2000)

Age group	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
15-19	0.0153	0.0170	0.0171	0.0132	0.0164	0.0134	0.0085	0.0081	0.0085	0.0120
20-24	0.1795	0.1703	0.1625	0.1481	0.1670	0.1588	0.1365	0.1342	0.1304	0.1337
25-29	0.1350	0.1168	0.1216	0.1283	0.1035	0.1177	0.1294	0.1268	0.1270	0.1120
30-34	0.0462	0.0446	0.0402	0.0435	0.0406	0.0336	0.0369	0.0396	0.0421	0.0333
35-39	0.0130	0.0120	0.0102	0.0082	0.0057	0.0069	0.0073	0.0102	0.0099	0.0062
40-44	0.0060	0.0050	0.0034	0.0033	0.0016	0.0018	0.0012	0.0017	0.0013	0.0015
45-49	0.0016	0.0014	0.0012	0.0012	0.0006	0.0008	0.0006	0.0008	0.0004	0.0007
Adjusted TFR	1.98	1.83	1.78	1.73	1.68	1.67	1.60	1.61	1.60	1.50

Table 6. Comparisons of Number of Births from Various Sources (1991-2000)
(in millions)

Year	*Hukou* birth registration[1]	SFPC birth registration[2]	Estimated births from 2000 census[3]	SSB annually adjusted figures[4]	Estimated TFRs from the SSB annual series[5]	Re-adjusted birth figures	Re-adjusted TFR
	(1)	(2)	(1)	(3)	(4)	(5)	(6)
1991	16.81	16.97	20.87	22.58	**2.01**	22.28	**1.98**
1992	15.10	15.96	19.48	21.19	**1.84**	21.09	**1.83**
1993	14.52	15.70	18.60	21.26	**1.83**	20.60	**1.78**
1994	14.28	15.75	17.09	21.04	**1.81**	19.96	**1.72**
1995	14.40	15.21	17.56	20.63	**1.78**	19.34	**1.68**
1996	14.30	14.55	15.77	20.67	**1.81**	19.04	**1.66**
1997	13.86	13.88	14.96	20.38	**1.82**	18.34	**1.60**
1998	13.43	13.83	14.48	19.42	**1.82**	17.96	**1.61**
1999	13.67	12.88	11.85	18.34	**1.80**	17.44	**1.59**
2000	16.21	12.92	14.08	17.71	**1.80**	15.82	**1.50**
Total	146.58	147.65	164.74	203.22		191.87	

Source: 1. the *hukou* series from the *National Population Statistics by City and County* 1990-2000.

2. the SFPC series from the CPIRC research report 2003: 10 [in Chinese].

3. the 2000 census series taken from Zhang and Cui 2003: 27 [in Chinese].

4. the SSB series from the *China Population Statistics Yearbook* 1991-2002

5. the estimated TFRs based on the SSB annual series available at:
http://www.sfpc.gov.cn/data/sfpcdata2001-07-19.htm.

Appendix:

Table A1. The SSB Adjusted Factors for Their Surveyed CBRs and TFRs (1991-2000)

Year	Unadjusted CBR[1](‰)	Officially adjusted CBR[2] (‰)	Adjustment factors (%)	Unadjusted TFR[3]	Officially adjusted TFR[4]	Adjustment factors (%)
1991	18.32	19.68	6.91	1.83	2.01	8.96
1992	16.35	18.24	10.36	1.69	1.84	8.15
1993	15.58	18.09	13.88	1.64	1.83	10.38
1994	15.32	17.70	13.45	1.60	1.81	11.60
1995	14.42	17.12	15.77	1.46	1.78	17.98
1996	14.32	16.98	15.67	1.55	1.81	14.36
1997	13.47	16.57	18.71	1.49	1.82	18.13
1998	13.28	15.64	15.09	1.50	1.82	17.58
1999	12.70	14.64	13.25	1.47	1.80	18.33
2000	11.40	14.03	18.75	1.22	1.80	32.22

Source: 1. the unadjusted CBR series from CPIRC report, 2000 from the census.

2. the official adjusted CBR series from the *China Population Statistics Yearbook* 2002.

3. the unadjusted TFR series from the *China Population Statistics Yearbook*, 1991-1993 from research reports (Sun and Hu 1993).

4. the official adjusted TFR series available at: http//www.sfpc.gov.cn/data/sfpcdata2001-07-19.htm.

