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The Astonishing Population Averted by China's Birth Restrictions: Estimates, Nightmares, and Reprogrammed Ambitions

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Abstract China launched an unprecedented program to control its population in 1971. Experts have dismissed the official estimate of 400 million births averted by this program as greatly exaggerated yet neglect to provide their own estimates. Counterfactual projections based on fertility declines in other countries suggest that China's program-averted population numbered 360–520 million as of 2015. The low end of this range is based on Vietnam—China's best national comparator, with a two-child program of its own—and the high end is based on a 16-country comparator selected, ironically, by critics of the official estimate. The latter comparator further implies that China's one-child program *itself* averted a population of 400 million by 2015, three-quarters of the total averted population. All such estimates are projected to double by 2060, due mostly to counterfactual population momentum. These and other findings presented herein affirm the astonishing impact of China's draconian policy choices and challenge the current consensus that rapid socioeconomic progress drove China's fertility well below two children per family. International comparisons of fertility and income suggest instead that China's very low fertility arrived two or three decades too soon. If China had not harshly enforced a norm of 1.5-children during the last quarter century, most mothers would have had two children, one-half birth higher than observed.

Keywords China · Birth planning · Fertility transition · One-child policy · Coercion

Introduction

China launched an unprecedented program to control its population in 1971, convinced that this was its key to prosperity and the restoration of a long-lost global power (Aird

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1990; Banister 1987; Greenhalgh 2008; Johnson 2016; Scharping 2003; Tien 1991; White 2006). In pursuit of this "Chinese dream" (*Economist* 2013), the ensuing decades witnessed cycles of birth quotas, enforcements, incentives, and loopholes. By the mid-1970s, most Chinese parents were limited to two children, followed in 1979 by a quota of one child only. In the mid-1980s, a pivotal loophole allowed most rural couples a second child if their first was a daughter, creating a norm of 1.5 children (Gu et al. 2007) that was enforced for a quarter-century through crushing financial penalties and other means (*Xinhua* 1991). After another major loosening in 2013 (*Xinhua* 2013), China lifted all remaining one-child restrictions in 2015 (*Xinhua* 2015).

So, how much smaller is China's population due to its 45 years of birth planning? A vast audience will ask this question in the coming decades—government officials, climate and environmental scientists, other scholars and researchers, the media, students, and the general public—all of whom will look to demographers for an answer. Given China's colossal footprint as a demographic billionaire (Tien 1983), no policy intervention in history has done more to reduce the earth's human population, and no single statistic better summarizes its impact.

Yet, the demographic impact of China's birth restrictions—a question for the ages—has been neglected. Population experts have dismissed official estimates that the program averted 400 million births as greatly exaggerated (Basten and Jiang 2014; Cai 2010; Greenhalgh 2010; Wang et al. 2013; Whyte et al. 2015), but they have provided no estimates of their own. The neglect may result from a preoccupation with eliminating one-child restrictions (Greenhalgh 2003; Gu and Wang 2009; Hvistendahl 2010). With that bitter policy battle now over, the collateral damage to basic science has been exposed. Nicolas Eberstadt (U.S. Congressional-Executive Commission on China 2015:4) recently testified before the U.S. Congress that, "Strange as this may sound, demographers and population specialists have yet to offer a plausible and methodologically defensible estimate of just how much this extraordinarily ambitious and ruthless adventure in social engineering has actually altered China's population."

This study seeks to redress that long strange and yawning gap in knowledge. My goal is neither to criticize nor to defend China's policy choices but rather to estimate the demographic impact of those choices. The most formidable challenge is to justify, among the countless possibilities available, what China's fertility history might have looked like without birth planning. I estimate China's averted population since 1970 through counterfactual projections based on fertility declines in countries with similar characteristics. Among them, a 16-country comparator hand-picked by critics of the official estimate implies a policy-averted population of 520 million as of 2015, 400 million due to the one-child program itself. I project that these estimates will double by 2060, largely because of population momentum in the counterfactual projection.

Then I build on these findings to challenge the core consensus in recent literature: namely, that the fall in China's fertility to very low levels was due less to one-child restrictions than to socioeconomic progress. Comparisons across countries surpassing similar income thresholds suggest instead that China's very low fertility arrived two or three decades too soon. If China had not imposed draconian penalties to enforce a norm of 1.5 children over the last 25 years, most mothers would have had two children—one-half birth higher than observed. Thirty years after Wolf (1986) served up a similar tonic to the field, I reaffirm the astonishing impact of China's effort to control its population and reprogram parental preferences in line with its ambitions.

Prior Estimates and Debates: The Quest for the Right Projection

Population projections have anchored debates at every major transition in China's birth planning program. The prevailing belief in the 1950s and 1960s that a large and growing population was China's key to amassing wealth and power was eventually upended by projections of its population hurtling out of control (Tien 1983). China's government reversed course in the early 1970s, launching a program soon dubbed the "later, longer, fewer" campaign that promoted later marriage, longer birth intervals, and fewer children. By the mid-1970s, this program evolved into a two-child policy, although opinions vary as to whether that quota was voluntary or coercively enforced.[1] China's total fertility rate (TFR) plummeted from almost six births per woman in 1970 to less than three by the late 1970s (Fig. 1). Even so, Song and Li (1980) projected that if China's TFR remained at three births per woman, its population would top 3 billion by 2050 (see also Greenhalgh 2008; Scharping 2003; Tien 1991). To avoid this Malthusian nightmare, central policymakers enacted the one-child decree in 1979.

Population projections have also been central to the work of those promoting less draconian alternatives to one-child quotas. Among the earliest of these, Liang (1979, 1985) proposed a two-child limit with late marriage and wide birth spacing, essentially a return to "later, longer, fewer." Bongaarts and Greenhalgh (1985) showed that Liang's proposal could keep China's population under the official target of 1.2 billion by the year 2000. Policymakers relaxed the policy differently, enacting a loophole in the mid-1980s that allowed most rural parents a second child if the first was female (Goodkind 2015; Smith et al. 1997). The resulting national norm of 1.5 children (Gu et al. 2007) lasted more than 25 years.

The use of counterfactual projections to estimate the demographic impact of China's fertility restrictions can be traced as far back as 1980, when 56 million births were said to have been averted during the 1970s (cited in Tien 1991:222). A decade later, a flurry of estimates appeared. Zhao (1991) calculated 400 million births averted between 1970 and 1990 based on the assumption that China's TFR of 5.8 in 1970 had otherwise remained constant. A more moderate figure of 200 million births averted between 1971 and 1990 was offered by Peng Pei Yun (Zhang and Yang 1992), former director of China's National Commission for Population and Family Planning (NCPFP; the government body tasked with implementing the birth planning program), although it is not clear how that statistic was derived. Goodkind (1992) presented even lower estimates for 1971–1990 based on fertility declines elsewhere in Confucian Asia. His central estimate of 110 million averted births was biased downward by comparators that were far more urbanized and economically advanced than China (Singapore, Hong Kong, and Taiwan), although he also offered a higher estimate of 155 million based on fertility in Vietnam.

In the late 1990s, the NCPFP commissioned a study that determined 338 million births were averted by China's fertility restrictions between 1970 and 1998 (Yang et al. 2000; see also Wang 2006). In 2006, the NCPFP claimed that 400 million births had

[1] Some experts propose that "later, longer, fewer" was largely voluntary (Basten and Gu 2013; Hesketh et al. 2005), enjoyed popular support (Zhao 2015), or was the "golden age" of China's fertility transition (Wang and Cai 2010). Others emphasize its coercive elements (Lavely and Freedman 1990; Mosher 1983; Whyte et al. 2015), a view with which I agree.

