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Is Demography Just a Numerical Exercise? Numbers, Politics, and Legacies of China's One-Child Policy

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Demography, as once advertised on the cover of this journal, is "the statistical study of human populations." In the long history of the discipline, tracing back perhaps to John Graunt's primitive construction of the life table in 1662 (Smith and Keyfitz 2013/1977), the statistical study of human beings has expanded well beyond earlier interests, which were mostly concerned with relationships between vital rates and population size and composition. While many researchers still distinguish between demography and population studies, *Demography*, as the flagship journal of the Population Association of America (PAA), now encompasses scholars from anthropology, economics, geography, political science, public health, sociology, and many other fields. Demographic processes and outcomes are seen as among the best measures to understand human societies and changes. Practitioners in the field now study social phenomena ranging from health to wealth, from

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inequality to animosity, using a demographic perspective to examine the connections between social, economic, political, and cultural forces and demographic processes. Today, among the thousands of members of professional organizations in the field of demography who flock to professional meetings across the globe and publish their research outcomes in professional journals and other outlets, only a very small proportion still live a professional life of calculating vital rates and projecting population outcomes of changing vital rates.

For those who use population projection methods to examine population change, most do so with caution and humility, making clear that their projections are just projections, outcomes of statistical exercises driven by a certain set of assumptions. One good example is the population projection conducted by the United Nations Population Division (UNPD), which more than any other agency in the world has the responsibility and technical capability of providing authoritative global and national population projections. In May 2011, the UNPD (2011) published World Population Prospects (WPP) for 2010. In comparison with its 2008 edition (UNPD 2009), UNPD's 2010 projection for China, the largest national population in the world, was revised drastically downward, with a difference in peak total population between the two projections of 67 million (from 1.463 to 1.395 billion). The difference in projected population size for 2050 is even larger, *by 120 million*. The primary reason for such vast differences, only two years apart, is a downward adjustment of China's fertility level and assumptions of China's fertility trend between then and 2050 (Cai 2012).[1] Similarly, the 2012 revision (UNPD 2013) changed the projected fertility rates for a number of low-birth-rate countries in response to demographers who argued that although the *statistical* model was internally logical, it did not square with the *social* experience on the ground (Basten 2013). These examples illustrate not only how projections just a few years apart by the world's most authoritative population projection agency can be so different, but also how a responsible organization carries out its work with caution, humility, openness, and a willingness to listen and engage. As UNPD (2017:3) stated in its WPP 2017 report, "There is inherent uncertainty in population projections, which depend on assumptions about plausible future trend in specific demographic variables."

Yet, not all practitioners of population projections approach their work with such a sense of responsibility and humility, keeping in mind the mechanics as well as the limitations of their projections. Some take their exercises too far, bestowing on their work a scientific certainty situated between shaky and non-existent and a social interpretation situated between questionable and even misleading. We call this type of work "spreadsheet demography."

Spreadsheet demography sees human beings as "units" to fit into a demographic model in which parameters are "free" to vary without consideration of their empirical or sociological meaning. To be absolutely clear, this is not to say that such demographers do not view the subjects of their work sympathetically or with care. Sometimes, however, numerical exercises can also be presented in such a way as to contribute—knowingly or not—to an undesirable social outcome. A simplified message, derived

[1] UNPD has continued to revise and refine its population projections since then, as it did in the past, with updated information of demographic parameters as input and new assumptions. The latest edition, published in 2017, projects a peaking year of 2029 with a peaking population number for China at 1.442 billion (UNPD 2017).

and presented unidimensionally, can underestimate the multidimensional complexity of society. It is these exercises that follow the fashion of "spreadsheet demography," exercises that are devoid of critical self-reflection, wedded to outdated theories and divorced from social and cultural realities that give demography and demographers a bad name (Greenhalgh 1996). In other words, in spreadsheet demography, *population* takes primacy over *people*.[2]

There is no better and more important example to appreciate the power—and the perils—of spreadsheet demography than the subject matter we examine in this comment: the process of fertility decline in the largest human population on earth and, in particular, the role of China's birth control programs, especially the one-child policy.[3] In a recent article published in this journal, Daniel Goodkind makes an eye-catching claim: the birth control programs enforced by the Chinese government contributed to an "astonishing" 1 billion "averted births," and "China's one-child program *itself* averted a population of 400 million by 2015," a number that confirms "the current official estimate" (Goodkind 2017a:1375).[4] The basis for this confirmation exercise[5] is demographic projections built on a set of seemingly sophisticated counterfactuals.

Using this confirmation exercise as an example, we examine here the pitfalls and harms of spreadsheet demography. First, we offer a brief background on the use of numbers—specifically, "the number of births averted"—within the political context of China's birth control programs in general and the one-child policy in particular, as the confirmation exercise's newly arrived results echoing and, in fact, "matching the current official estimate" (Goodkind 2017a:1394). Second, we focus on the specific counterfactuals presented in this confirmation exercise and their methodological flaws. Third, and perhaps most importantly, we discuss criteria that demographers and social scientists in general should consider when assessing social engineering programs like the one involved in China's fertility decline, and we discuss two common misconceptions that have sometimes clouded our judgment in studies of demographic processes: demographic determinism and treating populations only as numbers. Whereas the case under examination is China's fertility transition and the legacies of the one-child policy, the lessons we learn from this example bear relevance for demography and demographic research more generally.

[2] We use the term "spreadsheet demography" metaphorically. This is not a label for works carried out with spreadsheet programs, but a term to characterize demographic exercises (including population projections) undertaken without considering their empirical or sociological meaning, that are devoid of critical self-reflection, and that take primacy of population over people.

[3] Although not all Chinese were equally restricted in their births over the policy's three and half decades, the one-child restriction applied to a majority of the population (Gu et al. 2007). The Chinese government formally announced the ending of the one-child policy in October 2015 (Wang et al. 2016). China still has a birth control policy in place today, with restrictions on births at parity three and above. This remaining practice is likely a transitional step before totally abolishing all forms of mandatory birth control.

[4] In Goodkind's (2017a) article, our research is used as a straw man. Yet, we and almost all those whose works are criticized in that article were not invited to review and to respond prior to the paper's publication.

[5] As Goodkind (2017a) acknowledges, his article took several iterations before being published in *Demography*, including two versions presented at the 2016 and 2017 annual meetings of the Population Association of America (Goodkind 2016, 2017b), and an earlier working paper (Goodkind 1992). We refer them collectively as "the confirmation exercise."

400 Million, 1 Billion, or 3 Billion?

In the middle of the first decade of the new millennium, China's National Population and Family Planning Commission (NPFPC) was facing an existential crisis. By that time, China's latest census conducted in 2000 and multiple other sources had all but confirmed that fertility in China had dropped to well below the replacement level in the preceding decade (Feeney and Yuan 1994; Guo 2004a, b; Retherford et al. 2005; Zhang and Zhao 2006). Even those who were skeptical of data quality arrived at the same conclusion after a round of data triangulation exercises (e.g., Goodkind 2011). The NPFPC, a ministry-level state bureaucracy created in 1981 specifically for birth control, refused to recognize fertility numbers from the 2000 census and other surveys, including its own, and insisted that the fertility level was higher and facing high risk of "rebounding" (NPDSP 2007). Even China's National Bureau of Statistics (NBS), the official source for all government statistics, had decided to part ways with the NPFPC after years of disagreements over the fertility level in China. In 2007, the NBS published its own fertility estimates, finding a total fertility rate (TFR) number of 1.6 for 2005 (NBS 2007).

Another source of anxiety for the NPFPC was the fate of the one-child policy, by then already two-and-a-half decades old. Even the progenitors of the policy, which was framed as an emergency measure to halt population growth in late 1979 to 1980, conceded that such a controversial and costly policy was meant to last for only 30 years (Central Committee of the Communist Party of China 1980). Anticipating the end of the policy, Chinese scholars and former government officials formed a research group at the turn of the century to systematically examine policy content, implementation, effects, and social consequences, as well as steps to phase out the policy (Hvistendahl 2010). After three years of research on a range of topics related to the one-child policy, this group, which included almost all leading Chinese demographers, submitted a collective policy proposal based on their studies in spring 2004 to the leaders of NPFPC and to China's top leaders. Meanwhile, many other social groups had started to openly voice their opposition to the one-child policy. The NPFPC was under increasingly intense pressure to provide its superiors and the public solutions to two critical issues: what should be China's next step in its birth control program, and what would be the fate of the commission itself?