Table A2. The Cases of Birth Control Operations in the 1990s

Year	Abortion (millions)	IUD insertion (millions)	Sterilization (millions)
1988	12.68	n. a	n. a.
1989	10.38	15.52	8.71
1990	**13.49**	**15.88**	**10.02**
1991	**14.09**	**16.82**	**12.52**
1992	10.42	14.63	8.29
1993	9.50	13.46	6.14
1994	9.47	13.21	5.53
1995	7.48	13.03	4.88
1996	8.83	12.88	4.64
1997	6.59	12.11	4.01
1998	7.38	11.39	3.63
1999	6.76	10.74	3.53
2000	6.66	9.98	3.04

Source: 1. the abortion series from the *China Health Yearbook* 2000.

2. the IUD and sterilization series from the *Handbook of Data on Population and Family Planning* 2001 (CPIRC)

Note: these abortion figures included those from pre-marital women, which were not covered by the family planning statistics.

Table A3. The Contraceptive Prevalence Rates (CPR) and the Percentage Distribution of Contraceptive Users and Non-users among the Currently Married Women (1992-2001)

Survey time		1992	1997	2001
Proportion of currently married women		73.5	80.9	82.0
Contraceptive prevalence rate		83.4	85.3	86.9
Contraceptive users	Contraceptives used	Percentage distribution	Percentage distribution	Percentage distribution
	Sterilization	53.5	49.2	46.0
	IUDs	40.1	43.4	45.6
	Pills & condoms	5.6	6.1	7.1
	Others	0.8	1.3	1.3
	Total	100	100	100
Non-users	Reasons of non-use	Percentage distribution	Percentage distribution	Percentage distribution
	Being pregnant or will be pregnant	58.6	41.3	42.9
	no sex life	21.4	40.1	39.9
	fear of side effects or unavailability	20.0	18.6	17.2
	Total	100	100	100

Source: own calculations based on the SFPC 1992, 1997 and 2001 surveys.

Note: the sampled women of reproductive age (15-49) in three surveys were 107,213 in 1992, 15,213 in 1997 and 39, 586 in 2001, respectively.

Table A4a. The Adjusted Female Age Structure based on the Three Recent Censuses (1991-2000) (in thousands)

Age group	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
15-19	56,300	53,471	50,468	48,171	46,899	45,680	46,871	47,723	47,868	48,302
20-24	62,203	63,337	63,576	61,504	59,193	55,908	53,097	50,119	47,840	46,580
25-29	57,260	60,283	58,967	60,176	61,104	61,810	62,934	63,173	61,113	58,818
30-34	37,446	36,311	40,164	45,512	50,377	56,982	59,942	58,634	59,846	60,751
35-39	43,563	44,248	45,071	42,781	40,207	37,238	36,115	39,864	45,241	50,062
40-44	31,888	34,305	36,851	39,449	41,584	43,095	43,770	44,516	42,311	39,762
45-49	23,913	24,963	26,462	27,734	29,883	31,487	33,874	36,243	38,952	41,063
	312,573	316,918	321,559	325,327	329,247	332,200	336,603	340,272	343,171	345,338

Table A4b. The Surveyed Female Age Structure in the SSB Annual Surveys (1991-2000) (in thousands)

Age group	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
15-19	53,480	49,937	47,636	46,790	42,586	42,149	43,138	43,530	42,850	50,152
20-24	62,154	62,246	59,739	58,752	52,433	50,863	47,876	45,344	42,895	46,635
25-29	60,292	59,203	59,702	61,317	60,732	62,359	63,579	61,392	59,929	57,371
30-34	35,914	39,994	45,440	47,611	52,324	59,787	61,358	60,503	60,571	61,953
35-39	44,284	45,395	45,621	41,923	40,403	38,022	38,257	43,371	49,582	53,005
40-44	33,636	35,915	38,413	40,177	43,453	45,187	46,001	46,515	44,038	38,999
45-49	24,791	25,917	27,543	28,806	32,215	34,170	36,492	39,300	41,662	41,581
	314,551	318,607	324,094	325,376	324,146	332,537	336,701	339,955	341,527	349,696

Source: 1. the own adjusted based on the 1982, 1990 and 2000 census, the life table is the 1990 census-based life table.

2. the SSB female age structure obtained by multiplying the sample ratio with the surveyed female age structure in each survey from the *China Population Statistics Yearbook* 1991-2000.

Reference

Attane, Isabelle. 2001. Chinese fertility on the eve of the 21st century: fact and uncertainty. *Population: An English Selection* 13 (2):71-100.

Attane, Isabelle. 2003. Ethnic minorities in China: recent demographic trends. Paper read at International Workshop on China's Population Change at the Beginning of 21st Century, 10-12 December 2003, at Canberaa, Australia.