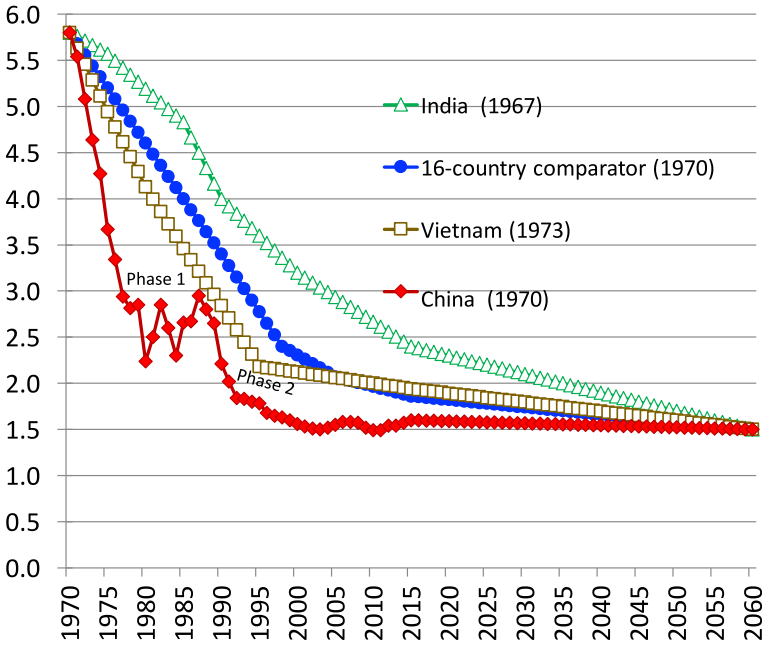

Fig. 1 Total fertility rate (TFR) in China and counterfactual scenarios, 1970–2060. For China, the annual TFR series 1970–1989 is drawn from Banister (1987) and Feeney and Yuan (1994). These estimates are adjusted within each five-year interval to match estimates provided by UNPD (2015). From 1990–2014, annual TFR estimates are drawn from the U.S. Census Bureau (2015). The projection for China from 2015–2020 incorporates a slight bump up for a possible increase following the lifting of one-child restrictions. See the text for further details. For Vietnam and India, estimates come from UNPD (2015), which are provided in five-year intervals. These estimates were interpolated in order to center on years ending in 0 and 5, and then spliced and pasted such that the TFR in 1970 matched that which China had (5.8). Years shown in legend parentheses indicate the actual year in which their TFRs were estimated to be 5.8. Given that Vietnam's estimated TFRs from censuses and annual surveys are consistently above UNPD estimates from the 1990s forward, an additional upward adjustment was made to UNPD estimates for 1990–1995 to match official estimates, and then TFRs were interpolated between that interval and UNDP estimates for 2015. For the 16-country comparator, TFRs were chosen to produce CBR estimates matching those listed in Wang et al. (2013) for 1990 and 1998. An additional TFR average was constructed for 2015. All scenarios are presumed to converge after 2015 to a TFR of 1.5 by 2060. *Sources:* United Nations Population Division (2015); U.S. Census Bureau (International Database 2015); other Chinese sources listed in Banister (1987); and Feeney and Yuan (1994)

been averted during the prior 30 years (*Xinhua* 2006), a claim repeated verbatim in 2011 (*People's Daily* 2011). Experts dismiss this claim. Greenhalgh (2010:112) advised that it "be taken with a large grain of salt." Cai believed such "boasts" (Cai 2010:420) to be deceptive, a "rewriting of China's fertility reduction history" (quoted in Olesen 2011). Wang (2013) proclaimed it to be "wildly exaggerated." Basten and Jiang (2014:502) mocked its veracity by calling it a "'fact'," hung within quotation marks. Whyte et al. (2015:158) declared the estimate of 400 million to be "entirely bogus," the greatest of all "myths" surrounding China's birth planning program.

Why the chorus of criticism? Some official statements attribute 400 million averted births to the one-child decree itself (e.g., *People's Daily* 2011), but critics claim the true number to be one-quarter of that—approximately 100 million births (Wang and Cai 2010)—an opinion vigorously conveyed to popular media (Hvistendahl 2010; Wang

2013; Whyte et al. 2016). However, critics provided little documentation for their claims and neglected to estimate the impact of birth planning since its inception in 1970 (U.S. Congressional-Executive Commission on China 2015). The preoccupation with only the marginal effects of the one-child decree typified debates in its final years. Scholar advocates lobbying for repeal argued that one-child limits were increasingly irrelevant (yet still harmful),[2] while authorities hoping to preserve the program trumpeted its impact. In response to withering criticism, defenders of the official estimate of 400 million retreated, stating that it refers to the impact of the birth program since 1970, when the TFR was nearly six births per woman and there was more downward headroom to observe the program's effects (Olesen 2011). Still, critics dismiss even this more modest claim as an exaggeration, for reasons I explain shortly.

Although history does not permit reruns, fertility declines in countries with characteristics similar to China's provide a sense of what that show might have looked like. I propose three such alternate scenarios.

Three Comparators for Estimating China's Averted Population

Vietnam: The Ideal National Comparator (and a Neglected One)

China provides an important model for understanding Vietnamese history, politics, and society (Woodside 1988; Womack 2006), and Vietnam provides an equally illuminative model for understanding China (Chan et al. 1999). Womack (2009:1) was particularly direct about this: "There is no country more similar to China than Vietnam, and no country more similar to Vietnam than China." Some of these striking similarities are summarized in Table 1.

Along general cultural dimensions, both countries share a Confucian heritage, tonal languages, a similar written script (Vietnam used a form of Chinese characters prior to the seventeenth century), and cultural norms of eating (with chopsticks). Such similarities stem in part from their geographic contiguity. Vietnam's northern region borders two Chinese provinces: Guangxi and Yunnan. Numerous historical parallels include ancient dynastic cycles as well as tumultuous changes during the twentieth century: communist revolutions, cultural upheavals, and then sweeping market reforms under single party rule starting in the late 1970s and 1980s. In the wake of reforms, these two largely agricultural albeit well-educated societies both experienced rapid development. China's world-leading growth enjoyed the limelight in recent years, and Vietnam was close behind. China's gross national income (GNI) per capita (purchasing power parity (PPP), current international dollars) quadrupled from $1K to $4K in just 13 years (1990–2003), and Vietnam broke past the same milestones in 16 years (1992–2008).

[2] Around 2001, scholar advocates resolved to eliminate one-child restrictions (Hvistendahl 2010), an agenda that attracted generous support (MacArthur Foundation 2005:46; 2008:40). After the full lifting of one-child quotas in 2015, advocates credited themselves with debunking government claims and criticized unspecified others in the academic community for misinforming policymakers, while themselves presenting conflicting narratives of the program's impact (Wang et al. 2016:85; Zhao 2015). For example, Wang et al. (2016:85) claimed that, "while playing a limited role in reducing China's population, the one-child policy . . . has created . . . perhaps as many as 100 million, of China's 150 million one-child families."

Table 1 Comparisons between China and other countries: Culture, political history, socioeconomic factors, and reproduction

Dimension	China	Vietnam	India	South Korea	Thailand
Culture					
Tonal language and close grammatical similarities	Yes	Yes	No	No	No
Confucian heritage	Yes	Yes	No	Yes	No
Chopsticks	Yes	Yes	No	Yes	No
Border with China	—	Yes	Yes	No	No
Political History					
Last emperor's final year	1911	1945	NA	1910	Ongoing
Communist revolution	Yes	Yes	No	No	No
Single party system	Yes	Yes	No	No	No
Market reforms after the 1970s	Yes	Yes	Yes	No	No
Education (2001)					
Percent adults literate	85.8	92.7	58.0	97.9	95.7
Percent youths literate	97.9	95.4	73.3	99.8	99.0
Economic Factors					
Inequality Gini	37.0	35.6	33.6	NA	39.4
Year at 33 % urban	1997	2014	2015	<1980	2001
Year GNI/capita at					
$1,000 current international PPP	1990	1992	<1990	<1990	<1990
$2,000 current international PPP	1996	2000	2000	<1990	<1990
$4,000 current international PPP	2003	2008	2009	<1990	<1990
Reproductive Factors					
Focus on surgical contraceptive methods	Yes	Yes	Yes	No	No
Year TFR at 5.8	1970	1973	1967	1964	1965
Strong son preference	Yes	Yes	Yes	Yes	No
Male shortage (1970–1990)	No	Yes	No	No	No
Punitive Birth Quotas?					
Penalty: Typical share of income for violators	Yes, 2–7 years	Yes, 2–7 months	No	No	No

Sources: Education from UNDP (2003). Economic statistics from World Bank Databank (accessed February, 2016). Fertility (TFR) from the United Nations Population Division (2015) revision; interpolated. Male shortage from Goodkind (1997). Birth planning penalties from Scharping (2003) and Goodkind (1995).