It was in this context that the Minister of the commission, Zhang Weiqing, published an article in May 2006 in the official journal of the Central Committee of the Communist Party of China, *Qiushi* (translation: "Seeking Truth"), declaring that up to the end of 2005, China's mandatory birth control programs, which became nationwide policy starting in 1970, a decade before the launch of the one-child policy, had prevented 400 million births. Minister Zhang credited his claim to "a study by experts" and urged birth control officials and the public to continue their efforts of birth control (Zhang 2006). To make his point, Minister Zhang emphasized that "the births prevented" *did not* include those averted as the result of other factors, such as socioeconomic development; hence, he gave total credit for the "400 million births averted" to China's birth control programs. The Chinese public, accustomed to such government propaganda, understood that such a number was intended to justify the continued relevance of the birth control bureaucracy and was a form of resistance to calls to phase out the one-child policy.

Three years later, the "400 million averted births" estimate was injected with new life. A vice minister of the NPFPC, while attending the 2009 United Nations Climate Change Conference in Copenhagen, repeated this number to the international media and linked this number of "averted births" to China's contribution to fighting global climate change (Population Control Called Key to Deal 2009). When "400 million averted births" resurfaced in 2009, the starting point for this number was also conveniently but mysteriously shifted from 1970 to 1980, with "the total number of births averted" kept as the same at 400 million, thus giving all the credit of "averted births" to the government's launching of the one-child policy. Some journalists and scientists working on a simplistic understanding of the link between population and the environment celebrated this huge number as a triumph. As recently as in 2014, a special issue of *The Economist* still credited China's one-child policy as the fourth most important out of 20 policy actions taken to reduce CO_2 emissions, following the Montreal protocol, the use of hydropower worldwide, and the use of nuclear power worldwide (Curbing Climate Change 2014).

As the claim of "400 million averted births" started to gain currency and influence, two authors of the current article examined the original study on which the claim was based and wrote an article to point out the very fragile underpinnings of the number presented in that study (Wang and Cai 2010). We learned that the study was sponsored and conducted by China's State Family Planning Commission (SFPC), the predecessor of NPFPC, and was headed by a former vice minister of the SFPC. Our examination of that report also revealed that the original study was nothing more than a numbers exercise, and a very simplistic one. To calculate the number of births averted, the authors of that study used a simple linear extrapolation approach, assuming that China's crude birth rate would continue an imposed linear trend between 1950 and 1970.[6] The authors of that study assumed that this linear trend could continue from 1970, the beginning of China's mandatory nationwide birth control programs, to 1998, when the study was completed. The authors compared this extrapolated line of birth rates with the observed birth rates for China for each of the years between 1970 and 1998, arriving at 338 million births averted at as a result of the differences between the two birth rate trajectories (Yang et al. 2000).

To demonstrate the fragility of the claim of 400 million averted births, we used two simple comparisons: (1) one with a counterfactual using the average crude birth rates of 16 countries that had a crude birth rate similar to China's and a population size over 1 million in 1970, and (2) another simple comparison of China's fertility rate after 1970 with those of four Asian countries (India, Indonesia, Iran, and Thailand). We noted that all countries experienced different degrees of fertility decline; in particular, Thailand, which had no coercive birth control policy, had similar (but smoother) fertility decline trajectories compared with China (Wang and Cai 2010; Whyte et al. 2015). Our calculations and criticisms of Yang et al.'s (2000) study, however, were not intended in deriving a better estimate of "the number of births averted." In our view, such estimates based on a simple demographic exercise are highly unreliable and, more importantly, pose a high risk of misinterpretation, a point we will address in more detail later in this article.

[6] The real change of crude birth rate in China between 1950 and 1970 was anything but a clear linear trend. During that period, China experienced huge swings in birth rates—from 34.0 per thousand in 1957 to 18.2 per thousand in 1961, and then to 43.4 per thousand in 1963—a result of the Great Leap Forward movement and the following famine.

Although it should be clear by now that the estimate of "400 million births averted" was a politically motivated construction with little scientific grounding, the message has stuck. Indeed, "400 million averted births" was not deemed "astonishing" enough. Goodkind's (2017a) recent *Demography* article further suggests that fully *1 billion* births have been averted. How different is the new calculation from the previous ones? The NPFPC's original claim was that 400 million births were averted by 2005, but the confirmation exercise actually showed only 257 million averted by that year if using Vietnam as the counterfactual (an issue we will return to in the next section) and only 381 million if using the 16 countries we originally selected but with the author's new projections. Even stretching the time span to 2010 and using Vietnam as the preferred counterfactual, the estimated births averted was still only 313 million, about 100 million fewer than the number claimed by the Chinese government. So this new exercise actually proved the critique it criticized—namely, that the Chinese government previously exaggerated its claims of 400 million averted births.

How, then, did Goodkind (2017a) arrive at the staggering number of 1 billion births averted, which is more than double the claim by China's birth control agency itself? To achieve a desired number in demographic projection exercise takes little imagination: it can be done by stretching the projection end point, by selecting a counterfactual that helps to make the best case, or both. This is exactly what Goodkind (2017a) did to calculate births averted. To arrive at the number of 1 billion averted births, he more than doubled the time length of projection—going forward no fewer than 50 years, to 2060[7]—and picked the 16 comparator countries as a counterfactual (see Goodkind 2017a:1384, last row of his table 2). In other words, the estimate of 1 billion births averted relies on *only two factors*: (1) more than double the projection time, and (2) the use of comparators that are highly dissimilar to the case in comparison.[8] Anyone with a basic familiarity of population projection methods and with some minimal knowledge of China and the 16 countries used as a comparator should have serious doubts about this "astonishing" new estimate and dismiss it as nothing more than a fanciful but ultimately meaningless exercise. Any small difference in initial assumptions, as a trained demographer should know, can lead to enormously different outcomes if a projection is taken indefinitely into the future (Basten et al. 2013).

As it turns out, the estimate of 1 billion is *not* by far the most staggering projection when it comes to China's birth control program. Nearly four decades ago, as China's post-Mao leadership was gearing up to propose a more extreme birth control policy, a much larger and scarier number was thrown to the Chinese public: *4.3 billion*. Song Jian, a missile scientist whose population projections were used as "scientific proof" by politicians in support of the one-child policy (Greenhalgh 2003, 2008), calculated that

[7] Goodkind (2017a) provides no explanation or justification why 2060 was chosen as the end point of his examination. One likely reason is that because his fertility convergence assumption (to a TFR of 1.5) determines the total population of his 16-countries counterfactual to have negative growth around 2060, thus he would produce a smaller number of so-called averted births had he further extended his projections to a future time—say, 2080.

[8] Our use of the 16 countries as comparators, as we discussed in our published papers (Wang and Cai 2010; Whyte et al. 2015), was not to claim China was similar to these countries, but to expose how simplistic the calculations sponsored by the Chinese birth control agency were, and to illustrate how these countries with similar birth rate level back in 1970s all experienced fertility decline in the absence of an extreme birth control policy like the one in China.

in the absence of drastic birth control policy, China's population would reach 4.3 billion by 2080. His group's projection was simple and familiar: it used an implausible rate of fertility and a long time span. If one uses the population projection scenarios by Song and colleagues (Song and Li 1980; Song et al. 1980)—namely, a total fertility rate of 3 and a time span of 100 years, from 1980 to 2080—the estimated births averted would not be 1 billion, but more than 3 billion.[9]

The Perils of Spreadsheet Demography

The newly constructed figures of births averted come with seemingly more sophisticated assumptions and counterfactuals in comparison to the simple projections by Yang et al. (2000) or Song and colleagues (Song and Li 1980; Song et al. 1980). A closer examination shows that it is still no more than an example of spreadsheet demography. Worse yet, the exercise is based on distorted facts and contradictory demographic assumptions.