Banister, Judith. 1987. *China's Changing Population*. Stanford: Stanford University Press.

———. 1994. Implications and quality of China's 1990 census data. In *1990 Population Census of China: Proceedings of International Seminar*. Beijing: China Statistical Publishing House.

Cai, Fang, and Yang Du. 2001. *2001: Report on China's Population Problem: Education, Health and Economic Growth*. Edited by F. Cai and Y. Du. Beijing: Social Science Documentation Publishing House.

Cai, Fang, and Chewei Zhang. 2000. *2000: Report on China's Population Problem : Solutions for Rural Population Problem*. Edited by F. Cai and C. Zhang. Beijing: Social Science Documentation Publishing House.

Caldwell, John C. 2002. Social upheavel and fertility decline. Canberra, Australia.

Chen, Shengli, and Shikun Zhang. 2003. *Research on Contemporary People' Preference of Marriage and Childbearing: 2002 National Preference of Marriage and Childbearing Survey*. Beijing: China Population Publishing House.

Chen, Wei. 2003. Induced abortion in China: trends, patterns and determinants. Ph. D. Dissertation, Demography & Sociology Program, The Australian National University, Canberra.

Chu, Junhong. 2001. Prenatal sex determination and sex-selective abortion in rural central China. *Population and Development Review* 27 (2):259-281.

Coale, Ansley J. 1984. *Rapid Population Change in China, 1952-1982*. Washington, D. C.: National Academy Press.

———. 1989. Marriage and childbearing in China since 1940. *Social Forces* 67 (4):833-850.

Coale, Ansley J., and Judith Banister. 1994. Five decades of missing females in China. *Demography* 31 (3):459-479.

Coale, Ansley J., and Shengli Chen. 1987. *Basic Data on Fertility in the Provinces of China: 1940-82*. Vol. Working Paper 104. Honolulu: East-West Population Institute.

Coale, Ansley J., Wang Feng, Nancy E. Riley, and Fude Lin. 1991. Recent trends in fertility and nuptiality in China. *Science* 251 (4992):389-393.

CPIRC Research Group. 2003. Studies of China's fertility level since 1990. Paper read at The 5th National Population Census Scientific Symposium., at Beijing, China.

Ding, Junfeng. 2003. Analysis about the impact of changes in fertility pattern on fertility level for China between 1991-2000. *Population Research* 27 (2):55-60 [in Chinese].

Feeney, Griffith, and Jianhua Yuan. 1994. Below replacement fertility in China? A close look at recent evidence. *Population Studies* 48 (3):381-394.

Feng, Xiaotian, and Qingsong Zhang. 2002. Review of research on changes in fertility preference of urbanites and peasants. *Market and Demographic Analysis* 8 (5):21-31[in Chinese].

Freedman, Ronald. 1979. Theories of fertility decline: a reappraisal. *Social Forces* 58 (1):1-17.

Gao, Lin. 1993. Analysis of China's sex ratio at birth. *Population Research* (1):1-6 [in Chinese].

Goodkind, Daniel. 2004. China's missing children: the 2000 census underreporting surprise. Paper read at 2004 PAA Annual Meeting, 1-3 April, at Boston.

Greenhalgh, Susan. 1988. Fertility as mobility: Sinic transitions. *Population and Development Review* 14 (4):629-674.

———. 1993. Thge peasantization of the one-child policy in Shaanxi. In *Chinese Families in the Post-mao Era*, edited by D. Davis and S. Harrell. Berkeley: University of Califonia Press.

———. 1994. Controlling births and bodies in village China. *American Ethnologist* 21 (1):3-30.

Greenhalgh, Susan, and Edwin A Winckler. 2001. Chinese State Birth Planning in the 1990s and Beyond. Washington. D.C.: Resource Information Center, U. S. Department of Justice.

Gu, Baochang. 1996. Fertility trends in rural China in the 1980s: cohort effect versus period effect. In *China: The Many Facets of Demographic Change*, edited by A. Goldstein and F. Wang. Colorado, USA: Westview Press.

Guo, Zhigang. 2000. Lifetime fertility of Chinese women: a look at the recent period fertility behaviour. *Population Research* 24 (1):7-18 [in Chinese].

———. 2004. Study for fertility of China in the 1990s. *Population Research* (2):[in Chinese].