In addition to these broad similarities, Vietnam is the only country to follow China's lead in birth planning. In the late 1980s, Vietnam enacted a two-child policy (Banister 1992; Goodkind 1995), the rationale of which was similar to China's and which included upfront fines in some areas for those exceeding that quota. Vietnam thus provides a unique window on what China's fertility history might have looked look like had it maintained a two-child quota beyond 1980. Other parallels include an early emphasis on surgical methods of birth control (Goodkind 1996) and strong son preference (Haughton and Haughton 1995). Given all these similarities,[3] the near total neglect of Vietnam as a comparator by China population experts is conspicuous.

[3] Despite the similarities, Vietnam was demographically unique for its severe shortage of males resulting from the War of Reunification (1965–1975) and its aftermath, which reduced Vietnam's fertility because of spousal separation, excess male war deaths, incarcerated military officers, and postwar international outmigration of males (Goodkind 1997; Hirschman et al. 1995; Merli 2000).

India: The Billionaires Club of Two

India provides another illuminating national comparator for China. Albeit a less ideal comparator given its lower level of education (Table 1), India also implemented an aggressive family planning program in the 1970s (Sen 1999). Moreover, as the world's only other population billionaire—likely to surpass China as the world's most populous nation around 2025—comparisons between the development of India and China have inspired considerable interest. One challenge to understanding these billionaires is that there are no comparable population peers. This special status invites a host of questions about the possible advantages and disadvantages of being a billionaire, including the availability of huge domestic markets (Keefer 2007) and the difficulties (and rewards) of governing large and diverse populations.

The Critic's 16-Country Comparator

As noted earlier, experts have dismissed the NCPFP estimate of 338 million births averted by China's birth planning program between 1970 and 1998 (Yang et al. 2000) as a gross exaggeration. Wang et al. (2013) contended that counterfactual assumptions of fertility decline in that study were too slow, biasing upward the gap between the counterfactual and China's actual fertility decline. They proposed instead a counterfactual based on countries that had a similar crude birth rate (CBR) to China's when its fertility restrictions began (35.5 births per thousand people). They identified 16 countries with a CBR between 30 and 38 in 1970, most of which are in Asia, South America, and Latin America: Albania, Brazil, Columbia, Costa Rica, Jamaica, North Korea, South Korea, Lebanon, Malaysia, Panama, Paraguay, South Africa, Thailand, Turkmenistan, Uzbekistan, and Venezuela.

This comparative grouping seems plausible, and the critic's point is well taken. Yang et al.'s (2000) counterfactual CBR declined only marginally, to 29 in 1990 and 28 in 1998, but the average CBR in the 16-country comparator fell much faster, to 26 in 1990 and 21 in 1998 (Wang et al. 2013: table 1; Whyte et al. 2015: fig. 3). Surprisingly, however, the critics never estimated China's averted population based on their own proposed fertility comparator. I thus provide such estimates herein.

Population Projections for China and the Counterfactuals

The following population projections begin with China's population as of midyear 1970 (814 million) distributed by age and sex. That population is projected forward using cohort component methods that rely on annual estimates and projections of demographic change. Mortality rates by age and sex are assigned in 1970 and 1990, followed by projected life expectancies by sex to 2060. Annual rates by age and sex are interpolated between specified years and extrapolated to match projected life expectancies. The source of these parameters is the United Nations Population Division (UNPD 2015). Net migration is assumed to be 0. Table 4 in the appendix summarizes the key population change parameters.

As to China's fertility, the critical element in my projections, a wide variety of estimates are available (Goodkind 2011; Gu and Cai 2011). Many such estimates are

derived from data reported in censuses, surveys, or registration. However, the completeness of fertility reporting in China has been questionable: ruinous fines for out-of-quota children have given parents and officials unique incentives to conceal them (Banister 1987; Merli 1998; Retherford et al. 2005; Scharping 2003; Smith 1994; Zeng et al. 1993). 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. Both choices result in more *conservative* estimates of China's averted population because fertility in each source is *higher* than most other sources, which narrows the gap in fertility between China and each counterfactual. Sex ratios at birth come from the same sources. Age-specific fertility rates (ASFRs) for China are specified in 1970, 1980, 1986, and 2000 (UNPD 2015).

Population projections under the counterfactuals begin with identical parameters but substitute the TFR trajectories of Vietnam, India, and the 16-country comparator (see Fig. 1).[4] For Vietnam and India, I use UNPD estimates that are cut and pasted so that fertility levels in 1970 begin with the same level that China had (a TFR of 5.8). The TFR in Vietnam actually reached 5.8 about three years later than in China (1973), whereas India did so about three years ahead of China (1967). For the 16-country comparator, I chose TFRs so that crude birth rates in 1990 and 1998 matched those listed in Wang et al. (2013) and then computed their TFR average in 2015 (U.S. Census Bureau 2015). I assume that TFRs in China and each counterfactual will converge to 1.5 by 2060.

Figure 1 suggests that China experienced two phases of aberrant fertility decline. The first was during the 1970s and early 1980s. By the late 1980s, Vietnam's fertility transition had nearly caught up to China's, for several reasons: (1) China's decision in 1980 to allow couples to marry at earlier ages (Banister 1987; Feeney et al. 1989); (2) pent-up demand to make up for lost childbearing during the 1970s; (3) the desire for more children after decollectivization (Tien 1991); (4) the 1.5-child loophole in the mid-1980s; (5) lax enforcement of existing regulations; and (6) Vietnam's enactment of a two-child policy in the late 1980s. The second phase occurred after 1990 following China's central decree of 1991, which strengthened penalties and enforcements against birth quota violators (to be discussed shortly). China's TFR between 1990 and 2015 averaged 0.5 below that of the Vietnam counterfactual and 0.7 below that of the 16-country comparator.

China's Policy-Averted Population, 1970–2060

The population averted by China's birth planning program is estimated by comparing the total population projected under each counterfactual with that projected for China itself. Estimates are shown in Table 2. As of 2015, the cumulative averted population

[4] The counterfactual ASFRs also omit China's ASFRs in 1980 and 1986, instead gradually interpolating China's ASFRs between 1970 and 2000 (raked annually to match counterfactual TFRs). This violation of *ceteris paribus* assumptions was required to avoid an *overestimation* of China's averted population (of almost 10 % by 2015). Under one-child limits, China's ASFRs by 1980 became tightly compressed among women in their 20s. Counterfactual TFR assumptions would have raked such compressed ASFRs much higher (at the expense of later childbearing), resulting in an unrealistic acceleration of population growth.

since 1970 implied by the three comparators—all rounded to tens of millions—ranged from 360 million (Vietnam), to 520 million (the 16-country comparator), to 940 million (India). The first two bookend the most defensible estimates. Vietnam is the best national comparator (Table 1) and provides a sense of what China might have experienced had it maintained a two-child limit with less draconian enforcements. The 16-country comparator hints at China's future had it not engaged in birth planning and instead relied on voluntary family planning and socioeconomic progress to reduce fertility. Under the latter comparator, China's averted population is projected to grow to almost 950 million by 2060—one-tenth of the world's projected population (UNPD 2015).

The counterfactual based on India likely provides high ceiling estimates given its lower level of education.[5] Nevertheless, had China's fertility glided down India's gradual path of decline (Fig. 1), its population would have mushroomed into the very nightmare envisioned by demographers as the one-child era began (Song and Li 1980): a total Chinese population of 3.3 billion by 2060 (Fig. 2).

Increases in China's averted population are driven not only by excess fertility rates in the counterfactuals but also by basic population dynamics. In any society, the number of births depends on birth rates and the number of mothers of childbearing age. Counterfactual estimates of averted births in China reflect the same two factors: averted births to existing mothers (differences in current birth rates) and averted mothers (prior generations of averted births). Population growth enhances both factors. According to my projections, the number of Chinese women aged 20–29 doubled between 1970 and 1990; thus, counterfactual differences in birth rates over time magnified into larger cohorts of averted births. Measurements of China's averted mothers are further driven by population "momentum" in the counterfactual world: unlike that world, China's first generation of policy-averted female births will not grow up to be mothers themselves, thus preventing a second generation of births, and they in turn will be followed by third and later generations of averted births.