Making a case for the "births averted" and giving full credit to China's well-known birth control program requires three components: (1) discounting or even dismissing the effects of all other potentially relevant and important factors; (2) using unrealistic counterfactuals to help make the case; and (3) blurring the timeline or underlying processes of demographic changes. We next examine each of these three components behind the new calculation of births averted.

Did China's Fertility Transition Occur in a Socioeconomic Vacuum?

China's unique and extreme birth control policy, implemented in the particular Chinese political tradition and fashion, often leaves one with the easy impression and conclusion that fertility decline in China resulted from government coercion. And this is exactly what Goodkind's (2017a) confirmation exercise has done. To make such a case, and to match the official 400 million estimate, he dismissed as "not credible" all other studies that demonstrated the importance of China's socioeconomic development. He listed "five reasons to doubt the primacy of socioeconomic progress" and went on to state boldly that "international comparison of fertility and income suggest instead that China's very low fertility arrived two or three decades too soon" (Goodkind 2017a:1375).[10]

Can these dismissals and assertions stand up to data and more serious analyses? We do not discount the powerful effects of China's often-coercive birth control programs, and we are fully aware of the limitations of any empirical attempts, including that of our own here, to disentangle the roles of socioeconomic development and family planning programs. To us, the story is not either/or, but is instead the relative weight of each and,

[9] The 4.3 billion scenario was based on a constant TFR of 3.0 for 100 years; the TFR was from a 1975 survey. In a later edition of their calculation, when more reliable fertility data had become available showing that the 1975 TFR was about 3.6, Song and Yu (1985:246) claimed in a footnote that "such a difference in fertility has no effect for population projection."

[10] This statement is not consistent with the fertility assumption he used in his projection, which assumes that fertility for all the counterfactuals converge to a TFR of 1.5 by 2060. If that assumption is true, China's very low fertility is not "two or three decades too soon," but more than a half-century too soon.

more challengingly, their interactive effects as well as their effects at different phases of China's fertility decline.[11]

The Chinese case was often perceived as an outlier in the global fertility transition, partly because of its unique government birth control programs and partly because its fertility transition started when the country was extremely poor as measured by GDP per capita. However, if we look beyond the simple (macro) economic determinism, the picture is rather different. The fact that China's fertility level was much below the correlation line for GDP per capita or urbanization reflects the nature of the Chinese planned economy at the time, with its low-income, high-accumulation, and "industrialization without urbanization" development model. During China's socialist years and preceding to the implementation of the one-child policy, China had already made noted achievement in health and female literacy (Banister 1987; Banister and Preston 1981; Jamison et al. 1984; Walder 1989), two of the critical factors generally acknowledged as the preconditions for fertility decline in modern times (e.g., Mason 1997) and as explanations for the onset of China's fertility decline (Freedman et al. 1988; Lavely and Freedman 1990; Poston and Gu 1987; Wang 1988). As shown in Fig. 1, for both female secondary education enrollment rate and under-five mortality, China's fertility level in 1976—the first year for which we have data from the World Development Indicators (World Bank 2017) for these two development measures—was not far from the line showing the association based on global data. Chinese socialism was also unusual in producing close to universal, full-time employment of married women in urban regions, another factor discouraging high fertility (Whyte and Parish 1985). One could thus make the case that when the Chinese government launched its earlier birth control program, the Chinese public was largely "ready" to reduce their fertility because rapid improvements in health in earlier decades meant that fewer births did not equate with fewer surviving children.

There is no denying that the Chinese government sponsored, and in fact enforced, birth control programs to tame rapid population growth. As with everything else in the 1970s in China, birth control, when it became a government program, was included in its five-year and annual plans and was carried out as a mass campaign combining propaganda with coercion. Our analyses of induced abortion and contraceptive operation statistics showed that when the "later, longer, fewer" campaign began in the early 1970s, cases of IUD insertions spiked (Whyte et al. 2015). However, the more intense campaigns came after the mid-1970s, and especially around 1980, when the birth control program in China took a decisive turn (Liang 2014a).

We might also observe some similarities to other settings, especially the East Asian Tigers, which also saw rapid fertility decline under strong, albeit noncoercive family planning policies. It is common knowledge to readers of this journal that Hong Kong, Taiwan, Macau, and Singapore have large or predominant Chinese populations with very low fertility rates. Furthermore, the fertility rate of the Chinese diaspora, such as the Chinese population in the United States, is lower than among other groups (Morgan

[11] Although the debate about the role and the effectiveness of government policies in fertility transition is ongoing (Bongaarts 2011; Bongaarts and Sinding 2011; Bulatao 1993; Casterline and Sinding 2000; Jain and Ross 2012; Tsui 2001; Shen et al. 2017), general consensus is that socioeconomic development is the fundamental force driving fertility change in the long run but that government policy could play an instrumental role in the relatively short term under the right social and cultural contexts.

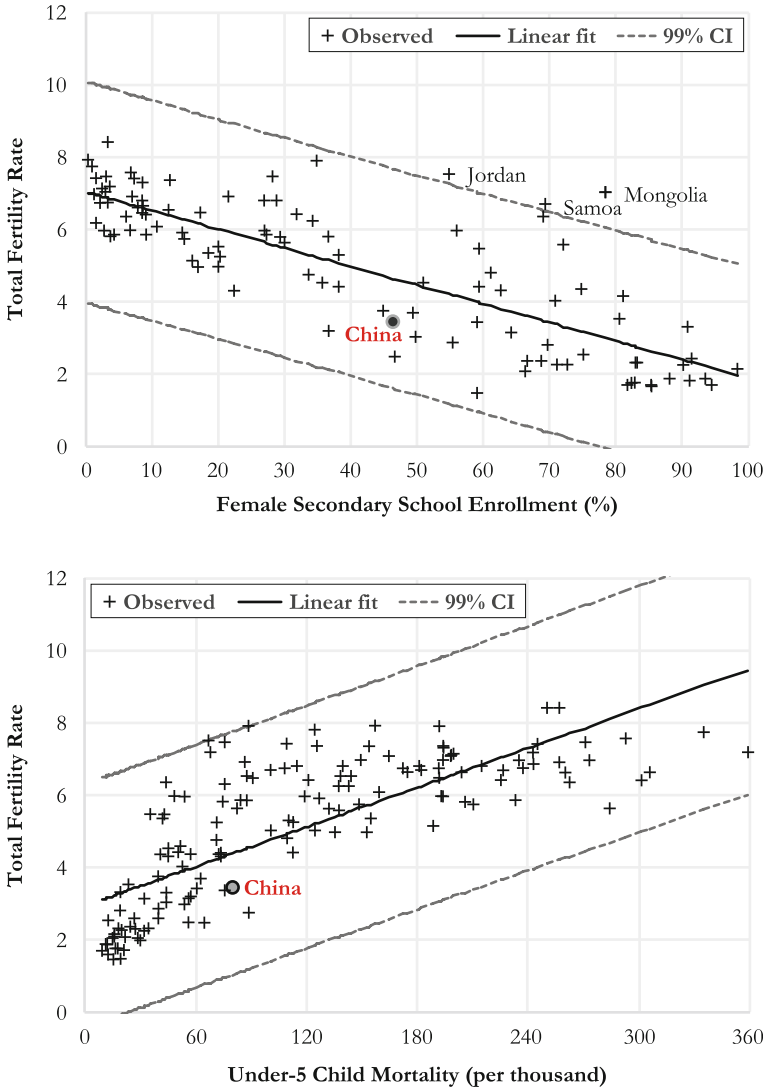

Fig. 1 Correlations between female secondary school enrollment, under-five mortality and TFR, 1976. *Source:* World Bank (2017)

et al. 2017). None of these groups were subject to Chinese state birth control restrictions.