Hu, Ying. 1994. Evaluation of the sampling method and data quality of annual population change

survey. *Population Research* 18 (6):22-27 [in Chinese].
International Statistical Institute. 1991. *Fertility in China: Proceedings of the International Seminar on China's In-Depth Fertility Survey*. Voorburg, the Netherlands: International Statistical Institute,.
Jia, Tongjin, and Yin Sai. 1995. Current status and problem analyses about the population change survey. *Population Research* 19 (5):28-31 [in Chinese].
Jiang, Leiwen. 2002. Has China completed demographic transition. Paper read at 2002 IUSSP Regional Population Conference, 10-13 June 2002, at Bangkok, Thailand.
Jiang, Zhenghua, Erli Zhang, Shengli Chen, and Jianli Chen, eds. 1995. *Selected Papers of the 1992 Fertility Sample Survey in China*. Edited by SFPC. Beijing: China Population Publishing House.
Johansson, Sten, Xuan Zhao, and Ola Nygren. 1991. On intriguing sex ratios among live births in China in the 1980s. *Journal of Official Statistics* 7 (1):25-43.
Kaufman, Joan, Zhang Zhirong, Qiao Xinjian, and Zhang Yang. 1992. The quality of family planning services in rural China. *Studies in Family Planning* 23 (2):73-84.
Li, Chengrui, ed. 1986. *A Census of One Billion People: Papers for International Seminar on China's 1982 Population Census*. Boulder: Westview Press.
Li, Nan. 1993. Causes and solutions for underreporting and misreporting in population statistics. *Population and Economy* (4):42-45. [in Chinese].
Liang, Zhongtang. 2003. Research on China's population total and women fertility level in 2000. *China Population Science* (6):9-16 [in Chinese].
Ma, Yingtong. 2002. Three decades with differing performance of China's birth control. *China Population Science* (6):1-9 [in Chinese].
Ministry of Health. 2000. *China Health Ststistical Digest*. Beijing: China Health Publishing House.
Peng, Peiyun. 1993. Accomplishments of China's family planning program: A statement by a Chinese official. *Population and Development Review* 19 (2):399-402.
People Daily. 1988. Statistical falsification has been a fashion, and the family planning statistics was nearly useless. *People Daily*., 24 October, 1988, P.1 [In Chinese].
Poston, Dudley L, and Baochang Gu. 1987. Socioeconomic development, family planning, and fertility in China. *Demography* 24 (4):531-551.
Qiao, Xiaochun. 1998. Speculations on China's population policy research in the 21st century. *Population Research* 23 (2):1-9 [in Chinese].
Scharping, Thomas. 2003. *Birth Control in China, 1949-2000 : Population Policy and Demographic Development*. London: Routledge.
SFPC. 1993-2000. *China Family Planning Yearbook*. Beijing: China Population Publishing House.
———, ed. 1995. *Selected Papers of 1992 Fertility Sampling Survey in China*. Beijing: China Population Publishing House [in Chinese].
———, ed. 2000. *Selected Papers on the 1997 National Population and Reproductive Health Survey in China*. Beijing: China Population Publishing House [in Chinese].
Shao, Wei, and Shuzuo Li. 1993. Basic thoughts and strategies of improving the quality of family planning statistics. *Population Research* 17 (3):56-58 [in Chinese].
Shao, Xiazhen. 2000. Analyses of impacts of land allocation system to fertility. *China Population Science* (5):17-24 [in Chinese].
Smith, Herbert L., Ping Tu, M. Giovanna Merli, and Mark Hereward. 1997. Implementation of a demographic and contraceptive surveillance system in four counties in North China. *Population Research and Policy Review* 16 (4):289-314.
SSB. 1991. *10 percent sampling tabulation on the 1990 population census of the People's Republic of China : computer tabulation*. Beijing: Chinese Statistical Publishing House.
———. 1991-2002. *China Population Statistics Yearbook*. Beijing: China Statistical Publishing House [in Chinese].
———. 1993. *Data of the 1990 Population Census of China*. Beijing: China Statistical Publishing House.
———. 1997. *Data of the 1995 National 1% Population Sample Survey*. Beijing: China Statistical Publishing House.
———. 2002. *Data of the 2000 Population Census of China*. Beijing: China Statistical Publishing House.
Su, Songgua. 1989. Quality control of family planning statistics. In *China Family Planning Yearbook*, edited by SFPC. Changchun: North Women and Children Publishing House.
———. 1996. Estimate of fertility in the first half of the 1990s. In *Chin Family Planning Yearbook*, edited by SFPC. Beijing: China Population Publishing House.