Figure 3 shows the impact of these powerful population dynamics based on the 16-country comparator. Averted births among existing mothers traced twin peaks centered on 1980, the year following the one-child decree, and 1992, the year following a subsequent policy crackdown (*Xinhua* 1991). Yet, by 2012, averted mothers accounted for the majority of averted births, and such counterfactual population momentum will propel China's averted births forward long after its fertility restrictions have ended, surpassing *1 billion* by 2060 (Goodkind 2017).

Populations Averted by "Later, Longer, Fewer" Versus One-Child Quotas

For decades, experts have questioned the demographic impact of China's one-child restrictions based on a pair of observations. First, three-quarters of China's fertility decline occurred during the 1970s under "later, longer, fewer" (Whyte et al. 2015). Second, following the one-child decree of 1979, the fertility decline in the 1980s was very modest. The typical inference is that the TFR of 2.8 at the end of "later, longer, fewer" established an effective ceiling and that the impact of

[5] Similarly, Sen's (1999) choice of Kerala as a fertility comparator—an outlier among Indian states with very high levels of education—underestimated China's program impact.

Table 2 Population projections for China based on its own fertility and counterfactual scenarios of fertility decline, and implied cumulative averted population, 1970–2060 (in millions)

		China's Projected Population Based on Fertility Decline in:			Cumulative Averted Population		
	China	Vietnam	16-Country Comparator	India	Vietnam	16-Country Comparator	India
1970	814	814	814	814	—	—	—
1975	908	921	925	930	14	17	22
1980	975	1,035	1,048	1,068	60	73	94
1985	1,044	1,147	1,177	1,224	103	133	180
1990	1,136	1,257	1,309	1,389	121	173	253
1995	1,201	1,356	1,437	1,557	155	236	356
2000	1,251	1,449	1,556	1,737	198	305	486
2005	1,285	1,542	1,666	1,924	257	381	639
2010	1,318	1,631	1,772	2,112	313	455	794
2015	1,349	1,711	1,869	2,289	362	520	940
2020	1,375	1,778	1,952	2,454	402	577	1,079
2025	1,383	1,833	2,023	2,615	450	639	1,231
2030	1,374	1,876	2,078	2,765	503	705	1,392
2035	1,354	1,908	2,120	2,900	553	765	1,546
2040	1,329	1,925	2,147	3,015	596	817	1,685
2045	1,298	1,929	2,159	3,108	631	861	1,811
2050	1,258	1,919	2,156	3,182	662	899	1,924
2055	1,212	1,899	2,139	3,233	687	927	2,021
2060	1,165	1,870	2,110	3,260	705	945	2,095

Notes: The fertility declines assumed under each scenario are shown in Fig. 1 (and Table 4 in the appendix). For details on the 16-country comparator (Wang et al. 2013; Whyte et al. 2015), see the text.

the one-child program was no greater than the decline below that ceiling (Wang and Cai 2010; Wang et al. 2016).

The flaws in such inferences become clear when one considers two other eventful policy shifts that occurred around this time. First, at least one-third of the plunge in fertility during the 1970s was caused not by two-child quotas but by the sharp rise in the minimum age at marriage required by "later, longer, fewer" (Coale 1984). Conversely, the one-child decree of 1979 was immediately followed in 1980 by a sudden lowering of the minimum marriage age, as many as five years in some areas (Banister 1987). As young adults took advantage of this, earlier marriages were followed by a rise in first births (Coale 1984). Had China not relaxed its marriage restrictions, fertility from 1981 to 1986 would have been at least 15 % lower than observed (Feeney et al. 1989).[6] A second policy shift concerns the decollectivization of the agricultural sector, which began in 1978. Ironically, this smashing of China's "iron-rice bowl" undermined the monitoring and birth planning enforcements that had pulled down fertility so dramatically under collectivization in the 1970s, thereafter

[6] If the intention of the one-child decree was to control population growth, why did China simultaneously relax the later marriage component of "later, longer, fewer"? Among possible answers, the most plausible seems to be that authorities reasoned (incorrectly) that later marriage was rendered demographically irrelevant after the one-child decree was implemented (Banister 1987:159–161).

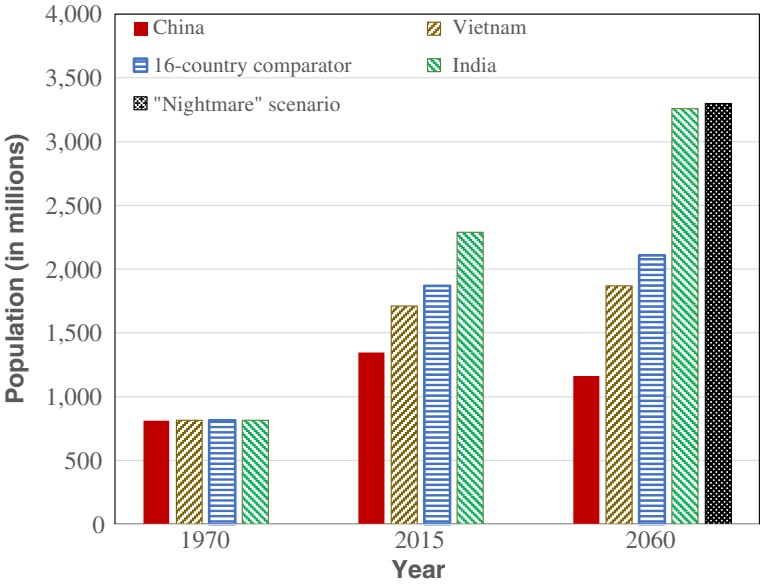

Fig. 2 Population projected for China based on its own fertility and counterfactual fertility scenarios: 1970, 2015, and 2060 (numbers in millions). Data are projections from Table 2. The nightmare scenario was projected by Song and Li (1980)

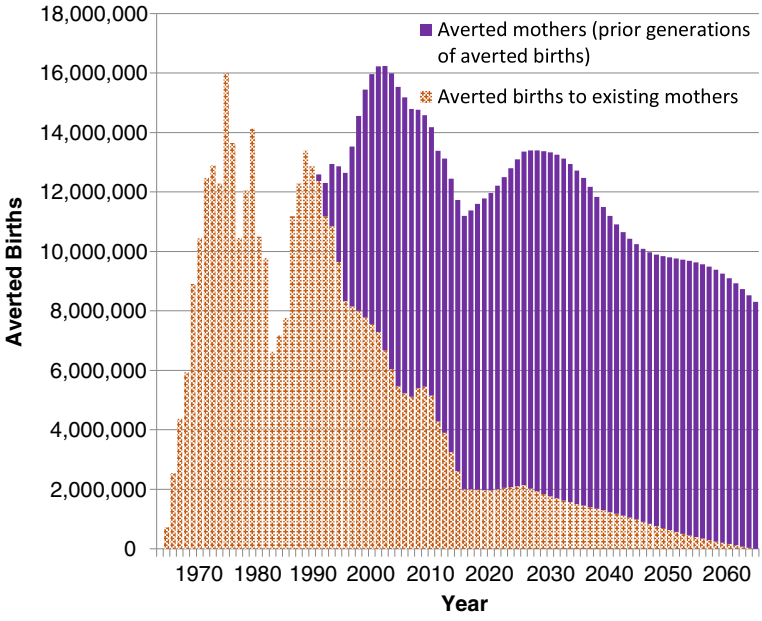

Fig. 3 Averted births in China based on the 16-country comparator, 1970–2060: Averted births to existing mothers versus averted mothers. Averted births to existing mothers reflect differences in fertility rates between China and the 16-country comparator in each year. Averted mothers refer to prior generations of averted births who will not become mothers themselves

encouraging rural parents to have more children (Tien 1991; Zhu 1982), sons in particular (Almond et al. 2014). Given decollectivization and the childbearing opportunities lost during the 1970s, if China had not enacted the one-child decree in 1979, its TFR should have rebounded (Whyte and Gu 1987) above its presumed ceiling toward counterfactual levels (Fig. 1; see also Goodkind 2017). An additional consideration involves the cumulative power of time. Impressive as it was, the vertical decline in fertility rates under "later, longer, fewer" was confined to a single decade, whereas the horizontal era of one-child quotas lasted 35 years.