China's descent into below-replacement fertility in 1991, the same year as the introduction of "one-vote veto," also coincided with and followed China's spectacular economic boom—a boom that is already the most-told story of modern economic transformation and growth. In the three-and-a-half decades when the one-child policy was in force, China moved away from a centrally planned economy and transformed into a market-oriented economy that is increasingly global. During this period, China saw massive internal migration, urbanization, and rapid expansion in education, including tertiary education. Per capita income increased nearly 40-fold in 36 years, from

220 in 1980 to 8,260 in 2016, in current dollars (World Bank 2017). By the early twenty-first century, China's fertility level was largely in line with its GDP per capita level, and it was no longer an outlier from that perspective even globally (Cai 2010).

Did China's fertility drop to "very low fertility two or three decades earlier than socioeconomic progress would warrant" had China "not imposed draconian penalties" (Goodkind 2017a:1376, 1389)? Demographic trends around the world suggest that the transition to very low fertility is an increasingly common feature. What can be learned about the relationship between fertility and income from Goodkind's international comparison is this: there is no so-called income threshold for reaching the very low fertility. The countries listed in his comparison reached a TFR of 1.5 at very different levels of GNI per capita, ranging from $3,000 to $38,000. It is thus untenable to conclude that "comparisons across countries surpassing similar income thresholds suggest instead that China's very low fertility arrived two or three decades too soon" (Goodkind 2017a:1375).

How Good is Vietnam as a Single Case Comparison?

For his confirmation exercise, Goodkind selected Vietnam as "the best national comparator and provided a sense of what China might have experienced had it maintained a two-child limit with less draconian enforcements" (p. 1383).[12] To justify this selection, he chose a number of indicators to show "striking similarities" and relied on one sentence borrowed from a respected scholar, "there is no country more similar to China than Vietnam, and there is no country more similar to Vietnam than China."[13] The author (Womack 2009) whose one sentence was taken out of context, however, also continued by noting differences between Vietnam and China:

> Vietnam is a smaller economy, and it is less wealthy than China. China has had the advantage of seven additional years of reform and openness, and it did not have the disadvantages of war and of lingering international hostility. The United States normalized relations with China in 1979, but with Vietnam only in 1995.

[12] Goodkind also suggests that in our earlier publications, we were neglectful in not including Vietnam as one of the 16 comparison countries. He further states that "Given all these similarities, the near total neglect of Vietnam as a comparator by China population experts is conspicuous" (Goodkind 2017a:1380). Had he followed more closely the data sources on Vietnam (given his job responsibility at the U.S. Census Bureau's International Program) or checked with us, he would have learned the reason. In 2010, when our initial article was written, we used data provided by the World Bank (2010) to find countries that had crude birth rate (CBR) of between 30 and 38 per thousand (enveloping China's CBR of 33.4 in 1970) and a population of 1 million or more in 1970. Vietnam's crude birth rate in the WDI 2010 was 40.6 (with a TFR of 7.0), outside the range that we chose. The UNPD subsequently revised Vietnam's population data between 2010 and 2014. By 2014, the UNPD had changed Vietnam's CBR for 1970 to 36.5 (and its TFR to 6.4). This revision could have been partly due to a major adjustment in Vietnam's mortality, which would lead to adjustment in fertility as well: between 2010 and 2014, UNPD revised Vietnam's life expectancy for females in 1970 from 51.5 to 65.0, a jump of 13.5 years! This adjustment, as the examples we give in the beginning of this article for China, illustrates again that estimates are subject to revision and demonstrates how serious demographers do their work.

[13] The sentence immediately preceding the one noting similarities between China and Vietnam is, "To the constant irritation of the Vietnamese, external observers are struck with the similarities between China and Vietnam" (Womack 2009:10).

> Moreover, Vietnam entered the WTO in 2007, while China entered in 2001. (Womack 2009:10)

These observed differences between Vietnam and China are well supported by data available from the World Bank. In Fig. 2, we compare income levels, measured as GDP per capita in constant 2010 dollars, for China and Vietnam (for which data are available since 1984). In addition, we also include two other Southeast Asian countries: (1) Malaysia, given that it was used as a comparator in an earlier iteration of the confirmation exercise (Goodkind 1992); and (2) Thailand, which we used in our 2010 comparison. The vast divergence in income levels between China and Vietnam is more than evident. Back in the mid-1980s, these two countries had income levels that were not too far apart. By the turn of the century, China's per capita income level was already twice that of Vietnam; by 2015, China's was more than three times greater than Vietnam's. The same divergence can be observed in the level of urbanization, as shown in Fig. 3. Up to 1980, China and Vietnam had roughly the same level of urbanization. Thereafter, their urbanization levels vastly diverged, as with the case in income growth. By the turn of the century, urbanization level in China rose to 35.6 %, compared with Vietnam's 24.4 %; by 2015, the gap further increased, with China at 55.6 % and Vietnam at 33.6 %. Today, more than half of China's population live in urban areas, compared with about one-third of Vietnam's population.

These vast economic differences between China and Vietnam, we believe, could help explain the difference in fertility levels between these two countries, especially after the mid-1980s. In Fig. 4, we plot trends in fertility for four countries: China, Vietnam, Malaysia, and Thailand. After the mid-1980s, the one of these four countries that China resembles most is not Vietnam, but Thailand. In fact, the trends and levels in China are highly similar to those in Thailand, a country that did not have coercive birth planning policies. Moreover, as shown in Figs. 3 and 4, although Thailand had higher income and urbanization levels than China earlier on, the gaps between these two countries have quickly closed and even reversed, especially in the last two decades. If Thailand is seen as a reference, a country that now has similar income level, lower

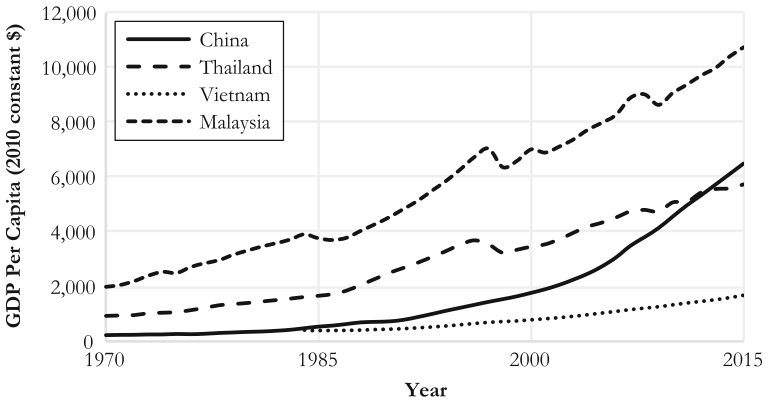

Fig. 2 Per capita GDP (constant 2010 dollars): China, Vietnam, Malaysia, and Thailand, 1970–2015. *Source:* World Bank (2017)

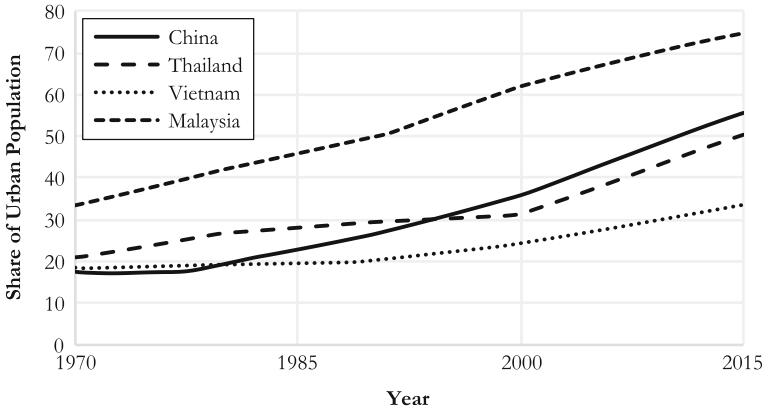

Fig. 3 Share of population as urban: China, Vietnam, Malaysia, and Thailand, 1970–2015. *Source:* World Bank (2017)

urbanization level, and a very similar fertility level compared to China, it is hard to be convinced that "China's very low fertility arrived two or three decades too soon" (Goodkind 2017a:1375).

