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China's Missing Children: The 2000 Census Underreporting Surprise

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Abstract

We compare the age and sex structure of China's 2000 population census to an estimate of that structure based on a projection from the 1990 census. The fit of Chinese adults between the two censuses is excellent, so much so that a major concern with the 2000 census is all the more apparent. Based on China's own official estimates of demographic change, our intercensal analysis indicates a shortfall in enumeration of more than a quarter of all children under age five and an eighth of those between five and nine, a total of nearly 37 million children missing in the 2000 census. Sex differences in child underreporting were fairly minor. We show that the shortfall is primarily due to underreporting of children in the census, as opposed to flawed projection assumptions that might have generated too many. Child underreporting in China is not unprecedented – it occurred in its censuses of 1982 and 1990, likely in part because parental truth telling can lead to fines or punishments under birth quota restrictions in place since the 1970s. Yet child underreporting rates in 2000 nearly tripled compared to previous censuses. We attribute that increase to policy enhancements beginning in the early 1990s holding officials at all jurisdictional levels personally responsible for enforcing birth quotas. Given the resulting confluence of incentives among officials and parents to underreport, China's census takers were apparently less able to account for the country's children in 2000 than ever before.

INTRODUCTION

Final tabulations from China's 2000 census were released to the public in September 2002 and reveal much about recent social changes there, where population policies and related demographic trends have often been unique.

The results from the 2000 census spark consideration of how China's population policies have affected its demographic self-accounting. The intercensal analysis in this report, which relies on China's own official estimates of demographic change, suggests that the count of adults in 2000 was excellent. Yet that very excellence makes a severe underreporting of children all the more noticeable. Nearly 37 million children below age 10 were lost to underreporting, over one-quarter of all children below age five and over one-eighth of those between five and nine. These figures vastly exceed those occurring in censuses taken elsewhere in the contemporary world as well as China's previous censuses of 1982 and 1990. Underreporting was somewhat higher for daughters than sons, but that difference pales in comparison to the massive underreporting for both sexes.

The goal of this report is to provide evidence of this unprecedented loss due to underreporting and to examine why it happened. We begin by summarizing the background and implementation of China's 2000 census, including innovative efforts to produce a more accurate count. Then we describe the basic analytic approach used in our analysis – a comparison of the age and sex structure in the 2000 census with an estimate of that structure based on a projection from the 1990 census incorporating China's own official estimates of demographic change. The analysis reveals the unprecedented gap in child counts in the 2000 census, a gap which cannot be explained by faulty projection assumptions. We show that most potential flaws in those assumptions are of minor demographic significance. Mis-specified fertility could have a larger impact, but raising fertility above official estimates would increase the gap of underreported children, and the lowest possible levels of fertility would still imply record levels of underreporting.

A precedent for underreporting children in China was established in both the 1982 and 1990 censuses. Parents did so in part to avoid penalties for violating China's family planning regulations, which have been in place since the 1970s (Banister, 1987; Johannson and Arvidsson, 1994). Yet underreporting of children in the 2000 census was nearly triple that of prior censuses. We suggest that accurate reporting in 2000 was particularly discouraged by augmentations of population policy beginning in the early 1990s which held officials personally responsible for violations of family planning rules within their jurisdictions. Although the significance of these policies has been noted in prior literature, their full impact is only now apparent. Given the resulting confluence of incentives among both officials and parents to underreport, China's census takers were apparently less able to account for the country's children in 2000 than ever before.

BACKGROUND, IMPLEMENTATION, AND BASIC FINDINGS FROM THE 2000 CENSUS

China's 2000 census was the fifth conducted since the founding of the People's Republic in 1949. Earlier censuses were taken in 1953, 1964, 1982, and 1990. As in previous censuses, forms were to be completed by census takers, not respondents themselves, since a 12-percent illiteracy rate was considered too high to rely on self-completed or mail-back forms (Zhang, 2000). All forms were supposed to be completed during face-to-face interviews, although some of the information could have been completed (or at least verified) on the basis of China's household (*hukou*) registration system, which indicates the age and sex of all household members. Because these registers may not always be kept current at all localities, special updates (rectifications) are made just prior to a census.

In the past, such freshly rectified registers provided a blueprint that ensured a high quality census (Lu and Meng, 2000; Zhang, 2000; Lavely, 2001). However, the completeness of the registers eroded during the 1990s. Cui (2000) found a growing shortfall in registered counts (maintained by the Ministry of Public Security) compared with the estimates made by the National Bureau of Statistics (NBS). Cui identified an increased tendency to not register children as a

major reason for this expanding gap, and evidence provided later in this paper supports that contention.

Other challenges in China's 2000 census included the selection of interviewers. In prior censuses, China was able to draw interviewers from the vast network of agencies affiliated with the government. However, deepening market reforms in the 1990s left government enterprises with far fewer people than before, so the pool of available interviewers with prior census experience had shrunk. This was particularly problematic because China's huge population required that nearly six million census takers be recruited (Zhang, 2000), most of whom were cadres, officials, teachers, or other volunteers (China Daily, October 11, 2000).

Counterbalancing these emerging challenges, China's 2000 census benefitted from a number of innovative improvements, such as the introduction of a short form and a long form. As elsewhere, this system facilitates the collection of more detailed information while reducing the total burden on census takers which, given the lack of mail-back forms and a less experienced pool of interviewers, was considerable in China. Ninety percent of households received the short form, while the remaining 10 percent were scheduled to receive the long form. The long form included all questions asked on the short form, as well as a separate battery of questions. Some long form questions addressed topics never covered before, such as housing. The 2000 census was also the first in China to benefit from high speed scanning and optical sensing technologies, which reportedly reduced the amount of time required for, as well as errors resulting from, manual data entry (ibid.; Lu and Meng, 2000).

Another significant change concerns the definition of migration. In the 1990 census, people who were living at a new locality were only recorded there if they had either formally changed their household registration (official migration) or had spent at least one year continuously away from the place at which they were officially registered (unofficial migration). That definition led to an undercount of unofficial migration, since many Chinese visit their natal homes during the winter New Year's holidays, and such visits would have precluded them from being recorded as migrants at their new locality even if they had resided there for years (Zhang,

2000). Thus, in the 2000 census, the minimum duration of residency was thus reduced from one year to six months.

Another change involved shifting the date of the census from July 1 (used in 1982 and 1990) to November 1, a change intended to minimize census undercounts. November was preferable because it avoided the hottest summer months when flooding in many areas of China makes enumeration difficult, yet it was before the arrival of cold winter weather that could interfere with counts elsewhere. Seasonal migrants are also more likely to be home in November than in July. Moreover, a November census ensured that natal visits during the Lunar New Year holiday (typically in early February) would occur more than six months prior to the enumeration, so those making such visits would not be improperly disqualified as migrants under the six-month rule (ibid.). To further improve migration measurements, the 2000 census introduced a special form to record those who had resided in any locality for less than six months. Such forms provided a potential check on the completeness of census counts because short-term migrants might not have been counted at the location where they were officially registered.