Sun, Huaiyang, and Ying Hu. 1993. Causes of the recent deceleration of population growth. *Population Research* (6):8-12 [in Chinese].
Sun, Xueli, and Kaishi Qing. 1993. Problems and solutions to the underreporting of births. *Population and Economy* (1):49-51 [in Chinese].
Tan, Kejian. 1998. Population and family planning statistics viewed: New characteristics and counter-measures. *Population and Economy* (4):28-31 [in Chinese].
Thomas, Neil, and Neil Price. 1996. The evolution of population policy in rural China. *Health Policy and Planning* 11 (1):21-29.
Tu, Ping. 2000. Trends and regional differentials in fertility transition. In *The Changing Population of China*, edited by X. Peng and Z. Guo. Oxford: Blackwell Publishers Inc.
Tu, Ping, and Zhiwu Liang. 1994. An evaluation of the quality of enumeration of infant deaths and births in China's 1990 census. In *1990 Population Census of China: Proceedings of International Seminar.* Beijing: China Statistical Publishing House.
Wang, Jinyin. 2003. Changes in fertility pattern and fertility estimates in China (1990-2000). *China Population Science* (4):32-38 [in Chinese].
Wang, Qian, and Haidong Wang. 1995. SFPC special survey in Hubei and Hebei provinces. *Population Research* 19 (3):27-29 [in Chinese].
White, Tyrene. 1991. Birth planning between plan and market: The impact of reform on China's one-child policy. In *China's Economic Dilemmas in the 1990s: The Problems of Reforms, Modernization, and Interdependence*. Washington, D.C.: US Government Printing Office.
Whyte, Martin King, and S. Z. Gu. 1987. Popular response to China's fertility transition. *Population and Development Review* 13 (3):569-571.
Winckler, Edwin A. 2002. Chinese reproductive policy at the turn of the millennium: Dynamic stability. *Population and Development Review* 28 (3):379-418.
Wu, Jie. 1997. Analysis of the sampling errors in the annual population change survey. *Statistical Research* (3):53-55 [in Chinese].
———. 2001. The post-enumeration survey in population census. *Market and Demographic Analysis* 7 (5):54-60 [in Chinese].
Xie, Cheng. 1990. Analysis of the reasons of false population statistics. *Population Research* (5):44-45, 19 [in Chinese].
Yao, Xinwu, and Hua Yin. 1994. *Basic Data of China's Population*. Beijing, China: China Population Publishing House.
Yu, Xuejun, and Zhenming Xie. 2000. Studies on China's fertility level. In *China Population and Development: Review and Prospect*, edited by X. Yu and Z. Xie. Beijing: Renmin Publishing House.
Yuan, Jianhua, Hongwen Yu, Xiru Li, Yi Xu, and Tao Jiang. 2003. From estimates of fertility levels to future population projection. *China Population Science* (1):15-21 [in Chinese].
Zeng, Yi. 1996. Is fertility in China in 1991-92 far below replacement level? *Population Studies* 50 (1):27-34.
———. 2000. Marriage patterns in contemporary China. In *The Changing Population of China*, edited by X. Peng and Z. Guo. Oxford, UK: Blackwell.
Zeng, Yi, Ping Tu, Baochang Gu, and Yi Xu. 1993. Causes and implications of the recent increase in the reported sex ratio at birth in China. *Population and Development Review* 19:283.
Zha, Ruichuan, Yi Zeng, and Zhigang Guo, eds. 1996. *Data Analyses of the 1990 Population Census of China*. Beijing: China Higher Education Publishing House.
Zhang, Guangyu. 2003. Estimates of China's fertility in the 1990s: data sources, regional disparity and the underreporting of births. Paper read at International Workshop on China's Population Change at the Beginning of 21st Century, 10-12 December 2003, at Canberra, Australia.
Zhang, Guangyu, and Xin Yuan. 2004. Rethinking the underreproting of births and fertility estimates in the 1990s. *Population Research* (2):[in Chinese].
Zhang, Weiguo. 1998. *Economic Reforms and Fertility Behaviour : A Study of A Northern Chinese Village*. The Hague, The Netherlands: The Institute of Social Studies, 1998.
Zhang, Weimin, and Hongyan Cui. 2003. Estimates of completeness in the 2000 population census of China. *Population Research* 27 (4):25-35 [in Chinese].
Zhang, Weimin, and Gang Xu. 2002. Implementation and challenges of the 2000 Population Census. *Population Research* 26 (4):17-22 [in Chinese].
Zhang, Weimin, Hongwen Yu, and Hongyan Cui. 1997. Current changes of China's population: a brief analysis of the population data of China's 1995 1% population sample survey. In *23rd IUSSP General Population Conference Symposium on Demography in China.*, edited by CPA. Beijing. China.