Here we add a note about Malaysia, a country that until recently had a much higher level of income and urbanization, but also a slower descent toward replacement-level fertility. In an earlier version of the confirmation exercise attempting to arrive at a "number of births averted" in China, Goodkind (1992) used Malaysia (and especially "the Chinese population in Peninsular Malaysia") as "a plausible alternative trajectory" (p. 10). We do not know why he replaced Malaysia in this new iteration with Vietnam and the 16-country group (as well as India). However, in recent years, Malaysia's fertility level has also dropped to replacement level, and fertility for the Chinese in Malaysia had dropped to 1.4 by 2014 (Department of Statistics Malaysia 2015). Obviously, neither Vietnam nor Thailand (nor, for that matter Malaysia) was China. Each country has its idiosyncratic social, cultural, and historical context, and thus a single case comparison should be used only as a reference point and not a judgment criterion.

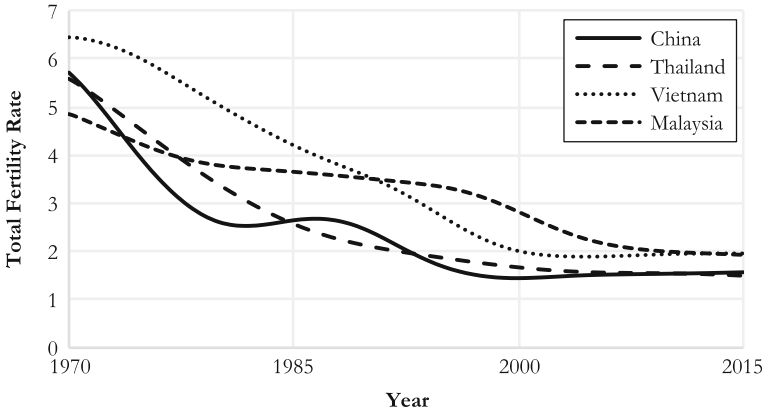

Fig. 4 Total fertility rates: China, Vietnam, Malaysia, and Thailand, 1970–2015. *Source:* World Bank (2017)

If Vietnam is indeed used as a comparator, given that Vietnam lags behind China both in birth planning and in socioeconomic development, then one would expect China to reach below-replacement fertility *before* Vietnam. However, the confirmation exercise's Vietnam-based counterfactual for China reaches replacement-level fertility in 2002, *after* Vietnam; indeed, according to the 2015 WPP (UNPD 2015), Vietnam reached replacement-level fertility in 2001. Of course, this contradiction would not matter when it comes to matching the official estimate of "400 million" because the "best comparator" will be just ignored.

How to Match the "400 Million Averted Births"?

The most alarming claim that Goodkind (2017a) made is that "(b)y 2015, given ongoing excess fertility in the comparator, increases in young mothers, and population momentum, the estimated population averted under the one-child era was 400 million" (p. 1386). He even offered a suggestion: "Instead of attacking official claims that the one-child decree averted 400 million births—a strategy that ensured the resistance of central policymakers—what if advocates had publicly confirmed that estimate and emphasized that the impact was destined to grow far larger?" (Goodkind 2017a:1395).[14] The problem is that there is no such 400 million averted births to confirm.

The confirmation of 400 million averted births is a textbook example of spreadsheet demography. In addition to dismissing the socioeconomic context of demographic change, shifting the goal post of projection end point, and using comparators that seem stretched and arbitrary, the exercise relies on numerical manipulation with two flawed demographic assumptions.

First, the confirmation exercise of "400 million averted births" assumes that in the absence of launching the policy, China's TFR would have jumped from 2.8 in 1979 to 4.6 in 1980. Our own calculations using the population projection input information that Goodkind provided confirm that only with such an extreme assumption can his results be replicated (see the appendix for details). Such an important assumption, however, is mysteriously missing in the main body of the text. Goodkind did not provide specific numbers in the main text, but offered two general claims: "if China had not enacted the one-child decree in 1979, its TFR should have rebounded above its presumed ceiling toward counterfactual levels," and "had China not enacted the one-child decree in 1979, fertility should have rebounded above three births per family" (Goodkind 2017a:1386, 1394).[15] Obviously, as a numerical exercise, a jump of TFR from 2.8 to 4.6 in one single year can be programed in computer code, but it is absurd in reality and should give pause to any demographer or even a layperson.

[14] What Goodkind misses here was that the 400 million estimate was exactly what the Chinese birth control officials used to defend the one-child policy and to scare the public into believing that another baby boom and population explosion would ensue if the policy were abandoned.

[15] Goodkind (2017a) cites his Fig. 1 in the article and also a paper presented at the 2017 annual meeting of the Population Association of America (PAA) (Goodkind 2017b). The figure in the article simply illustrates the gaps between China and the constructed counterfactuals, saying nothing about the jump itself. The cited 2017 PAA paper is a PowerPoint presentation in which the rebound was illustrated with a hand-drawn line as a gradual process in the early 1980s, peaking at TFR of 4.0 around 1985, and then gradually declining and reaching replacement around 2000, which is certainly not the same as what is presented in his published 2017 article.

To support the assumed huge fertility rebound without the one-child policy so to arrive at the estimated effect of the one-child policy on averted births, the author made two lines of argument in one short paragraph. Both, however, are contradictory with the footnotes and citations in the same short paragraph. On one line he argues for a fertility rebound because of the "sudden lowering of the minimum marriage age" immediately following the one-child policy (Goodkind 2017a:1384). However, lowering minimum marriage age in 1980 was more a result of the one-child policy, as shown in the author's own quotation of Banister's (1987) work: "authorities reasoned (incorrectly) that later marriage was rendered demographically irrelevant after the one-child decree was implemented" (Goodkind 2017a: footnote 6, quoting Banister's work). Lavely's (1984) fieldwork in Sichuan also confirms this observation. In other words, China would not have lowered the marriage age had there not been the one-child policy.[16] On the next line, Goodkind cites Whyte and Gu (1987) and argues that de-collectivization in rural China would have encouraged rural parents to have more children, thus "given de-collectivization and the childbearing opportunities lost during the 1970s, if China had not enacted the one-child decree in 1979, its TFR should have rebounded" (Goodkind 2017a:1386). Indeed, Whyte and Gu (1987:474) wrote that "that the policy was more an effort to prevent the birth rate from rebounding upward."[17] The main conclusion of Whyte and Gu's analysis, however, is that "attitudes and aspirations of Chinese peasants have been at least partially 'modernized'" with high expectation for their children's success, especially in education, by the early 1980s (Whyte and Gu 1987:487). Although Whyte and Gu's discussion was more in the context of the one-child policy, there are ample reasons to believe that such an ideational change did not start from the one-child policy and, in fact, could trace its roots to certain features in Chinese culture. It is reasonable to expect that without the one-child policy, even if there was any fertility rebound following decollectivization, it would have been only mild and short-lived because the liberalization of the Chinese economy and high aspiration of children's success would present as an increasingly important check on fertility, setting the stage not only for below-replacement fertility a decade later but also for the very low fertility levels that emerged even later.

The second flawed assumption in the confirmation exercise is in the age patterns of childbearing in China. In Fig. 5, we plot six lines of mean age of childbearing (MAC): four from Goodkind (2017a), one based on data of the observed trend in China, and one from the 2015 WPP (UNPD 2015). The four from Goodkind (2017a) bear little resemblance to what has been observed in China, to the UNPD estimate/projection for China, or to the general trends of fertility transition elsewhere in the world. As a student of demography, one learns that fertility transition starts with a decline in MAC and the reduction in high-parity births, but it continues with a reversal and a rise in MAC because of delayed childbearing. Such a pattern can be seen in the UNPD estimate/projection for China, although it portrays a reversal somewhat later, and at a

[16] The legal minimum marriage age was not lowered in 1980, but rather was increased by two years relative to the 1950 Marriage Law. Compared with the "later" marriage ages enforced during the 1970s, however, the effect was to legally permit earlier marriages.

[17] For a long time, China's birth control target was phrased in terms of annual number of births, or the (crude) birth rate. With a large cohort born after the Great Leap Forward famine entering their reproductive ages, the birth rate was expected to rise even if TFR were kept at the same level.