The preliminary communique on the 2000 census (National Bureau of Statistics, 2001a) reported a provisional total of 1.266 billion people on the Mainland of China (excluding 30 million residing in Hong Kong, Macau, and Taiwan). According to the final tabulations from the 2000 census released last autumn, China had 1.245 billion people, a 1.6 percent reduction from the preliminary account. A post-enumeration sample survey indicated a 1.8 percent undercount in the census (Population Census Office, 2002), which amounts to about 22 million people. If we reinflated the total to accommodate the undercount, China's population would be 1.268 billion. The official 1.8 percent undercount in 2000 is well above the 0.1 percent reported for the 1990 census, although the actual undercount in 2000 could be higher still if under-reported people were measured properly (Cui, 2000; Becker, 2001; Lavely, 2001).

INTERCENSAL ANALYSIS OF THE COMPLETENESS OF THE 2000 COUNT

We use intercensal methods to analyze the completeness of China's 2000 census count. Simply put, we compare census counts in 2000 by sex and single years of age to the

corresponding counts we estimated based on projections from the 1990 census. The projection begins with unadjusted census counts as of July 1, 1990 and then ages that population forward to the date of the 2000 census (November 1). The cohorts in 1990 are subjected to annual fertility, mortality, and international migration, inputs for which vary by age and sex and from year to year. The aggregated inputs are listed in Appendix 1. Mortality estimates are based largely on findings from the 1990 and 2000 censuses, with values interpolated for intervening years. Reliable measures of net international migration are not available, so our assumptions are based on a variety of indirect evidence, including labor flows from China and immigration statistics in the United States and other countries.

Our projection program generates new birth cohorts each year in accordance with whatever fertility levels are specified. We choose total fertility rates so that the crude birth rates outputted from our program match China's official crude birth rate series (National Bureau of Statistics, 2002). Age-specific fertility patterns are drawn from the 1990 and 2000 censuses (with values interpolated for years in between and scaled to match the total fertility rate each year). The program generates births annually by multiplying age-specific fertility rates by the number of women at each age group. The resulting total number of births are then allocated between males and females according to the sex ratio at birth (males per 100 females) specified. Reported sex ratios at birth in China are too high due to excess underreporting of females births (Goodkind and West, 2004), so we entered values three per hundred below that reported in Chinese censuses and surveys throughout the projection period.

The results of the intercensal analysis appear in Figure 1, which compares the 2000 census population at each age to our projected population. Overall, the census count trails the projected count by 0.8 percent (not shown). Adult counts between the two censuses show an excellent match of identical cohorts, which lends validity to the count of each census. Chinese societies are known for good age reporting due in large measure to the significance of birthdays within the traditional lunar calendar. Figure 1 shows a few single-year discrepancies among adults, although positive spikes are typically counterbalanced by negative spikes at adjacent ages. The single-year discrepancies would largely disappear if the data were smoothed over broader age groups.

However, Figure 1 shows that below age 10 the census count is consistently below projected counts. The gap at ages 0-9 numbers almost 37 million, nearly 3 percent of China's total population. The gap is proportionately largest among the cohorts born most recently. Table 1 conveys similar information, showing percent differences from age 0 to 19 by sex and single years of age, as well as by five-year age groups. Census counts fall below projected counts by 26.2 percent at ages 0-4 and 12.1 percent at ages 5-9. Below age 10 the difference amounts to 18.8 percent underreporting. Findings in Table 1 correspond well with other official Chinese data. For instance, the shortfall below age 1 in 2000 is 20.6 percent, a statistic very close to the 19.0 percent difference between the crude birth rate measured in the census (11.4) and the official crude birth rate for 2000 reported shortly afterwards (14.0; National Bureau of Statistics, 2002). By publishing the latter statistic (which we use in our projections), Chinese authorities implicitly acknowledged sizeable underreporting of fertility in the 2000 census and, by extension, underreporting for the same cohort at age zero.

Skeptics may doubt the validity of a 37 million gap of children under age 10, since the gap indicated by the aforementioned post-enumeration survey was only 22 million for the entire census. Yet post-enumeration surveys throughout the world are known to suffer from defects that limit their ability to detect underreporting (Whitford and Banda, 2001). Moreover, independent evidence from education enrollment data suggests that the intercensal estimate is reasonable. China collects annual data on the number of children entering the school system, which typically occurs at age six. Zhang and Cui (2003) compared such school enrollment data (through 2002) with comparable cohorts at ages 4-9 in the 2000 census. The resulting underreporting percentages at ages 4-9 were then applied to the cohort at ages 0-3 (which had not entered the school system as of 2002). Their analysis suggested 30.1 million children under age 10 missing in China's 2000 census. However, this figure may prove to be an underestimate, since children at ages 0-3 experienced greater underreporting than children at ages 4-9 (Table 1). In fact, the numerical undercount at ages 4-9 implied by enrollment data was 20.0 million (ibid.), a full three million *above* our intercensal estimate of 17.0 million for the same cohort (not shown).

As to sex differences in underreporting, Table 1 shows that daughters were more likely to be underreported than sons (28.1 percent versus 24.4 percent at ages 0-4), yet this sex difference is modest compared to the extraordinarily high levels of underreporting for both sexes. We reiterate that our projections assume sex ratios at birth (males per 100 females) about three per hundred below those reported due to greater underreporting of young girls. That is, between the 1990 and 2000 censuses, we believe the true sex ratio at birth rose from 108.3 to 114.0 rather than from the reported 111.3 to 116.9. Projections based on reported sex ratios at birth imply an even smaller sex difference in underreporting (27.0 percent versus 25.5 percent at ages 0-4; not shown) because greater numbers of females "truly missing" at birth due to prenatal sex selection imply fewer females "statistically missing" (alive yet hidden) in the census. Note that the issue of "missing daughters" is typically a relative one compared to sons, encompassing both prenatal and postnatal discrimination as well as differential underreporting (e.g.,Coale and Banister, 1994; Cai and Lavely, 2003). In contrast, our intercensal approach provides pure measures of statistically missing daughters and sons, since children of both sexes presumed to have died or left China are removed based on projection assumptions (sex ratio at birth, mortality by sex, etc.).

Contrary to findings below age 10, Table 1 shows an excess at ages 10-19 in the 2000 census compared with the projections. Why? We see no reason to expect a census overcount at these ages. Rather, as suggested by Zhang and Cui (2002), it is likely due to prior underreporting in the 1990 census. If our unadjusted base population from the 1990 census suffered from underreporting at ages 0-9, then we would underproject the cohorts 10 years later at ages 10-19. Assuming all of the projected shortfall at ages 10-19 is due to underreporting in 1990, Table 1 implies 8.0 percent underreporting at ages 0-4 in 1990, almost double the 4.2 percent implied at ages 5-9 in 1990 (these figures are below those listed on Table 1, the algebra of which shows the inflation required of the original cohort at ages 0-9 in 1990, not the percent undercount of that cohort). The 2000 census showed a comparable ratio across these age groups (26.1 percent compared with 12.2 percent), although overall rates of underreporting below age 10 roughly tripled compared with 1990.

POTENTIAL FLAWS IN PROJECTIONS?

Why would counts of children in the 2000 census fall so far short of the projected counts? In addition to underreporting, the discrepancy could be due in part to over-projections of children resulting from faulty assumptions of demographic change. We demonstrate below that potential flaws in most projection parameters would have minor demographic consequences. Table 2 and Figure 2 summarize the findings. Flawed fertility assumptions could have a much larger impact, but if actual fertility exceeded official estimates then child underreporting would be more severe than indicated above, and even the lowest conceivable levels of fertility would imply record proportions of children missing from the 2000 census.