To separate the population impact of each major policy era, I first isolate the impact of "later, longer, fewer" using two projections described earlier: one based on China's own fertility, and the other based on the critic's 16-country comparator. By 1980, the latter population was 73 million larger because of its inclusion of averted children under age 10 (Fig. 4, top panel; see also Table 2). I then project both populations forward from 1980 under the demographic changes specified for China (Table 4 in the appendix). Resulting differences reveal the multigenerational population impact of "later, longer, fewer" as the original decade of averted children reproduces itself in the virtual world. Moreover, by subtracting the population averted by "later, longer, fewer" from the population averted as a result of China's overall birth program since 1970 (Table 2), the impact of one-child restrictions emerges as a residual.

Table 3 shows the averted populations attributable to each of the two policy eras. The cohort of 73 million children averted by "later, longer, fewer" as of 1980 had shrunk slightly by 1985 because like a real cohort, a virtual cohort is subject to mortality, and females in this virtual cohort would not begin to reproduce a second generation of averted births for several years. Even before 1990, however, they had already been overtaken by children averted during the *first decade* of the one-child era. By 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,[7] more than three-quarters of the 520 million averted by the birth planning program overall. By 2060, the one-child era will have averted a population of more than 800 million.

The underlying dynamics of this growth are vividly illustrated by China's changing age and sex structure. Figure 4 shows the impact of "later, longer, fewer" and the one-child program on that structure. As noted earlier, the averted population in 1980 was due entirely to the "later, longer, fewer" decade—all children under age 10. By 2020, the second generation born to this virtual cohort is projected to be 30 % smaller largely because of China's below-replacement fertility. In contrast, the population averted under the one-child program is far greater, especially so by 2060.

[7] I obtained similar estimates from projections starting in 1980, which required two new fertility trajectories to measure the marginal impact of one-child quotas versus the "later, longer, fewer" program then in place. As noted earlier, China's fertility under the one-child program (the lower trajectory) would have been at least 15 % lower than observed in the 1980s had it not simultaneously relaxed the minimum age at marriage. Moreover, if China had *not* enacted the one-child program (the upper trajectory), the TFR should have rebounded toward counterfactual levels.

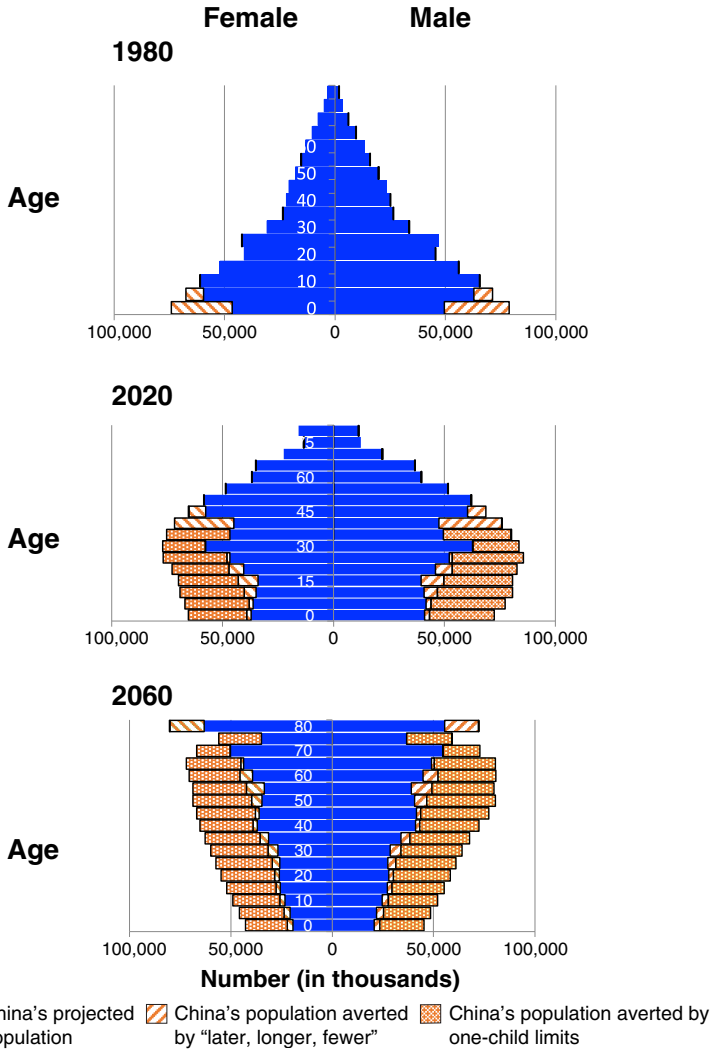

Fig. 4 Projected population by age and sex for China and for the averted populations (under the 16-country comparator) due to "later, longer, fewer" (1970–1979) and one-child restrictions (1980–2015): 1980, 2020, and 2060

What Drove China's Fertility to Very Low Levels? Five Reasons to Doubt the Primacy of Socioeconomic Progress

The aforementioned estimates, in addition to challenging expert opinions about the numerical impact of China's birth planning program, raise doubts about the edifice of assumptions that underlies those opinions. Although most observers accept Wolf's (1986) case that the "later, longer, fewer" program played the preeminent role in China's fertility transition during the 1970s, the current consensus is that socioeconomic progress thereafter drove fertility from replacement to well below two births per woman (Basten and Jiang 2014; Cai 2010; Greenhalgh 2008; Gu and Cai 2011; Gu

Table 3 Estimated contributions of "later, longer, fewer" and the one-child era to China's overall program-averted population based on the 16-country comparator (in millions)

	China's Projected Population Based on Fertility Decline in:			Cumulative Averted Population Due to:		
	China	16-Country Comparator	China, Applied to 1980 Base Population of 16-Country Comparator	Overall Birth Program	Later, Longer, Fewer	One-Child Program
1970	814	814	—	0	0	0
1975	908	925	—	17	17	0
1980	975	1,048	1,048	73	73	0
1985	1,044	1,177	1,117	133	72	60
1990	1,136	1,309	1,208	173	72	100
1995	1,201	1,437	1,276	236	75	161
2000	1,251	1,556	1,340	305	89	216
2005	1,285	1,666	1,393	381	108	274
2010	1,318	1,772	1,437	455	119	336
2015	1,349	1,869	1,471	520	122	397
2020	1,375	1,952	1,501	577	126	451
2025	1,383	2,023	1,517	639	133	506
2030	1,374	2,078	1,516	705	142	562
2035	1,354	2,120	1,503	765	148	617
2040	1,329	2,147	1,480	817	150	667
2045	1,298	2,159	1,447	861	150	712
2050	1,258	2,156	1,405	899	148	751
2055	1,212	2,139	1,356	927	143	784
2060	1,165	2,110	1,303	945	138	807

Note: For further details on the derivation of these estimates, see the text.

et al. 2007; Hesketh et al. 2005; Morgan et al. 2009; Sen 1999; Wang and Cai 2010; Wang et al. 2013; Whyte et al. 2015; Zhang and Zhao 2005). Sen (2015:1) summed up this consensus as follows: "the big fall in fertility in China . . . for which the one-child policy is often credited, has, in fact, been less related to compulsion and much more to reasoned family decisions." Similarly, Zhao (2015:684) claimed that the drop in China's fertility to well below replacement was "driven increasingly by the effects of the remarkable social, economic, and cultural transformations of recent decades."

These stories are not credible. Most of the plunge in China's TFR from 2.2 to 1.5 occurred by the mid-1990s (Fig. 1), after which there was little further decline as its economy took flight (see also UNPD 2015; Zhao 2015). Moreover, the causal presumption is muddy: China's roaring economy was itself partly a demographic dividend (Cai and Wang 2005) of policy-induced reductions in the proportion of youths within the population (Fig. 4). So what *are* the claims that undergird the current consensus? I summarize and challenge five of them in the following passage.