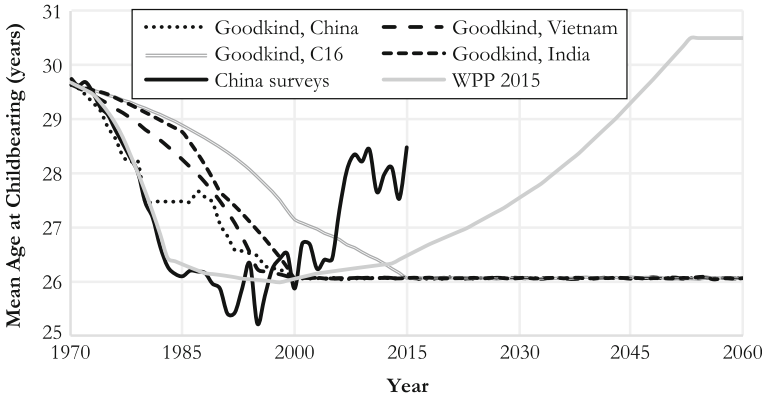

Fig. 5 Mean age of childbearing, observed versus proposed. *Sources:* The observed MACs for China are calculated using survey-based age-specific fertility rates: 1970–1981 from the 1982 fertility survey, 1982–1987 from the 1988 fertility survey, 1988–1992 from the 1992 fertility survey, 1994–2015 from either census or annual population change survey data. The three fertility survey data are from the Fertility Data of China compiled by Yao (1995), and all the census/population survey data are from NBS (1995–2016). The year 1993 is the average of 1992 and 1994. The MACs for the four scenarios in Goodkind's (2017a) calculation are calculated using the annual age-specific fertility data provided by Goodkind. World Population Prospects (WPP) 2015 uses the five-year period data provided by UNPD

slower pace compared with what has happened in China. The 400 million calculation did not use the UNPD estimates, as Goodkind claims; nor did the author give an explanation for his "adjustments." Its assumption that the 16-country counterfactual had a higher mean age of childbearing than the India counterfactual, and its assumption that China's MAC will stay fixed from 2000 through 2060 are beyond demographic common sense.

Using a "cut and paste" (Goodkind 2017a:1382) procedure to create an age pattern of childbearing for population projection reflects a lack of understanding of the intricate relationship between the quantum and tempo components of fertility (Bongaarts and Feeney 1998). Delay of childbearing as indicated by rising age at first marriage and MAC is a major factor for China's below-replacement fertility measured by period TFR (Morgan et al. 2009). This is the same mistake that the promoters of the one-child policy made: one child per couple is a cohort-based policy, and ignoring the tempo effect in its implementation led to large swings in period-based measures, such as TFR or CBR. This flaw would not be easily detected in a projection exercise because the projection results are likely to be dominated by the assumption about fertility level (quantum). Ignoring the strong delay in childbearing, however, would lead to an overestimate of period fertility.[18]

Moreover, the 400 million estimate was based on a false policy dichotomy: one-child policy versus no birth control policy. No one would realistically assume that China would stop birth control altogether in the absence of a one-child policy. The real meaningful counterfactual for the one-child policy should not be "no birth control" but

[18] One reason for China's current very low fertility is the continued rise in the age at first marriage. By 2015, the proportion of never-married women at age 30 had increased to over 10 %, from only 1 % in the 1980s. Unlike in the 1970s, when the increase in marriage age was largely due to government policy, this new round of increase is based on individuals' voluntary choice in a large context of rapid urbanization, rising educational opportunities, and gender equality (Cai and Wang 2014). We expect this trend to continue.

instead the continuation of its arguably less-restrictive birth control efforts of the 1970s. If we had to isolate the effect of the one-child policy, it should be compared with the possibility of continuing China's "later, longer, fewer" programs of the 1970s. The case of Yicheng, which Goodkind (2017a) also dismissed, and similar experiments with a two-children limit in other parts of China are actually informative about what could have happened in China in the absence of the one-child policy: a smoother fertility decline without the sharp rise in the sex ratio at birth and other negative social and demographic consequences (Gu and Wang 2009).[19]

In sum, Goodkind's (2017a) new estimate of averted births is just an example of spreadsheet demography by casual "cut and paste." It is built on distorted facts and contradictory demographic assumptions. The one-child policy did not avert 400 million births, even by 2015. For example, our own cross-examinations reveal that had the author calculated his projections with his statement that "fertility rebounded above three births per family" (p. 1394), his estimate would be somewhere between 130 and 239 million, not 400 million (see Table 1 in the appendix). But the truth is that an accurate estimate is impossible by a simple demographic projection exercise, and it would be highly misleading to pretend otherwise.

Population Versus People: Lessons From China's One-Child Policy

Our critique to this point illustrates how seemingly sophisticated demographic exercises can be vastly simplistic and erroneous by ignoring and dismissing well-established scientific facts and relationships, by choosing counterfactuals that are distorted and highly selective, and by making assumptions that are wildly unrealistic and indeed contradictory with each other, all in order to achieve a desired "astonishing" outcome. These, however, are *not* our main arguments. As we have shown, it does not take sophisticated knowledge of demographic methods, but only common sense, to see the problems in setting up a counterfactual for producing such a definitive "astonishing" estimate. What we are concerned about and would like to question is why the subject of "births averted" continues to capture some people's imagination and interest within the context of history's largest and most coercive government-sponsored birth control program.

Is "births averted" really "the single best statistic" to summarize the impact of the one-child policy, as Goodkind puts it?[20] Throughout the history of humankind, plagues, famines, wars, and natural disasters have taken a toll on human lives—some small, others massive. But never before or in other fields of scientific inquiry do scholars ask to measure the outcome of these losses in terms of the impact on population as a measure of *achievement*. It is worth noting that discussions and

[19] Goodkind dismisses the Yicheng case by quoting statistics from Wei and Zhang (2014): "Yicheng's crude birth rate was well below the Shanxi Province average from the 1940s through the 1990s, and then rose above the average after 2000" (Goodkind 2017a:1391). The quoted crude birth rate series of Yicheng is highly problematic: it shows no sign of the Great Leap Forward famine and does not correspond with census-based observations.

[20] The full quotation is as follows: "Given China's colossal footprint as a demographic billionaire, no policy intervention in history has done more to reduce the earth's human population, and no single statistic better summarizes its impact" (Goodkind 2017a:1376).

studies of other family planning programs rarely if ever talk about births averted. Instead of being fixated on a constructed or imagined number of births averted, why not look at real numbers showing the impact of the policy, such as how many children in China today are only-children and how many Chinese families have only one child because of the policy?[21] To some, the millions of births averted as a result of the one-child policy may still be welcome news. To us, though, it is a testimony to the enormous human sacrifice resulting from an ill-conceived and unnecessarily extreme policy.

Consider the following quotation:

> To date much attention has been focused on the detrimental effects of the one-child policy on the age structure of the population, intrafamilial relations, psychosocial characteristics of only children, and gender inequality. While important, these problems may be only the tip of the iceberg. By fundamentally altering the basic social and economic unit, the one-child policy may tear the fabric of Chinese society in a way that uproots people's sense of their place in the world; undermines the family's ability to take care of the old; and precludes the kind of economic development that has spurred the post–World War II industrial miracle in other parts of East Asia. (Bongaarts and Greenhalgh 1985:595)

When was this written? Last year; five years ago? No. It was written in *1985*. Even then, scholars could begin to see the potential implications of such a policy on familial and social relations in China. Why, then, do some still want to ask and answer the question of "births averted," even in the context of a policy that has created so many social challenges and potential long-term effects on the Chinese psyche? One possible explanation is our obsession with numbers as demographers.

Two fallacies are likely to occur when we focus only on numbers. The first is the simple notion of demographic determinism. Although repeatedly refuted in human history (for a recent example, see Lam 2011) and with the notion of "optimum population" now an elusive concept (Cohen 1995), the Malthusian shadow continues to reside among some proponents of a more aggressive approach to population control. The Malthusian fear is expressed through simple projections of food supply growing arithmetically and population growing exponentially. Although unprecedented rapid population growth in the second half of the twentieth century indeed presented a global crisis that needed to be understood and addressed, advocacy for population control sometimes came at the cost of compromising science.