Base Population of Potential Mothers in 1990

The children projected from 1990 to age 0-9 in 2000 were "born" during each intercensal year based on assumptions of age-specific fertility as well as counts of females at childbearing ages. Thus, if the 1990 census contained an overcount of future mothers, projected numbers of children in 2000 would have exceeded the census count that year. Yet such an overcount is highly unlikely. Childbearing rates are highest in the early to mid twenties, so the cohort of females aged 17-25 in 1990 would have born most children between 1991 and 2000. The teens and twenties are often prime ages for census undercounts due in part to substantial migration at those ages (Committee on Population and Demography, 1981). Our intercensal analysis suggests that the cohort of women aged 17-25 in 1990 were likely undercounted by 1.5 percent (not shown), which translates into a projected shortfall of 2.9 million births in our projections. If we corrected for that shortfall, the gap between the projected and census counts of children in 2000 would be 7.8 percent *wider*.

Net International Migration

Our projection could have overestimated children in 2000 if net migration out of China was set too low from 1990 to 2000. We acknowledge this possibility. China does not have comprehensive statistics on net international migration, let alone emigration or immigration, so

our estimates were based on indirect inferences. However, given China's huge population and relatively low rates of migration, even if outmigration estimates were doubled at all ages, the 36.8 million gap at ages 0-9 would be reduced by only 0.2 percent.

In addition to potential misestimates of migration across all age groups, misestimates could occur at particular ages. One relevant issue for China concerns international adoptions of infants and young children. The age- and sex-specific migration assumptions used in our projections already incorporate such adoptions, which reached about 10 thousand a year by 2000. This figure is based on the number of United States visas issued for children adopted from China (http://fwcc.org/statistics.html) combined with the assumption that the United States accounts for 50 percent of all international adoptions from China. We assume that 95 percent of those adopted were females.

Mortality

Projected counts of children in 2000 could have exceeded census counts if the infant and child mortality rates we set for 1990 and 2000 were too low. Although such a mis-specification is possible, in 1990 we inflated mortality rates beyond what was published in census tabulations that year. Above age zero, we doubled the number of deaths at each age in the six months prior to the census (which were higher than deaths recorded 6-12 months prior to the census) and then recalculated mortality rates. Because infant deaths were more severely underreported than at other ages, we used rates derived from China's 1988 two-per-thousand survey of fertility. In 2000, we adjusted mortality rates reported in the 2000 census upwards in line with recent intercensal findings (11 percent for males and 18 percent for females; Banister and Hill, 2004). Even if we raised infant mortality further, the projected figures would not change much. For instance, if we pegged infant mortality rates in 2000 to a level 25 percent higher (e.g., from 30.3 to 37.8 per thousand) the cohort of children aged 0-9 projected to 2000 would decrease by 2.1 percent (Table 2), a fraction of the gap implied by our analysis.

Fertility - rural/urban sampling factors

Estimates of underreported children are most sensitive to mistaken assumptions of fertility. If the official fertility statistics we used were too high, a corresponding inflation in projected child counts would incorrectly imply a census shortfall.

Since the late 1980s, China's National Bureau of Statistics (NBS) has conducted annual surveys of population change (during non-census years) from which fertility estimates are derived. The rural and urban proportions of this sample are determined on the basis of annual estimates of migration. The NBS likely underestimated urban proportions throughout the 1990s, since the urban percentage according to the 2000 census (nearly 37 percent) was almost four percentage points higher than what NBS had anticipated. Therefore, the sampling frame used in the annual surveys probably did not reflect full urban proportions. Since urban fertility is lower than rural fertility, such sampling may have resulted in an upward bias in fertility statistics. We estimate that the fertility estimates used in our projections, if lowered to better reflect true urban proportions, would account for only 1.5 million of the 36.9 million child shortfall in the 2000 census (Table 2).

Fertility - Other Factors Leading to Over-reporting?

Each year, the National Bureau of Statistics (NBS) estimates and publishes a national crude birth rate (e.g., National Bureau of Statistics, 2002). The official series from 1990 to 2000, which forms the basis for our projections, is shown on the top line of Figure 2. The difference between the top line and the bottom line (fertility levels implied by the 2000 census counts) produce the aforementioned 37 million child discrepancy, nearly 19 percent of all children under age 10.

The official fertility series is derived in part from aforementioned surveys of population change which are conducted by the NBS in each province of China. The NBS typically inflates the raw survey results for "sampling and investigation errors," errors derived in part from post-survey checks. Following the 1993 and 1994 surveys, formal checks detected 7 percent underreporting of births (Zhang, 2004). Yet the NBS does not believe that post-survey checks can detect the full extent of underreporting, so it inflates the raw survey results by more than the amount indicated by these checks. One measure of the inflation undertaken by the NBS can be

determined by comparing official crude birth rates (top line of Figure 2) to those derived from the crude birth rates reported by each province to the NBS (National Bureau of Statistics, 2002). The NBS lists these provincial rates without adjustment, the weighted average of which appears on the middle line. Some provincial statistical bureaus inflate their fertility figures prior to sending them to the NBS, so the difference between the top and middle lines of Figure 2 represents the extent to which the NBS has inflated raw surveyed fertility levels *beyond* the inflation already undertaken by the provinces (for estimates of the total NBS inflation from the raw data, see Zhang, 2004). Since 1990, when the NBS did not inflate provincial statistics, that additional inflation of fertility amounted to 11 to 13 percent from 1995-1999 and 2001-2002 (latter not shown). The NBS implicitly acknowledges an even higher rate of birth underreporting in the 2000 census. As mentioned earlier, the crude birth rate according to the 2000 census was 11.4, whereas the crude birth rate published later in the *China Statistical Yearbook 2002* was 14.0, about 19 percent higher.

To what extent are the NBS upward adjustments of fertility accurate? Some observers suspect that China's true fertility may be even higher than official adjustments suggest (Feeney and Yuan, 1994; Zeng, 1996), which would occur if the NBS underestimates actual underreporting. Others wonder whether the NBS inflates fertility too much, which might occur if the NBS derives its assumptions from data which suffer from greater underreporting than its annual surveys (Zhang, 2004).

Although exact levels of fertility in China may be somewhat uncertain, comparative perspectives allow us to rule out values that are not credible. For instance, the bottom line of Figure 2 shows the crude birth rates required in order for the census count of children in 2000 to match that projected from 1990. If those rates were correct, we would have to conclude that the fertility reported by the provinces (middle line) was overstated and that the NBS compounded that mistake by inflating it further (from the middle line to the top line) when it should have been deflating it (for a similar analysis of backprojected total fertility rates, see Zhang and Cui, 2002). Even less believable, the widening gap between the lower and middle lines suggest that the required deflation should have increased over time. To whom would we attribute a rising excess

of reported fertility in need of deflation? Based on two decades of accumulated findings on China's family planning program, we know that parents and local officials have incentives to underreport births (Banister, 1994; Tan, 1998).

The middle line on Figure 2 is also too low. A projection based on the provincial figures implies over 9.7 percent underrerporting of children under age 10 in the 2000 census, far above comparable rates in the 1982 and 1990 censuses (Table 3, to be discussed shortly). That implies a contradiction to the extent that provincial fertility is based on reported data – willful reporting of births during the 1990s should not have been followed by record underreporting of these same cohorts in 2000.