China Versus the Mini-Dragons: A Premature Demographic Destiny

Experts have often suggested that China's very low fertility is not unusual given the ultra-low fertility observed in other parts of East Asia (Gu et al. 2007; Morgan et al.

2009; Sen 2015; Wang et al. 2013; Whyte et al. 2015; Zhang and Zhao 2005; Zhao 2015). Given a common cultural heritage, it seems reasonable to expect that China might be destined to follow in the demographic footsteps of its smaller Confucian neighbors. But this conclusion cross-wires two events that occurred between 2000 and 2015: the record-breaking economic growth in China, and the descent to ultra-low fertility in Japan and the "mini-Dragons" of Asia, such as South Korea, Taiwan, and Singapore (Jones et al. 2009). What observers often overlook is how much less prosperous China was upon first reaching very low fertility (for an exception, see Merli and Morgan 2011). Figure 5, panel a, shows income per capita (measured by purchasing power parity (PPP) and in international dollars) in Asian societies upon first reaching a TFR of 1.5. China's was unusually low ($2,880), less than one-third of that in Thailand and an even smaller fraction of that in South Korea, Singapore, and Japan. Moreover, in three Asian societies where the TFR is still well above 1.5 (Vietnam, India, and Mongolia), 2014 income per capita (dashed bars) in these countries was *already* well above what China had when it reached that threshold. Figure 5, panel b, flips the comparison, showing TFRs when income per capita first broke past $3,000 (China's was 1.5). Vietnam is China's closest comparator, with a TFR of 1.9. All other countries had a TFR at or above 2.1, more than one-half a birth above that of China.

China and Taiwan: Dueling Chinese Models of Fertility and Income

Wolf's (1986) critique of socioeconomic explanations for China's fertility decline in the 1970s and early 1980s featured comparisons between China and Taiwan. Figure 6 updates Wolf's comparisons based on annual TFRs from 1980 to 2015 as well as income per capita at key junctures. Taiwan's income per capita exceeded $4,000 in 1980, when it had a TFR of 2.5—a full birth higher than China had when its income first reached $3,000 two decades later. Taiwan's TFR did not fall to 1.5 until 2001, when its income per capita exceeded $27,000—*nine times* that of China in 2001. Given that Taiwan is also more urbanized and better-educated, China appears to have completed its exceptional transition to very low fertility two or three decades earlier than socioeconomic progress would warrant.

Childbearing Preference Surveys From China's Affluent East Coast

Most parents in Jiangsu and Shanghai provinces who were permitted to have two children told survey takers around 2008 that they intended to have only one, citing economic considerations as their main reason. Based on such findings, researchers inferred that fertility should not increase much after the lifting of one-child restrictions (Cai 2010; Merli and Morgan 2011; Zheng et al. 2009). Although that inference may be correct, such responses do not reveal when and from where such preferences came. Even if parents cite economic concerns to explain their *current* preferences, they may not realize how China's birth planning program accelerated the shift in those preferences from having two children to having only one. Moreover, none of these surveys appear to have asked about the size of local fines or enforcements. Without such

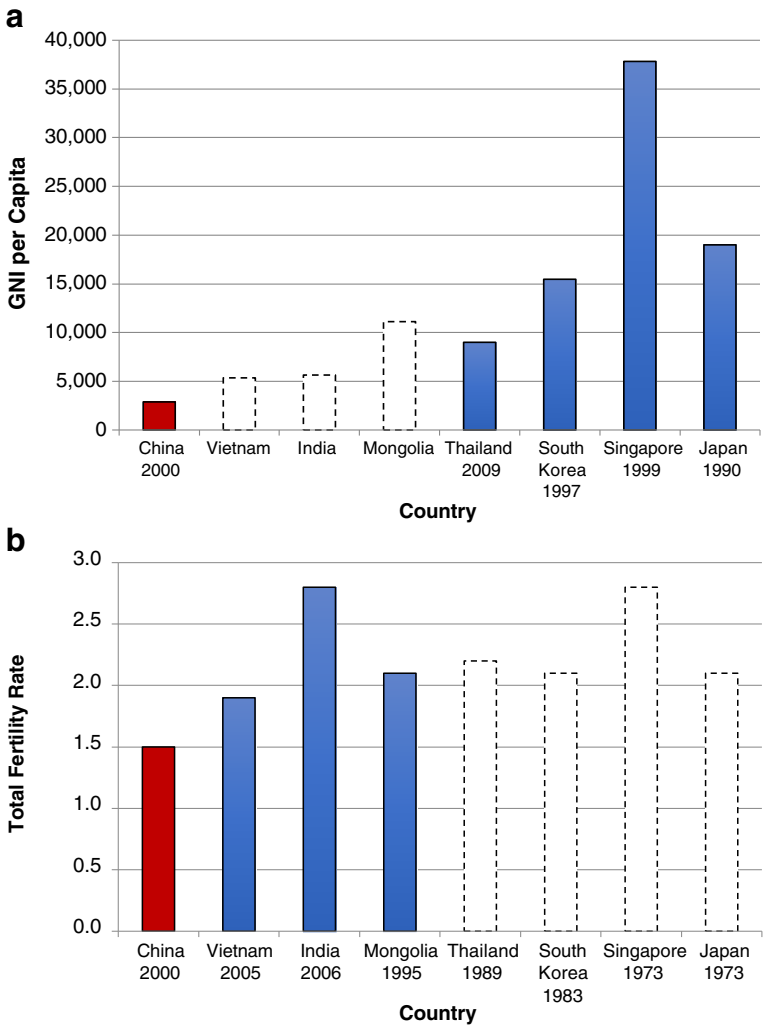

Fig. 5 GNI per capita (PPP, international $) in Asia when TFR fell to 1.5 (panel **a**), and TFR in Asia when GNI/capita reached $3,000 (PPP, international $) (panel **b**). In panel **a**, the years in which the TFR reached 1.5 are indicated on the *x*-axis. Dashed figures indicate 2014 GNI per capita PPP; the TFR in these countries has yet to fall to 1.5. In panel **b**, the years in which GNI/capita reached $3,000 are indicated on the *x*-axis. Dashed figures are estimated by the author because purchasing power parity (PPP) statistics are available only starting in 1990; estimates assume that the ratio of PPP and non–PPP GNI per capita statistics in each country prior to 1990 match those in 1990). *Source:* World Bank Databank (2016)

information, the impact of birth planning on local fertility preferences and practices cannot be determined (see the next section).

The Curious Case of Yicheng County

In the early 1980s, following the one-child decree, several officials pleaded with the Chinese government to permit a handful of localities to allow a two-child limit with

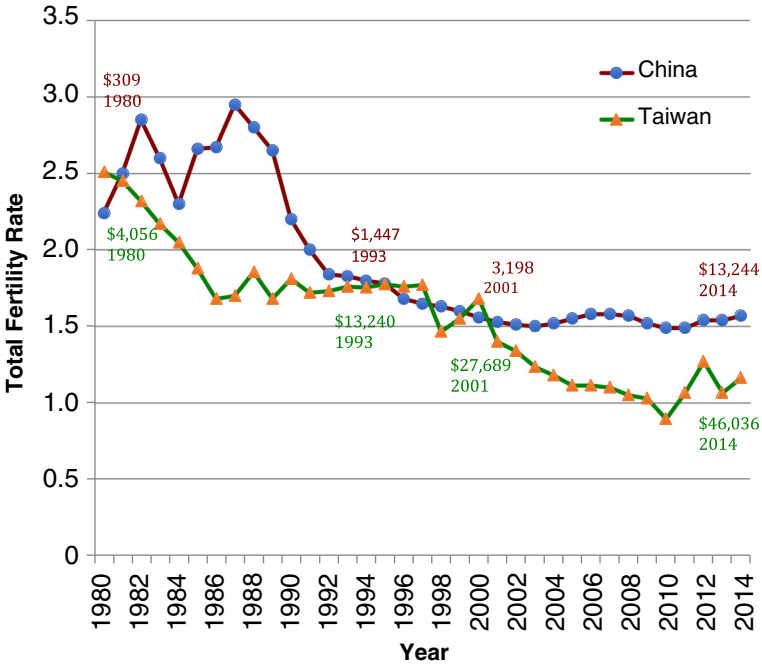

Fig. 6 Total fertility rates (TFRs) in China and Taiwan, 1980–2014, with GDP per capita in key years. Taiwan's fertility since the 1970s has regularly dipped in the Years of the Tiger (1974, 1986, 1998, and 2010) and spiked in the Years of the Dragon (1976, 1988, 2000, and 2012). See Goodkind (1993). *Sources:* GDP per capita (PPP, international $) for China and Taiwan: International Monetary Fund World Economic Outlook (October 2015; data for Taiwan are not available from the World Bank). TFRs for China: see Fig. 1. TFRs for Taiwan: Statistical Yearbooks of the Republic of China