In the eagerness to show the primacy of numbers and prowess of demographic exercises, researchers sacrifice not only science but also common sense and indeed a sense of humanity. Science does not study morality, but scientists have moral values, as echoed in Seltzer's (1998:544) reminder to "statisticians and demographers that there is an ethical dimension to their work." This is the second pitfall or fallacy sometimes seen in projection-based demographic exercises: putting *population* above *people*—namely, treating populations as aggregate numbers while forgetting

[21] Even with the number of only-children families estimated in China to date, it is literally impossible to establish how many only-children are entirely due to the policy versus a result of voluntary family decisions.

the individual human beings who make up the population. Goodkind's confirmation exercise criticizes us for presenting a seemingly paradoxical stance that the one-child policy had limited overall effect on population control (citing, as we do, the primacy of other social and economic factors) but that it also created hundreds of millions of only-child families and caused enormous social damages. The problem is that these are not mutually exclusive claims. Macro-level aggregated demographic impact might not have been as large as claimed, but the micro-level social impact can still be real and significant. Consider parents who have lost their only children and are not able to replace them (Wei et al. 2015). And consider all the other sacrifices the Chinese people, especially women, made during the policy enforcement: forced abortions and sterilizations, millions of (primarily female) infants abandoned and some killed, abortion resisters forcibly confined or coerced into operating rooms—the list of abuses could go on and on (Fong 2016; Greenhalgh 1994; Greenhalgh and Winckler 2005; Hardee et al. 2004; Hvistendahl 2011; Jiang et al. 2016; Johnson 2016; Riley 2017).

Such number-driven population thinking, neglecting individual lives and rights, was behind the rationales for launching the one-child policy. To achieve the political goal of increasing per capita income, population seen as the denominator had to be controlled at all costs (Greenhalgh 2003, 2008; Wang F. et al. 2013). The state planners who implemented the one-child policy planned population as they planned goods. Should demographers as scientists serve the ambitions of those planners? Scholars of global population change should recall that it is the same number-driven thinking that resulted in the huge backlash against simple-minded demography and family planning globally (Connelly 2008; Kaufman et al. 2006). More explicitly, in the 1994 Cairo International Population and Development Conference, the government-directed and target-driven birth control programs were criticized and rejected, and reproductive rights were advocated by a broad range of international organizations, especially NGOs (Kaufman 2012; McIntosh and Finkle 1995).

Can population numbers ever be apolitical? Goodkind (2017a:1376) stated that his "goal is neither to criticize nor to defend China's policy choices." But in a world where an increasingly vocal group of people are looking for short-cut solutions to rapid population growth, it is important to consider the implications of such a policy intervention holistically. For example, in 2017, the UN resident coordinator for Kenya suggested that "China is an example to the rest of the developing countries when it comes to family planning" (Xinhua 2017). Indeed, the NPFPC has been actively promoting its "successful experience" for other developing countries (CFPA 2017; NPFPC 2007). At issue, then, is about *what* questions to ask as a demographer or as a social scientist in general; how to present the results; and, critically, how others will *interpret* the "averted births."

We make no apologies for our research-based advocacy work. In fact, we take pride in it. Instead of calculating a "single best" summary statistic, our advocacy is not just driven by our conscience but is based on years and years of painstaking empirical work. Such advocacy involved Chinese scholars and

numerous scholars globally, as well as program officers at foundations. It is based on such scholarly work that we learn, for example, the distribution of fertility policy (Gu et al. 2007), fertility levels and trends (Basten and Jiang 2014; Cai 2008, 2009, 2013; Gu and Cai 2011; Guo 2004a, b; Guo and Chen 2007; Guo et al. 2014; Morgan et al. 2009; Retherford et al. 2005; Wang 2015; Zhang and Zhao 2006), social forces underlying China's below-replacement fertility (Cai 2010; Peng 2011; Zheng et al. 2009), fertility outcomes in the absence of the one-child policy (Gu and Wang 2009; Liang 1984, 2014a, b; Zheng and Zhang 2017; Zheng et al. 2009), economic consequences of demographic shifts (Wang 2005; Wang and Mason 2008; Zeng et al. 2010; Zuo 2010), population momentum under low fertility (Wang 2011; Wang et al. 2008), alternative demographic scenarios under different policy options (Guo 2004c; Wang G. et al. 2013; Zeng 2011), and China's demographic change within the global context (Basten and Jiang 2015; Morgan et al. 2017; Shen et al. 2012; Wang et al. 2011). Although one man's conspiracy view of this might be "linking arms" (Goodkind 2017a:1394), it was in reality as simple as working both together and independently. Our advocacy was, and is, built on scholarly investigation; a deep understanding of Chinese society, culture, economy and politics; published work and participation in numerous conferences and lectures; and engagement with the media and the broad public.

Moreover, it is with the involvement of many courageous individuals that eventually led to the abolition of the one-child policy: journalists who circumvented and resisted government censorship to report on the pressing demographic reality in China that changed public perception, scholars, members of China's People's Congress, business leaders who made consistent calls to phase out the one-child policy that generated political pressure, and most importantly, numerous average Chinese citizens who stood up to government coercion and spoke out for their rights that built up social momentum (Gu 2010; He 2013; Liang and Li 2012; Peng 2015; Yi 2013). This is by far not a simple feat that can be accomplished by a single statistic, however staggering it is.

China's one-child policy will go down in history as a textbook example of a failed social engineering project based on bad science. In addition to the human sacrifices that have already resulted, many lessons still need to be learned. Among them is the role of those whose professional expertise is in demography. One irony is that China's "later, longer, fewer" program in the 1970s was devised with no involvement of demographers or formal demography; it was based only on a practical understanding of China's demographic system. Yet, it covered all three components of fertility change. On the contrary, the one-child policy was a result of zealous planning, dressed up with pseudo-science, implemented with a total disregard for human life (Greenhalgh 2003, 2008; Liang 2014a, b; Wang F. et al. 2013) and ended with disastrous consequences for Chinese people and Chinese society. We cannot fault demographers for not being able to stop the launch of extreme policies that harmed people; that was beyond their power. However, we should ask ourselves about demography's role in policymaking. Some may hope that by producing an astonishing number of so-called births averted, one can astonish the world and

showcase the cleverness and prowess of demographic methods. But such a misplaced hope, once again, became the enemy of objectivity.

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Appendix

Here we document our examination of Goodkind's (2017a) numerical exercise. Population projection is driven by inputs, both the initial (base) population and assumed changes in population parameters. Our examination uses Goodkind's counterfactuals to replicate his results and to demonstrate how they would be different if his numerical parameters had been consistent with his own claims. To be perfectly clear, our exercise is neither an endorsement of his choice of counterfactuals nor an alternative to the numerical estimates that he has provided. Our examination is purely a check on Goodkind's computational procedures and outcomes.

As we discussed earlier in this comment, the key assumption behind Goodkind's "astonishing 400 million averted birth by the one-child policy" is his proposition that China's TFR would have jumped from 2.8 to 4.6 in one year between 1979 and 1980 if China had not implemented the one-child policy.[22] This assumption is hidden in his article; it was only vaguely discussed in two general claims: "if China had not enacted the one-child decree in 1979, its TFR should have rebounded above its presumed ceiling toward counterfactual levels" (p. 1386); and "had China not enacted the one-child decree in 1979, fertility should have rebounded above three births per family" (p. 1394). With the population projection inputs provided in Goodkind's Table 4, and more detailed inputs provided in an Excel file in response to our data request, we are able to replicate Goodkind's projection results using the U.S. Census Bureau's *RUP* package. Our replication confirms without ambiguity that the estimate of "400 million averted births due to the one-child policy" was based on a fertility jump to TFR of 4.6 in 1980.