In our view, true fertility in China must have been above that suggested by the provincial figures (e.g. above the middle line in Figure 2). It is hard to believe that the NBS would choose to inflate fertility above those levels unless it felt a strong justification for doing so. Given the severity of China's family program, the NBS' apparent presumption of 11-13 percent underreporting of births in the provincial figures seems plausible, even if somewhat too high. Moreover, if their assumption of birth underreporting has been too low, the implied number of children missing from the 2000 census would be even higher than the 37 million estimated herein.

COMPARISONS OF CHILD UNDERREPORTING IN 1982, 1990, AND 2000

The 2000 census was not the first of China's censuses to show underreporting of children. Table 3 compares underreporting at ages 0-4 and 5-9 in the 1982, 1990, and 2000 censuses (some of these data were presented in a different format in Table 1). The figures are derived from a series of intercensal analyses, each of which compares unadjusted counts of corresponding cohorts between two of the censuses. The top panel indicates underreporting of 7.0 percent and 8.0 percent at ages 0-4 in the 1982 and 1990 censuses, respectively, probably due in part to fear of penalties for reporting over-quota births under family planning restrictions in place since the 1970s (Banister, 1987; Johannson and Arvidsson, 1994). Yet underreporting in 2000 was roughly triple that of prior censuses.

In contrast to the striking increase in overall underreporting in 2000, patterns across age and sex reveal persistent underlying dynamics which may lend credibility to the series of census findings. First, all three censuses imply fairly balanced underreporting of sons and daughters, even if that for daughters is sometimes higher. Second, each census suggests that children were at least twice as likely to be underreported at ages 0-4 than at ages 5-9. To some extent, this may reflect the general tendency in censuses worldwide to underreport infants and toddlers more than school-age children (Committee on Population and Demography, 1981). Yet the pattern makes further sense in China, given that parents are more likely to fear penalties for reporting children born in the most recent past; as children get older, the likelihood of ex-post facto penalties fall and the benefits from (or even necessity for) correct reporting increase. For instance, children may have to be registered in their parent's household before they can attend school. This theory may be supported by a third finding that birth cohorts are more completely measured as those children grow up and are enumerated in later censuses. Intercensal comparisons available as of the early 1990s suggest that cohorts of children aged 0-4 in both the 1982 and 1990 censuses were underreported by 4.2 and 4.8 percent, respectively (Table 3, bottom panel), whereas intercensal comparisons as of 2000 imply underreports for the same cohorts were 7.0 and 8.0 percent, respectively (Table 3, top panel). The additional 3 percentage points of underreporting indicated by the 2000 census seem consistent with parents feeling safer to report their children once they reached older ages (or that children were then old enough to report themselves, as in the case of 18-22 year olds in 2000 who were 0-4 in 1982).

EXPLAINING THE 2000 CENSUS UNDERREPORTING SURPRISE

Prior to the 2000 census, few observers would have predicted such a drastic increase in the underreporting of children. In fact, two circumstances might have led us to expect better reporting in 2000.

The first concerns the demographic underpinning of China's family planning restrictions. These restrictions began in the mid 1970s with the "later-longer-fewer" campaign, which was

replaced by the more draconian one-child policy in 1979 (Banister, 1987; Feeney and Yuan, 1994). These policies called for financial and other penalties to be imposed against parents who exceeded strict birth quotas. Parents transgressing these rules would thus be reluctant to disclose their true childbearing histories to survey and census takers. Local officials were also urged to enforce family planning regulations (Banister, 1987). The greatest fear of policymakers was the impending runaway childbearing by the baby boom cohort of parents born during the 1960s, an enlarged cohort that reached peak childbearing years around 1991 (ibid.; Xinhua, 1991). Yet by the mid-1990s, that peak had passed. The demographic consequences of a relaxation in birth quotas was less severe in the late 1990s than in the late 1980s, an environment which should have encouraged better reporting. Even more importantly, fertility had genuinely fallen between 1990 and 2000 (Figure 2 and Figure 3), so a lower proportion of births were in violation of China's family planning regulations and subject to penalties. All else being equal, the proportion of births that might have been concealed from authorities should have fallen, not risen, by the time of the 2000 census.

A second reason to expect better reporting from parents is that market reforms (Greenhalgh et al., 1994) and budget cuts (Becker, 2000) have reduced the ability of many local officials to enforce fines on parents for excess childbearing. In addition, wherever such fines continue, rising prosperity in the 1990s has allowed some parents to better afford the "luxury tax" on additional children. In fact, officials in some localities have tried to raise revenue by encouraging parents to violate policies as long as the specified fines were paid (Tan, 1998; Pomfret, 2000).

Why, then, did child underreporting increase so dramatically in 2000 compared with 1982 and 1990? The critical factor appears to be an augmentation of family planning policies in the early 1990s, beginning with a central decree in 1991 holding local officials personally responsible for implementing family planning rules. Although the significance of this decree has been noted before (Xinhua,1991; Greenhalgh, 1994; Zeng, 1996; Winckler, 2002), its full impact can only now be appreciated with the release of the 2000 census data. The underreporting surprise contrasts with the view that China's family planning program by the late 1990s had begun to

move away from targets and penalties towards a gentler client-oriented approach (Gu, 2000; Winckler, 2002) – as of the 2000 census, fears of targets and penalties evidently distorted infant and child reporting more than ever before.

The 1991 decree evolved after two prior, centrally-directed campaigns to lower fertility in China. These included the later-longer-fewer campaign, which began in the mid-1970s, and the formal institution of the one-child policy in 1979. By the time the latter was announced, fertility had already declined drastically in China (see the total fertility rate (TFR) series on Figure 3). Despite these perceived successes, however, by the late 1980s concerns brewed over lax enforcement of the policies in certain areas. That laxness occurred at the same time that potential mothers were approaching record numbers (the number of women in their early twenties peaked around 1990). It also occurred despite a longstanding array of potential pressures and punishments against local officials who failed to restrict births (Banister, 1987). The 1991 decree was pivotal because central authorities emphasized that these punishments were actually going to be enforced. Family planning goals were elevated to the same level of importance as economic development, and officials were to be held personally responsible for achieving those goals, as stated in the following excerpt:

> "The top party and state leaders should be personally involved in the matter and should shoulder the principal responsibility . . .. Party committees and governments at all levels should shoulder responsibility to complete their respective localities' duty on population planning by implementing and perfecting the responsibility system in the management of the population and family planning targets. A good performance on family planning work and completion of population planning should be considered as an important measurement of the political achievements of party committees, governments, and their leading cadres at all levels . . .. A system of merits and demerits should be set up to provide rewards to those who have done a good job in family planning work and to punish as well as make leaders accountable for loss of control on population growth" (Xinhua, 1991).