later marriage and wide spacing (Liang 1985) essentially a return to "later, longer, fewer." Among the localities permitted to do so was Yicheng County in Shanxi Province. Critics of one-child quotas held up Yicheng as a quasi-experiment, which they claimed to show that a two-child limit could lead to lower fertility than a one-child limit and that socioeconomic factors were more important than compulsion in bringing about low fertility (Gu and Wang 2009). Wei and Zhang (2014) challenged these claims based on field interviews, statistical findings, and discussions with the key official who originally pleaded for the Yicheng experiment. Despite Yicheng's looser quota, the authors found its birth planning system to be highly coercive. In addition, its below-average fertility long predated China's birth planning era. 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.

The Bayesian-Based Claim

After scouring the literature, I found only one empirical argument that might be taken to support the belief that China's TFR would have fallen to 1.5 even without one-child restrictions. Wang et al. (2013:122) fit a Bayesian model to China's reported fertility in the 1970s and, based on the result, concluded that "if . . .

[China's] rapid fertility decline in the 1970s offers any hint about the country's future fertility trajectory . . . by 2010, fertility would have fallen to its currently observed level of around 1.5." But the very premise of this claim is misleading. It is not reasonable to suggest that any trend model fit to the least representative decade of fertility decline in history can provide a reliable forecast of birth rates 30 years later. Moreover, because Bayesian analysis is designed to yield estimates of statistical uncertainty, it is odd that the investigators provide no information about that uncertainty.

Back to the Preeminent Role of Birth Planning: The 1991 Crackdown and the Safety Valve Hypothesis Revisited

Given the inadequacy of socioeconomic explanations, China's premature plunge to very low fertility seems best understood in light of enhanced enforcements of existing birth quotas. In the following subsections, after reviewing such exceptional enforcements, I revisit the central policy question in this field: whether (and when) China's birth program has provided a "safety valve" on childbearing.

Loosened Quotas and Unprecedented Punishments: The 1.5-Child Norm and Its Enforcement

As noted earlier, China established a national norm of 1.5-children per family (Gu et al. 2007) by the late 1980s. According to the 1990 census, though, fertility remained above two births per woman (Scharping 2003). Policymakers responded in 1991 with a central decree that held local officials personally responsible for enforcing existing quotas (*Xinhua* 1991). The revised system for evaluating job performance was known as "one-veto down": local officials who failed to achieve preset population targets could be fired even if they otherwise performed well (Scharping 2003). The revision gave officials incentives to enforce the rules and monitoring systems that had long been in place to prevent over-quota births. Couples needed to apply to have a child, a process similar to obtaining a driver's license. Married women of childbearing age without authorization to have a child were monitored through various means (Merli 1998; Scharping 2003; Tien 1991), which in some urban work units might involve periodic urine tests or the provision of used tampons (Demick 2015).

The 1991 decree brought equally significant changes for parents who proceeded to have an over-quota birth. Financial penalties for violations ("social maintenance fees") were increased, reaching two to three times average annual salaries in many provinces and, given new pressures on local officials, were more likely to be enforced. Because most citizens could not afford to pay such a fine all at once, they could choose a term for repayment—typically 7 or 14 years (Scharping 2003), similar to a home mortgage. Such crushing penalties affected not only actual fertility but also childbearing preferences (Basten and Gu 2013: fig. 4; Merli and Smith 2002).

Based on anecdotal evidence, fines for violating birth quotas increased further, up to four to eight times average local salaries. Among the most celebrated cases of penalization was against film director Zhang Yimou, who was fined (and paid) more than

US$1.2 million for having two over-quota births (*Associated Press* 2014). Fines for more typical citizens were closer to the cost of raising a child to adulthood (about US$65 thousand; *Bloomberg News* 2015). Parents thus had three options: comply with local quotas, pay the price for unauthorized births, or try to conceal unauthorized births from statistical authorities (Merli 1998; Goodkind 2011; Smith 1994; Zeng et al. 1993). Many parents attempted the latter beginning in the 1980s, sometimes by adopting out their over-quota children. The 1991 decree thwarted that option by encouraging equally harsh penalties against adopters. As a result, some anguished parents abandoned their "illegal" children—typically daughters—many of whom ended up in state orphanages, 120,000 of whom were later adopted by international parents (Johnson 2016).

Still, experts often profess this exceptional context to be of secondary importance in explaining China's transition to very low fertility. Such claims are typically advanced in studies that neglect to mention the magnitude of the penalties or rely on flawed proxy measures of the program's impact. For example, the prevalence of agricultural household registration within counties (Cai 2010) may indicate what portion of parents enjoyed the 1.5-child loophole (as any indicator of rural/urban residence should), but it tells us nothing about enforcements or penalties, which vary widely across localities (Banister 1987; Merli and Smith 2002; Short and Zhai 1998).

The Safety Valve Hypothesis Reconsidered: How China's Policy Choices Helped Make One-Child Quotas Irrelevant

Debates about China's birth planning program have always revolved around its shaping of childbearing preferences and practices. For instance, did fertility fall to very low levels by the mid-1990s due to the 1991 crackdown, or did parents themselves internalize such norms? For years, central policymakers held to the former view: that birth restrictions were a *de facto* safety valve on underlying preferences for more children, which would spring forth like a jack-in-the-box the moment that valve was released. Most policy critics disputed that view, claiming that very low fertility was primarily attributable to China's rapid socioeconomic progress.

Both of these viewpoints are dubious. Critic's claims are undermined by aforementioned evidence that fertility in China was one-half birth lower than other areas of Asia upon reaching comparable incomes (Fig. 5, panel b). And the official view that birth restrictions were still required as a safety valve seems contradicted by the tepid public response to an expanded loophole in 2013 (*Xinhua* 2013), which allowed couples a second child if either husband or wife was an only child (Basten and Jiang 2014). There is, however, another explanation for these findings: following the 1991 decree, the 1.5-child quota *was* a safety value on fertility, but after two decades of harsh enforcement parental preferences had been reprogrammed in line with those quotas (Merli and Morgan 2011; Merli and Smith 2002; Nie and Wyman 2005).

Another reason for public indifference to the demise of the one-child era in 2015 is that central authorities stamped an expiration date on it two years earlier. The loophole of 2013 loosened birth quotas more than experts realize. Given that one-child restrictions began in the early 1980s, the proportion of only-child adults reaching marital ages rose dramatically after 2000, particularly in urban areas. The 2013 loophole, combined

with growing proportions of couples qualifying for that loophole, resulted in a "1.8"-child policy.[8] Given that China's TFR did not rise much past 1.6 births per woman under a 1.8-child limit, it seems unlikely to do so under a 2-child limit.

Conclusion: On Science, Advocacy, and the Post-One-Child Era

In the last dozen years of China's one-child era, most experts dismissed the government's view that its birth planning program played a central role in controlling population growth. Greenhalgh (2003:166) went even further, claiming that the very "ideas about China's population problem . . . were actively fabricated by Chinese population scientists using numbers, numerical pictures (such as tables and graphs), and numerical techniques (such as projections)" and that China's "virtual 'population crisis'" was a misconstruction of "scientizing rhetorics" (p. 163), the key objective of the author being "to clear the way for fresh consideration of policy alternatives [to one-child restrictions]" (p. 166). Other experts seemed to agree, linking arms to dispute the demographic impact of the one-child program (Basten and Jiang 2014; Cai 2010; Gu and Cai 2011; Morgan et al. 2009; Sen 2015; Wang et al. 2013, 2016; Whyte et al. 2015; Zhang and Zhao 2005; Zhao 2015; Zheng et al. 2009).