We further examine how different his estimate would be if one were to specify four simple alternatives. Two alternatives are closer to Goodkind's claim that "fertility should have rebounded above three births per family": (1) TFR rebounds from 2.8 in 1979 to 3.0 in 1980; and (2) TFR rebounds from 2.8 in 1979 to 3.5 in 1980. Two

[22] It is not entirely clear how Goodkind (2017a) derives his fertility estimates for China. He states, "To construct a fertility series for China, I turn to the two organizations that offer worldwide estimates based on broad demographic analysis: the UNPD and the U.S. Census Bureau. I use the former for estimates from 1970–1989 and the latter for 1990–2015" (p. 1382). However, earlier in that article, he states that "For China, the annual TFR series 1970–1989 is drawn from Banister (1987) and Feeney and Yuan (1994). These estimates are adjusted within each five-year interval to match estimates provided by UNPD (2015)" (p. 1378, in the caption to his Fig. 1). Our examination shows that Goodkind's TFR series for 1970–1989 is not the same as that of Banister (1987), Feeney and Yuan (1994), or the World Population Prospects (WPP) 2015. No apparent adjustment algorithm could explain such differences.

additional alternatives were suggested by Goodkind elsewhere: (1) TFR rebounds from 2.8 in 1979 to 4.0 in 1980, as suggested in his response to our question (Hvistendahl 2017); and (2) TFR rebounds from 2.8 in 1979 to 3.0 in 1980, and then to 4.0 in 1985, as suggested in his PAA 2017 presentation (Goodkind 2017b). All four of them will follow the same fertility decline process that Goodkind (2017a) specifies. For the Vietnam-based counterfactual, it is a two-stage process: a linear decline to 2.18 by 1995, followed by another linear decline to 1.5 by 2060. For the 16-countries based counterfactual, it is a three-stage process: a linear decline to 2.34 by 2000, followed by another linear decline to 1.86 by 2015, and then another linear decline to 1.50 by 2060. Goodkind provides no explanation or justification for these two- or three-stage setups.[23] But for the sake of demonstration, we use his setups, as well as his assumptions for population projection regarding sex ratio at birth,[24] mortality level and age pattern, fertility age pattern, and migration.

Because the purpose of this exercise is to evaluate the potential numerical difference of so-called policy effect of the one-child policy, our alternative projections start from 1980, using the single-year age structure for China in 1980 provided by WPP 2015 as the base population and comparing all the projection results with WPP 2015 every five years from 1980 to 2015.[25] This approach has two main advantages. The first is transparency. WPP is probably the most widely used estimate and thus could serve as "the fact" to counterfactuals. In comparison, Goodkind's estimate for China's total population is based on his tweaks of fertility estimate for China without explanation, and it is thus not transparent. The second advantage is simplicity. Because the counterfactual is set to compare with or without the one-child policy, it is straightforward to start from 1980. Goodkind's method requires a two-step process: (1) estimate the total policy effect since 1970, and (2) then subtract the effect of "later, longer, fewer" policy from the total policy effect to estimate the effect of the one-child policy.

The projection results and comparisons are presented in Table 1. They demonstrate what it takes for Goodkind to match the "400 million" number: a counterfactual far different from China, an unrealistically large fertility rebound in 1980, and an extended time interval. Falling short on any one of these criteria, the "births averted" by the one-child policy will be far smaller than the 400 million estimate. For example, had the so-called best comparator Vietnam been used, even assuming a still unrealistically large fertility rebound (TFR jumping from 2.8 in 1979 to 4.13 in

[23] The assumption that "TFRs in China and each counterfactual will converge to 1.5 by 2060" (Goodkind 2017a:1382) is curious because this convergence level is lower than both the U.S. Census Bureau's (2017) estimate (TFR = 1.60 in 2050) and the UNPD's estimate in WPP 2015 (TFR = 1.77 in 2060). Such a choice increases the so-called policy effect in Goodkind's projection exercise.

[24] Goodkind (Goodkind 2017a:1382) states that "sex ratios at birth come from the same sources." Reading the sentence in the same paragraph of this statement, one would assume the sources were WPP 2015 for 1970–1989 and the U.S. Census Bureau (2017) for 1990–2015. Our examination suggests that his sex ratios at birth for 1970–2010 are from WPP 2015 and that his sex ratios at birth for years after 2010 are some adjusted version of the U.S. Census Bureau's estimates.

[25] The base population of 814 million in 1970 in Goodkind's projection exercise is from WPP 2012—not from WPP 2015, as he claims. WPP 2015 estimates China's total population at 808 million in 1970. Moreover, UNPD uses Sprague multipliers to interpolate its five-year population age structure into a single-year population age structure. Goodkind uses the Beers multipliers in the U.S. Census Bureau's *RUP* program. Such a choice could have nontrivial effects on population projection because the two interpolation algorithms produce nontrivial differences for young females.

1980), the total number of "births averted" would be only 245 million by 2015. The number is even smaller if time is set at 2009, when the 400 million estimate was advertised by Chinese government in Copenhagen. (The numbers for 2010 in Table 1 provide a close approximation). Similarly, had Goodkind used a TFR closer to his own claim of "above three births per family," the "averted births" would be somewhere between 130 and 239 million, much smaller than his "astonishing" result.

Table 1 Comparison of WPP 2015 population estimates for China and population projected from 1980, with various fertility assumptions

		A. Using Goodkind's 16-Country Counterfactual									
		Projected Population					One-Child Policy "Effect"				
Year	WPP 2015	TFR 1980 = 4.6	TFR 1980 = 4.0	TFR 1980 = 3.0, TFR 1985 = 4.0	TFR 1980 = 3.5	TFR 1980 = 3.0	TFR 1980 = 4.6	TFR 1980 = 4.0	TFR 1980 = 3.0, TFR 1985 = 4.0	TFR 1980 = 3.5	TFR 1980 = 3.0
1980	978	978	978	978	978	978	0	0	0	0	0
1985	1,053	1,112	1,093	1,083	1,076	1,060	59	40	30	24	7
1990	1,155	1,246	1,213	1,218	1,183	1,153	92	58	63	28	–2
1995	1,228	1,375	1,331	1,347	1,292	1,253	147	104	119	64	25
2000	1,270	1,479	1,431	1,450	1,389	1,346	209	161	180	119	76
2005	1,306	1,566	1,514	1,530	1,468	1,421	261	209	224	162	116
2010	1,341	1,661	1,598	1,614	1,543	1,487	320	257	273	202	146
2015	1,376	1,755	1,681	1,703	1,615	1,549	379	305	327	239	173
		B. Using Goodkind's Vietnam Counterfactual									
		Projected Population					One-Child Policy "Effect"				
Year	WPP 2015	TFR 1980 = 4.13	TFR 1980 = 4.0	TFR 1980 = 3.0, TFR 1985 = 4.0	TFR 1980 = 3.5	TFR 1980 = 3.0	TFR 1980 = 4.13	TFR 1980 = 4.0	TFR 1980 = 3.0, TFR 1985 =4 .0	TFR 1980 = 3.5	TFR 1980 = 3.0
1980	978	978	978	978	978	978	0	0	0	0	0
1985	1,053	1,095	1,091	1,085	1,075	1,059	42	38	32	23	7
1990	1,155	1,207	1,201	1,215	1,174	1,148	53	46	61	20	–7
1995	1,228	1,307	1,300	1,321	1,269	1,238	79	72	93	41	10
2000	1,270	1,388	1,380	1,401	1,349	1,319	118	110	131	79	49
2005	1,306	1,463	1,454	1,472	1,419	1,385	157	148	167	114	79
2010	1,341	1,543	1,532	1,553	1,489	1,446	202	191	212	148	105
2015	1,376	1,621	1,609	1,639	1,557	1,506	245	233	263	181	130

Notes: and All projections were calculated using the *RUP* (U.S. Census Bureau 2012, version 1.80) software as part of Toolkits (USCB_Tools) provided by the U.S. Census Bureau. Both the input and output files are available upon request.

Sources: WPP 2015 is the source for the single age population structure for 1980 as base population, with total population for each year listed as comparison. With the sole exception of four alternative TFRs, all other inputs for population projection are from the input data provided by Goodkind.

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