The 1991 decree thus left officials with three choices: 1) to force their constituents to adhere to family planning policies and punish transgressors accordingly, 2) to accept being demoted or fired for failing to reduce fertility, or 3) to obscure or underreport birth statistics. The first option was increasingly unavailable to many cadres by the late 1980s, as they had lost the

means and authority to enforce such regulations in the wake of market reforms and risked their constituents' anger if they tried to do so (Greenhalgh, 1994; Rosenthal, 2000). The pressures from above regarding the second option were even more formidable. Party officials and committee secretaries were indeed being fired for "failing to accomplish goals and tasks in family planning work" (*Guangzhou Nanfang Ribao*, May 1, 1998; *Hefei Anhui Ribao*, October 8, 1998). At the same time, central authorities increasingly warned cadres against using abuse or coercion to achieve family planning targets (Lau, 2000). Caught between competing pressures, Chinese officials seem to have favored the third option. Merli and Raftery (2000), for instance, found manipulation of birth records collected in three out of four rural counties in 1992. Zeng (1996) reported a special survey in 32 villages of Hebei and Hubei which indicated that over 37 percent of births went unreported in 1993. Tan (1998) described in detail some of the strategies employed by local officials at various levels to obscure or underreport birth statistics. Where fertility surveys are undertaken at particular localities, strategies may include coaching participants how to answer, asking parents known to have violated birth quotas to be unavailable on the day of the interview, or wining and dining the survey team. Officials at various levels may also cooperate to report desired results up to higher administrative levels. According to Tan, such practices are now so routine and widespread that officials have become "semi-open" about them.

A variety of evidence suggests that the increase in child underreporting in the 2000 census was due to the 1991 decree. Some of that evidence is circumstantial – fertility reported in the 2000 census was conspicuously in line with China's family planning guidelines. Urban parents are typically allowed one child, whereas rural parents are typically allowed two, assuming the first child is a girl (the latter policy implicitly acknowledges son preferences). If all rural couples wanted at least one son, under these rules they would have about 1.5 children on average. Thus, assuming that urban couples all adhered to the one-child rule and the population was 37 percent urban in 2000, one would expect a national average of 1.32 children per couple (the figure should be higher due to a variety of legal loopholes in the policy, such as those for ethnic minorities and couples who are both themselves only children). The TFR reported in the full 2000 census (1.38) is remarkably close to our rough calculation of family sizes that would result from strict adherence

to China's family planning rules. These rules themselves may have put a ceiling on the number of children reported in the 2000 census, as well as on the blueprint of household registers underlying the census counts. Almost all births that parents and officials would have wanted to conceal seem to have been. Statistical authorities tried to mitigate such tendencies during the 2000 census by offering amnesty to parents and officials who revealed births previously hidden from the registers. However, similar pleas for openness during the 1990 census were often followed by ex-post facto punishments to those who complied (Rosenthal, 2000; Lavely, 2001). Having learned from family, friends, or their own personal experiences of such consequences following the 1990 census, respondents were almost certainly reluctant to report correctly in 2000.

Table 4 implies that the 1991 decree affected population recordkeeping well before the 2000 census. The table, compiled by Cui (2000), compares NBS estimates of China's population from 1990-1999 to the official household registration data compiled by the Ministry of Public Security. The percent shortfall in the household registers compared to NBS estimates rose from 0.9 percent in 1990 to 2.5 percent in 1999, nearly tripling across the interval. Cui identified child underreporting as a major cause of that increasing gap, which recalls the tripling of proportions of children underreported between the 1990 and 2000 censuses (Table 3). Yet the corresponding numerical gap between between 1990 and 2000 grew by only 20 million, well below the nearly 37 million gap for children alone implied by our intercensal analysis. Evidently, although household registers have traditionally provided a blueprint for China's censuses, there may not be a perfect correspondence between them. Further research into that correspondence could prove fruitful.

Table 4 also establishes a more precise link between the 1991 decree and the erosion of the registered counts. The two right-hand columns compare year-on-year increases in the annual gap between the NBS estimates and registered counts. In both percentage and numerical terms, the gap grew most rapidly between 1991 and 1994, just after the 1991 decree. Although the gap between the two series continued to grow in 1995 and beyond, that growth was at a slower pace. Other statistics we have calculated support the same conclusion – intercensal comparisons using China's 1995 one-percent survey suggest that the increased tendency to underreport children between 1990 and 2000 had been largely established by 1995 (not shown).

RISING INTERNAL MIGRATION – A MINOR FACTOR IN CHILD UNDERREPORTING

Table 4 implies that the growing shortfall in household registration in the 1990s might be explained largely by child underreporting. Rising internal migration had originally been anticipated to be a major cause of undercounts in the registers. In retrospect, it is not surprising that the role of migration might be minor. Once a child's official household residence is established, it can only be changed through official channels, even if the person has lived elsewhere for years. In fact, during the rectification of household registers prior to the 1990 census, migrants accounted for less than 10 percent of the 27 million people found to have "uncertain household registration," the other 90 percent being children whose births had not been registered (Cui, 2000). We do not know yet the number or types of rectification that occurred prior to the 2000 census, but it seems unlikely that migration would have played the key role in eroding the accuracy of national counts tallied from China's household registers.

Nevertheless, given accelerating migration in China since 1990, official registration is of decreasing usefulness in identifying where exactly people live. According to the 2000 census results, about 144 million people lived at a place other than where their official household registration (*hukou*) was located. The "floating population" of unofficial migrants constituted more than 11 percent of China's total population, double the percentage of 1990. Given an increasingly mobile population, the census of 2000 was critical to obtaining accurate local counts. Apparently, census takers did a good job of locating migrants at their proper locations because the proportion urban measured in the 2000 census (36.9 percent) was several percentage points higher than the NBS had expected just before the census.

Although the accelerating pace of migration did not appear to hinder the 2000 census count of adults (Figure 1), such movements could have contributed to the excess undercount of children. Unofficial migrant parents may have been less likely than non-migrant parents to report their children because of potential repercussions. Moreover, since the children of unofficial migrants may be barred from attending public schools in some cities, parents might not have the same incentive to register/report them as would non-migrant parents. Nevertheless, since China's

floating population constitutes only 11 percent of the population, even if all their children went unreported in the 2000 census (a highly unlikely supposition), that would still not be sufficient to explain the over-25-percent shortfall at ages 0-4. Migratory dynamics constitute at best a secondary explanation for the rise in underreporting of children.

CONCLUSION

Over the past several decades, a number of broad themes have unfolded regarding China's population policies. One theme is the tradeoff between individual rights and the authority of governments to override those rights in pursuit of other national priorities – in this case, population control. Another theme is the very rapid decline in fertility and the particular mechanisms through which that was achieved. Yet another theme, ever more prominent in the past decade or so, is the effect of population policies and rapid fertility decline on prenatal and postnatal discrimination against daughters. Although these themes remain relevant, the debate over human rights peaked more than a decade ago, few doubt the effect of China's population policies on reproductive trends, and the impact of such policies on daughters has received excellent coverage in recent years. The 2000 census results bring yet another theme to center stage. China's family planning policies have undoubtedly contributed to reduced childbearing, yet ironically, these very policies hinder statistical authorities from counting infants and children.

The erosion in household registers, the traditional blueprint for China's censuses, was a warning sign of what might transpire in the 2000 census, but few predicted the extent of what would happen. Based on China's own official estimates of demographic change, our intercensal analysis indicates that more than a quarter of children at ages 0-4 and more than an eighth at ages 5-9 went unreported, proportions nearly triple those of the 1990 census and implying nearly 37 million underreported children. These figures would change under different fertility assumptions, which might be justified if official estimates were not properly inflated for underreported births. Yet if China's true fertility were above official estimates even more underreporting would be implied, and even the lowest possible fertility estimates would imply record underreporting compared to what occurred in 1982 and 1990.