I counter-challenged herein that this orthodoxy is itself a scientific misconstruction. The boundaries between science and advocacy may be clearer now that the fuel for the latter is gone. One need not agree with the choices made by Chinese policymakers or the soundness of their reasoning to appreciate that China's demographic destiny in the absence of policy intervention was real. Both friends and foes of that intervention might reconsider the "awesome strength" (Lavely and Freedman 1990:365) of China's "longest campaign" (White 2006), which was "coercive in central design and intent" (Aird 1990:15) and required parents to make "coerced choices" (Johnson 2016:17). Since 1970, this campaign likely averted a population of 360–520 million by 2015. The lower end of this range draws from a counterfactual projection based on fertility decline in Vietnam, the best national comparator for China; and the higher estimate is based on a 16-country comparator chosen, ironically, by critics of the official estimate. Moreover, the latter comparator implies that the one-child program *itself* averted a population of 400 million by 2015, matching the current official estimate. In fact, all aforementioned estimates are projected to double by 2060.

Experts missed the astonishing impact of China's one-child program due in part to misinferences about its fertility transition. The immediate impact was masked by seesawing marriage policies. Moreover, had China not enacted the one-child decree in 1979, fertility should have rebounded above three births per family given decollectivization and the coerced loss of childbearing opportunities during the 1970s. Experts also missed the role of population dynamics. In addition to counterfactual excesses in fertility rates, the extraordinary population averted by the one-child

[8] The calculation of "1.8" is informal. The prevalence of only-children is inferred based on past TFRs in urban and rural areas. If 70 % of parents in urban areas around 2013 were only-children, then only 10 % of urban couples were still subject to one-child limits (a 1.9-child norm). If 20 % of rural parents were only-children (and parents with a firstborn daughter were already exempt), then only one-third of rural couples were still subject to one-child limits (a 1.7-child norm).

program has been propelled by population growth, counterfactual momentum, and the cumulative power of time across 35 years of one-child restrictions.

Evolving enforcements under the one-child program were also the key driver of China's fertility plunge below two children per family. That plunge in the early 1990s *preceded* two roaring decades of economic growth, and fertility fell no further as prosperity rose. Although socioeconomic progress has contributed to preferences for smaller families in China, as it has everywhere else in the world, the sudden fall in China's fertility to well-below replacement coincided with enhancements to a punishing birth planning program that did not exist anywhere else. Only later would socioeconomic progress help ease parental preferences into the prematurely low quotas that policymakers had chosen for them.

Readers looking for the simplest comparative takeaway might consider this. China deployed a national norm of 1.5 children per family in the mid-1980s, and fertility fell in line with that norm shortly after it strengthened financial penalties in 1991. Vietnam called for a two-child limit in the late 1980s with far less severe penalties, and its fertility fell to a floor around 2 (Fig. 1). However, China and Vietnam broke past similar income milestones around that time and had equally well-educated parents (Table 1). What was exceptional about China that caused its fertility to fall so far below replacement? Every comparative perspective examined herein points to the same conclusion: if China had not employed draconian penalties to enforce the national norm of 1.5 children over the past 25 years, most mothers *would* have had two children, one-half birth higher than observed (Fig. 1; Fig. 5, panel b; Fig. 6). Put another way, one-half of all Chinese couples had one child less than they otherwise would have had.

Critics opposed China's birth program for decades, culminating with a campaign by scholar advocates beginning in 2001 to lift all one-child restrictions (Hvistendahl 2010), but that policy ground on for another 14 years. Might the findings herein have handed advocates a more successful battle plan? 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 publically *confirmed* that estimate and emphasized that the impact was destined to grow far larger? And instead of arguing that China's fertility was driven to very low levels by socioeconomic progress, what if they had credited enforcement of the 1.5-child norm as being so *effective* in reprogramming parental desires that one-child restrictions were no longer needed? Might the triumph of basic science—or rather, of advocacy built on it (Pielke 2007)—have been the full repeal of one-child restrictions well before 2015?

The findings herein also reignite questions about the broader relevance of China's strategic demographic initiative (Tien 1991). To what extent was China's exceptional economic growth in recent decades due to the favorable age structures (Fig. 4) engineered by this initiative (e.g., its demographic dividend; Bloom et al. 2010; Cai and Wang 2005; Wang and Mason 2005)? How much did this initiative contribute to the "extraordinary demographic history" (Lam 2011) that helped the world dodge a "population bomb"? Has China's policy-reduced population benefitted the environment and biodiversity (Becker 2013; Brown 1995; Scott 2008), or has accelerated prosperity quickened environmental degradation amidst an ever more voracious quest for resources (Economy and Levi 2014)? Lastly, did the coerced sacrifices of two generations of parents indeed facilitate China's global ambitions?

These questions will be debated for decades to come. Reliable answers must begin with alternate scenarios of China's population growth. Demographers have the honor of lighting the way forward given their ability to navigate this specialized realm of measurements and relations. With accusations of "bad science" being hurled so often at China's birth planners in decades past, population experts should be more careful to ensure the soundness of their own science. Perhaps *that* ambition will be better achieved now that the era of one-child limits in China is officially, finally, behind us.

Acknowledgments This research is a revision of a Working Paper in Demography at the Australian National University (Goodkind 1992) and reflects the views of the author alone. It does not represent the views of any other institution or organization. The author's fieldwork in the 1990s in Vietnam, China, and other parts of Confucian Asia was made possible by the Andrew W. Mellon Foundation. The author gratefully acknowledges the reviewers and Editors of *Demography* for their extensive comments and guidance, as well as helpful feedback from Christophe Guilmoto, Siri Tellier, Hania Zlotnick, and Peter Donaldson.

Appendix

Table 4 Demographic change parameters used for the projection of China's population, and total fertility rates for the counterfactual projections

				Total Fertility Rates (TFRs)			
Year	Life Expectancy at Birth (both sex)	Infant Deaths per 1,000 Live Births	Sex Ratio at Birth, M/F × 100	China	Vietnam	16-Country Comparator	India
1970	56.5	81.6	107.0	5.80	5.80	5.80	5.81
1975	61.1	64.8	107.0	3.67	4.94	5.20	5.57
1980	64.9	51.4	107.0	2.24	4.13	4.60	5.19
1985	66.7	44.7	107.8	2.66	3.46	4.00	4.83
1990	67.4	42.4	110.2	2.21	2.84	3.40	4.00
1995	68.8	35.5	112.8	1.78	2.18	2.78	3.60
2000	70.1	29.8	114.8	1.56	2.12	2.34	3.20
2005	71.8	23.3	116.4	1.55	2.06	2.18	2.93
2010	73.4	18.1	116.6	1.49	2.00	2.02	2.67
2015	74.5	15.2	114.0	1.60	1.94	1.86	2.40
2020	75.6	12.7	109.0	1.65	1.89	1.82	2.30
2025	76.7	10.7	107.2	1.50	1.84	1.78	2.20
2030	77.7	9.0	106.2	1.50	1.79	1.74	2.10
2035	78.8	7.5	106.0	1.50	1.74	1.70	2.00
2040	79.8	6.3	106.0	1.50	1.70	1.66	1.90
2045	80.9	5.3	106.0	1.50	1.65	1.62	1.80
2050	82.0	4.4	106.0	1.50	1.60	1.58	1.70
2055	83.2	3.7	106.0	1.50	1.55	1.54	1.60
2060	84.4	3.1	106.0	1.50	1.50	1.50	1.50

Note: Counterfactual projections used the same projection parameters as for China but substituted the TFR series shown. In addition, to avoid overestimation of China's averted population, the age-specific fertility rates (ASFRs) in the counterfactuals gradually interpolated China's ASFRs between 1970 and 2000, prior to raking the ASFRs up to match counterfactual TFRs (see note 4).

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