Chinese parents apparently had no more incentive to underreport their children in the 2000 census than in prior censuses. Instead, the surprise increase in underreporting was most likely due to the enhanced enforcement of family planning penalties against officials for reporting over-quota births in their jurisdictions. By targeting those for whom family planning statistics determine political success or failure, and who were losing the ability to enforce punishments on parents anyway, these policies seem to have compromised the accuracy of data collection and transmission. After the central decree was issued in 1991, child underreporting rose most swiftly during the early 1990s, as illustrated by the growing gap between population estimates and official household registers (Table 4). Yet it was not until the 2000 census that the increase in underreporting became completely apparent, a bracing contrast to recent reports that China's family planning program has begun to evolve from a system of targets and penalties to one focused more on parental contraceptive needs. The 2000 census results suggest that concerns over targets and penalties distorted infant and child reporting more than ever before.

One resulting concern is the reliability of the census for public planning. For instance, census counts of infants and young children provide potential estimates of future school enrollments. Observers who misinterpret the increased statistical hiding of children in 2000 with actual declines in child cohorts (People's Daily Online, May 30, 2002; Xinhua, 2002) may be surprised by the number of children who eventually arrive at China's schools. Along with Zhang and Cui (2002, 2003), we have found that the number of children entering primary school in recent years far exceeded comparable cohorts counted in the 2000 census. Estimates of child cohorts based on either new enrollment statistics or projections from the 1990 census provide a better indication of child cohort sizes in 2000 (and future years) than the counts in the 2000 census itself.

Another concern is that the tendency to underreport children may not have been random. Parents with particular social characteristics could be more inclined to underreport than others. If so, comparisons of fertility patterns or attributes of children according to those social characteristics (region, education, ethnicity, etc.) may be of limited validity. For instance, census estimates of child wellbeing might be too low if disadvantaged children were more likely to have

gone unreported. Those analyzing child wellbeing using the 2000 census will want to pay particular attention to these biases.

Finally, we wonder if the propensity to underreport children will decline when the next census is taken in 2010. We are optimistic that it will, since news of the massive underreporting in the 2000 census should require policymakers to consider its underlying causes and recognize that China's census takers are not at fault. Efforts to encourage better reporting in 2010 are doomed if people continue to fear punishment for their honesty. The determination to underreport children in China will only decline when its policies reduce the incentives for doing so.

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Table 1. Percent Difference in Child Counts in China's 2000 Census Compared to Projections from 1990 Census

Age in 2000 Census	Primary Year of Birth	Total	Male	Female	Age in 2000 Census (five-year)	Total	Male	Female
0	2000	-20.5	-19.5	-21.5				
1	1999	-36.0	-34.0	-38.2				
2	1998	-25.6	-23.3	-28.2	0-4	-26.1	-24.4	-28.1
3	1997	-25.9	-24.0	-28.2				
4	1996	-22.9	-21.3	-24.8				
5	1995	-14.9	-13.1	-16.8				
6	1994	-18.2	-16.7	-19.9				
7	1993	-11.6	-10.2	-13.1	5-9	-12.2	-10.7	-13.7
8	1992	-9.2	-7.8	-10.8				
9	1991	-7.3	-6.1	-8.7				
10	1990	16.4	16.4	16.3				
11	1989	9.5	8.3	10.9				
12	1988	3.9	2.9	5.0	10-14	8.7	8.0	9.4
13	1987	9.2	8.4	10.1				
14	1986	4.5	4.2	4.9				
15	1985	0.6	0.3	0.8				
16	1984	5.7	4.8	6.7				
17	1983	2.3	0.9	3.8	15-19	4.4	4.0	4.9
18	1982	10.9	10.9	11.0				
19	1981	2.2	2.7	1.6				

Note: Negative percentages for ages 0-9 suggest underreporting in Census 2000. Positive percentages for ages 10-19 suggest prior differential underreporting at ages 0-9 in Census 1990. See text.

Source: Unadjusted counts from China's 1990 and 2000 censuses (Population Census Office, 1993 and 2002). Projections use demographic assumptions based on official Chinese data (see text).

Table 2. Potential Explanations for Underreported Children Below Age 10 in China's 2000 Census Compared to Those Projected from 1990 and Demographic Impact of Corrections for Each Posited Flaw

				Number	Percent of Overall Number
			Overall Census Shortfall of Children Below Age 10:	36,881,260	100.0
Potential Flaws in the Projections from 1990 to 2000			Posited Correction	Census Shortfall Due to Each Flaw:	
1	Overcounting of young mothers in 1990 census		Correct for undercount	-2,885,268	-7.8
2	Underestimation of net outmigration from China		Double net outmigration	72,845	0.2
3	Underestimate of infant mortality rate (IMR)		Raise 2000 IMR 25% more	770,487	2.1
4	Official fertility too high: Rural bias in Annual Surveys		Reweight by true % urban	1,503,619	4.1
5	Official fertility too high: Reasons other than #4	Scenario #1	None	0	0.0
		Scenario #2	Remove NBS* Inflation	19,789,240	53.7
		Scenario #3	Use Census-implied fertility	36,881,260	100.0
Potential Flaw in the 2000 Census Counts					
6	Underreporting of Children	Scenario #1	None	36,881,260	100.0
		Scenario #2	Remove NBS* Inflation	17,092,020	46.3
		Scenario #3	Use Census-implied fertility	0	0.0

*China's National Bureau of Statistics.

Note - See text for a discussion of above explanations, their plausibility, and above estimates. See Figure 2 for illustration of three scenarios of flaws in fertility versus underreporting.

Table 3. Percent of Children Underreported in China's 2000, 1990, & 1982 Censuses

Underreport in Year of the:	Percent Underreport Implied by Comparisons Between 2000 Census and Prior Censuses								
	2000 Census			*1990 census*			*1982 Census*		
	Compared to Cohorts Projected from 1990 Census			Compared to Cohorts at Ages 10-19 in 2000 Census			Compared to Cohorts at Ages 18-27 in 2000 Census		
Age in Census	Total	Male	Female	Total	Male	Female	Total	Male	Female
0-4	-26.1	-24.4	-28.1	-8.0	-7.4	-8.6	-7.0	-6.6	-7.4
5-9	-12.2	-10.7	-13.7	-4.2	-3.9	-4.7	-0.8	-0.8	-0.8

Underreport in Year of the:	Percent Underreport Implied by Comparisons Between 1990 and 1982 Census					
	1990 census			*1982 Census*		
	Compared to Cohorts Projected from 1982 Census			Compared to Cohorts at Ages 8-17 in 1990 Census		
Age in Census	Total	Male	Female	Total	Male	Female
0-4	-4.8	-4.9	-4.8	-4.2	-4.2	-4.1
5-9	-2.1	-2.0	-2.1	0.4	0.5	0.3

Source: for each census, we use unadjusted counts by age and sex. Projections to 2000 incorporate shift in census dates (July 1 in 1982 and 1990 vs. November 1 in 2000). Projections use demographic assumptions based on official Chinese data. See text for more details.

Table 4. China's Population from Population Estimates and Registration Records
(numbers in 1000s)

Year	National Bureau of Statistics Estimates	Ministry of Public Security Department of Household Registration	Annual Difference		Change in Difference From Previous Year	
			Number	Percent	Number	Percent
1990	1,143,330	1,132,740	10,590	-0.9%		
1991	1,158,230	1,145,110	13,120	-1.1%	2,530	0.2%
1992	1,171,710	1,155,630	16,080	-1.4%	2,960	0.2%
1993	1,185,170	1,165,970	19,200	-1.6%	3,120	0.3%
1994	1,198,500	1,176,740	21,760	-1.8%	2,560	0.2%
1995	1,211,210	1,187,880	23,330	-2.0%	1,570	0.1%
1996	1,223,890	1,198,660	25,230	-2.1%	1,900	0.1%
1997	1,236,260	1,209,030	27,230	-2.3%	2,000	0.1%
1998	1,248,100	1,218,180	29,920	-2.5%	2,690	0.2%
1999	1,259,090	1,228,120	30,970	-2.5%	1,050	0.1%

Source: 1990-1999 figures from Cui (2000). These figures were compiled prior to the taking of China's 2000 census.

Figure 1. China's Population as of November 1, 2000, by Age: 2000 Census Count versus Projection to 2000 from 1990 Census

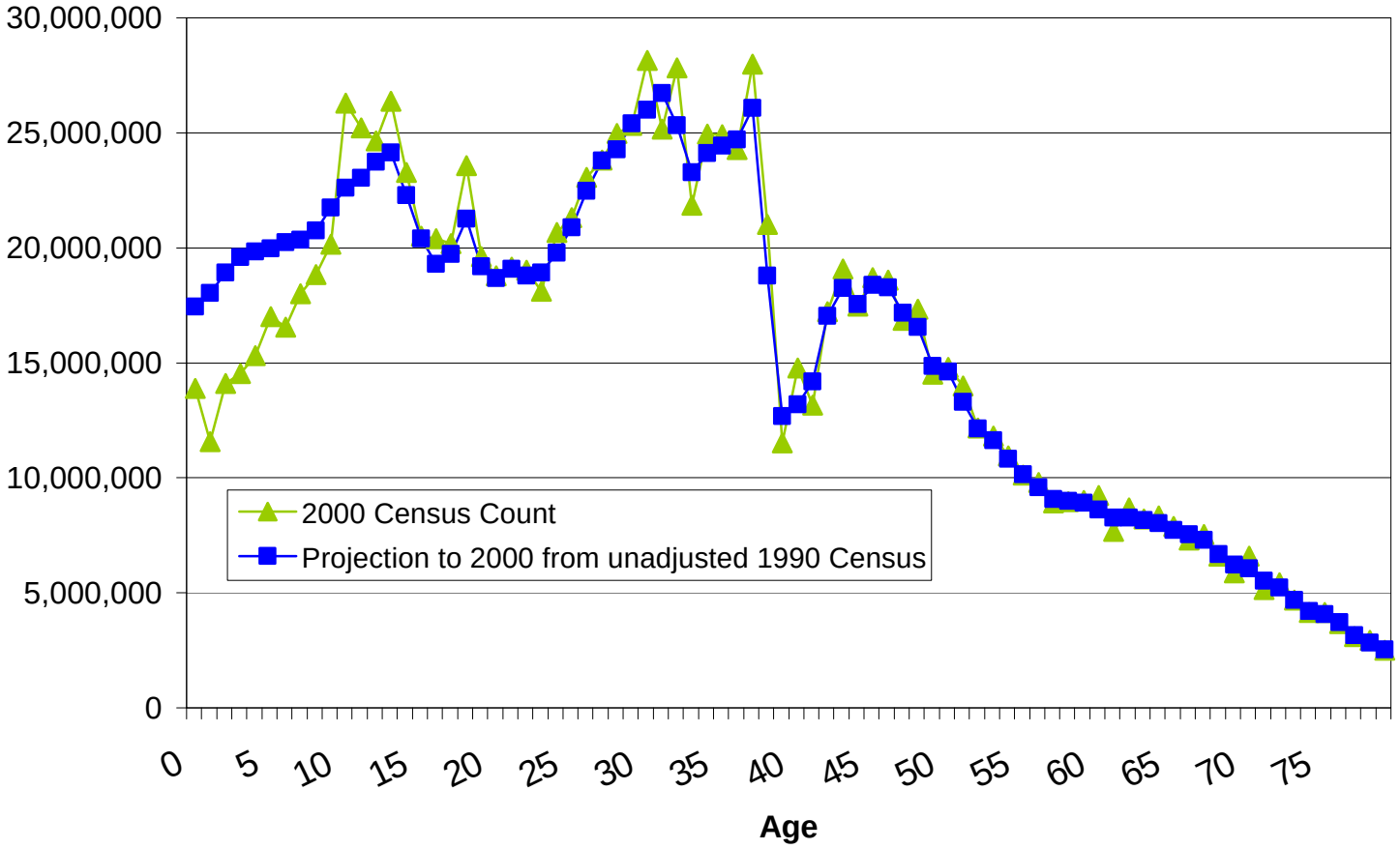
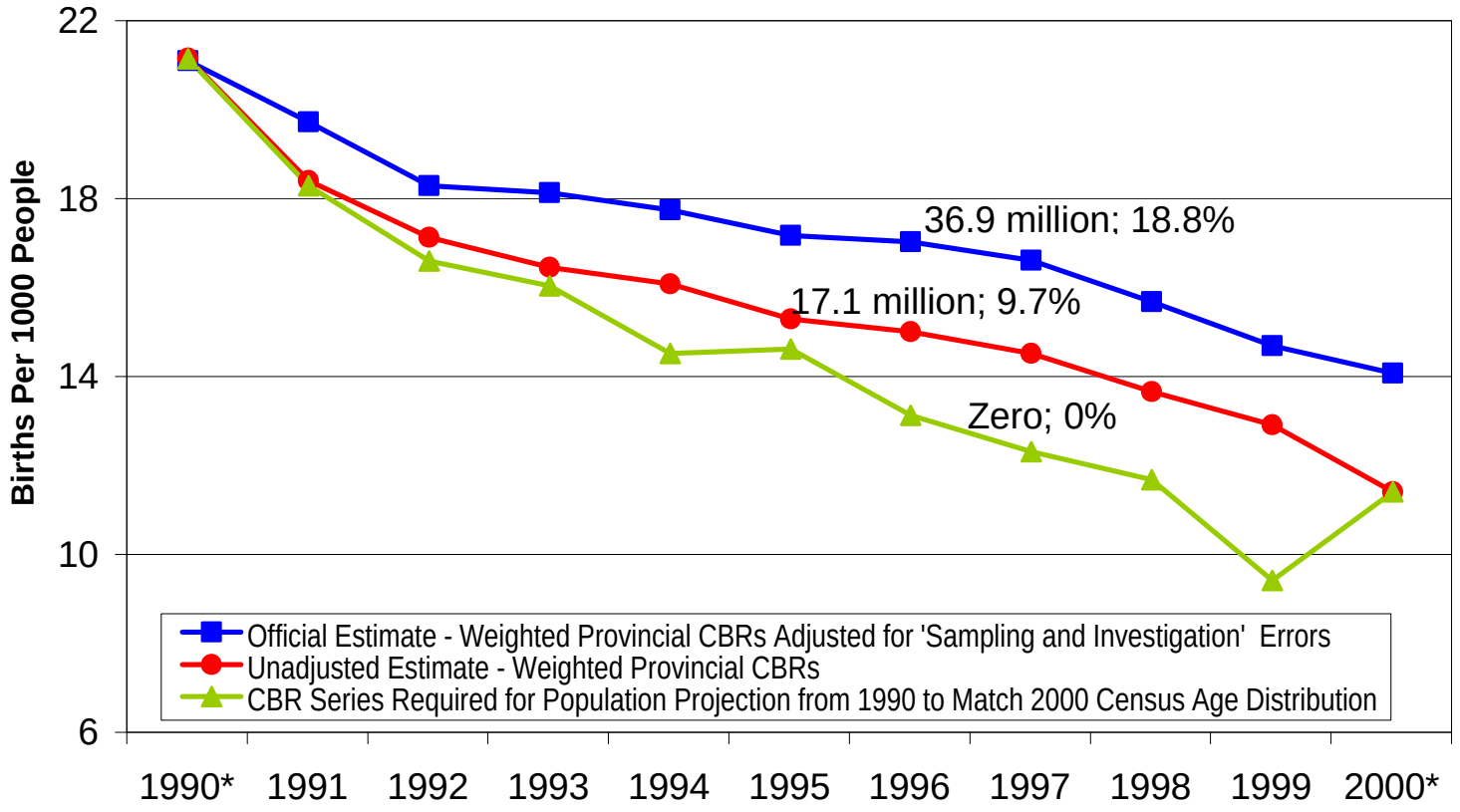


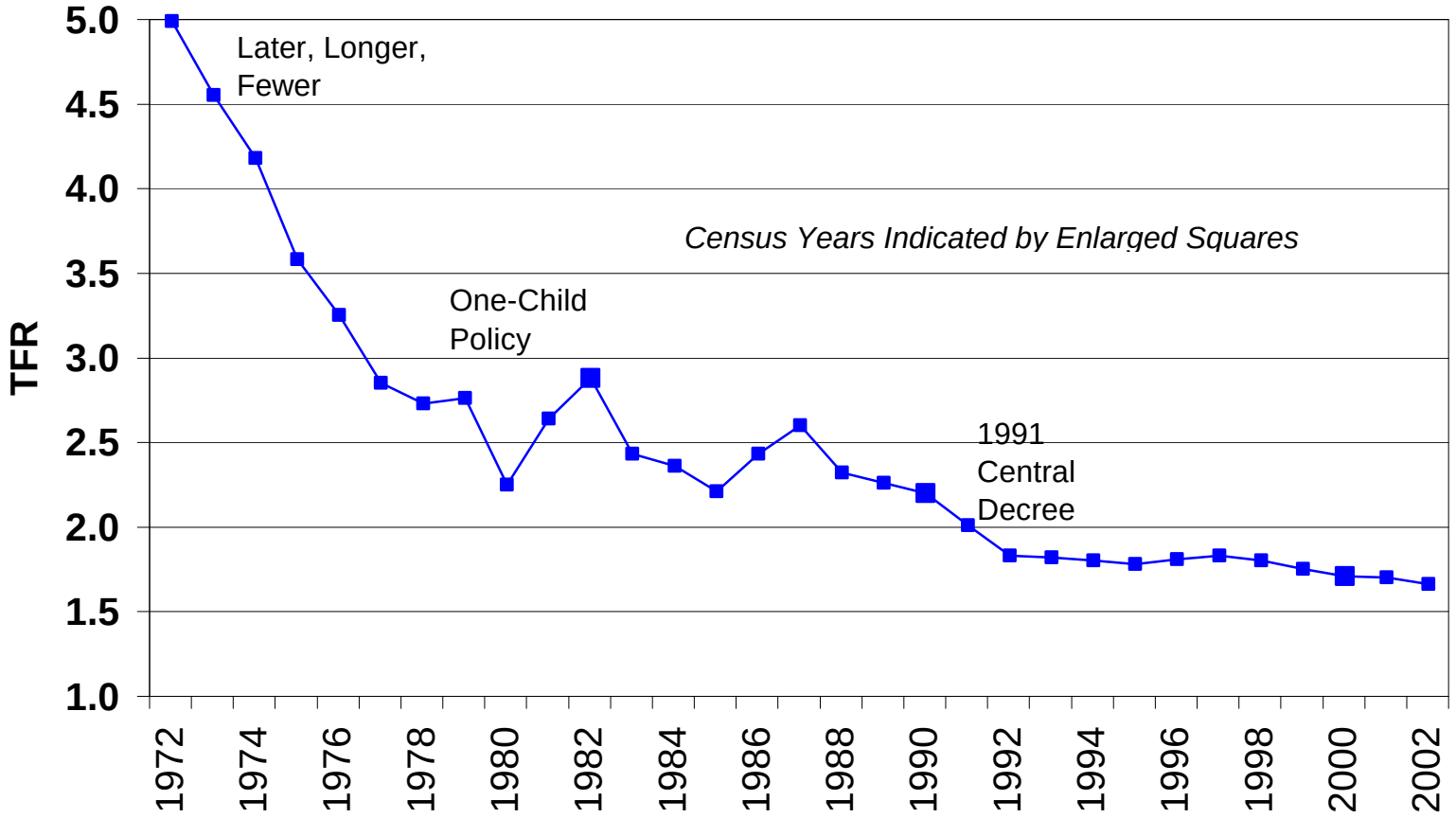
Figure 2. Crude Birth Rates in China, 1990-2000; Three Scenarios and Implied Numbers and Proportions of Children Underreported Below Age 10 in 2000 Census



*Census Years

Source: Top Line: National Bureau of Statistics (2002), Population Census Office (1993, 2002); Middle Line: Weighted average of. provincial CBRs from National Bureau of Statistics (2002); Bottom Line: Calculated from top line and data from Table 1.

Figure 3: China's Major Fertility Policy Enactments and Total Fertility Rates (TFRs), 1972-2002



Source: TFR series derived/converted from official crude birth rates (China Statistical Yearbook, 2003 and 1991).

Appendix 1. Aggregated Inputs Used in Projecting China's Population from 1990 to 2000

	<	Both Sexes Combined	>	
Year	Total Fertility Rate	Life Expectancy (years)	Infant Mortality Rate (1Q0)	Net International Migration (numbers)
1990	2.19	68.8	42.7	-300,000
1991	2.00	69.0	41.2	-322,094
1992	1.82	69.2	39.8	-344,188
1993	1.81	69.4	38.5	-366,281
1994	1.79	69.6	37.2	-388,376
1995	1.77	69.8	35.9	-410,470
1996	1.80	70.0	34.7	-432,563
1997	1.82	70.1	33.5	-454,658
1998	1.79	70.3	32.4	-476,751
1999	1.74	70.5	31.3	-498,846
2000	1.70	70.7	30.3	-520,939

Source: U.S. Census Bureau, International Data-Base 2004 (http://www.census.gov/ipc/www/idbnew.html). Total fertility rate inputs in our projections are chosen so that crude birth rate outputs match official estimates (National Bureau of Statistics, 2002). For estimates and adjustments of other parameters, see text. Inputs by age and sex not shown.