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Fertility by parity in China in the context of changing fertility policy

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Abstract

The study aims to investigate the dynamics of fertility by parity of Chinese women over the past seven decades under the context of changing fertility policy. Using data from population censuses, population sample surveys, and fertility surveys in China, the study estimates China's fertility by parity from 1949 to 2020 by adopting multiple fertility measures, including parity-specific total fertility rate, parity progression ratio, parity-progression-ratio-based total fertility rate, and cumulated cohort fertility rate, as well as the decomposition method. The study further evaluates the unique features of China's configuration of parity-specific fertility through an international comparative analysis of some Western countries based on data from the Human Fertility Database. It shows that in China, both the rigid fertility policy of restricting the number and timing/spacing of children implemented since the early 1980s and the recent relaxation of fertility policy of gradually easing the number and timing/spacing of children have had a significant impact on fertility patterns and levels, especially for parity two. However, the effect of fertility policy relaxation in a low-fertility context has been less sustainable than the earlier rigid fertility policy that contributed to the rapid decline in fertility for second and higher orders of parity. Under the joint influence of the Confucian fertility culture, rapid socioeconomic growth, and the internalization of long-standing strict fertility policies, China has formed a unique pattern of parity-specific fertility profile compared to those of some developed societies, with a universal progression to the first birth, a very low but policy sensitive progression to the second birth, and an extremely low progression to the third birth.

Keywords: Total fertility rate; Parity progression ratio; Fertility by parity; Fertility policy; China

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1. Introduction

Parity analysis is essential for a deeper understanding of fertility dynamics. The reduction of high-order births has been a main determinant of the initial decline toward low fertility, while the change of pace of postponement at birth order one and two has emerged as a crucial driver of recent fertility change among low-fertility settings (Bongaarts & Sobotka, 2012; Kohler, *et al.*, 2002). A rapid shift to delayed childbearing and a low probability of progression of a higher order after the first birth were regarded as the important features of lowest-low fertility in the late 1990s in European countries (Billari & Kohler, 2004). In

line with this, the increases of the first and second births resulted by a decline in the pace of fertility postponement have contributed substantially to the increases in the overall period total fertility rate (TFR) between 1998 and 2008 in European countries (Bongaarts & Sobotka, 2011).

Underlying the dynamics of period fertility, there has been a well-documented long-term decline in cohort fertility by parity across developed countries. In these countries, the reduction in the progression ratios to the third and higher orders was the main driver of fertility decline among women born between 1940 and 1955; the falling first or second birth played the major role in changes in fertility among women born between 1950 and 1970 (Zeman, *et al.*, 2018). Nevertheless, parity distribution of fertility in different countries may vary considerably even when they have similar levels of cohort fertility (Zeman, *et al.*, 2018).

As the most populous country, fertility in China is of global significance. Fertility in China has undergone significant changes since the foundation of People's Republic of China in 1949, which has been well-documented to be closely associated with its fertility policies. The extraordinary fertility transition in China since the 1970s is widely considered to be the product of a strict birth control policy interacting with socioeconomic development. However, there has been much confusion on the extent to which that fertility policy has been effective to lower the fertility because of the complexity associated with data quality and measurement issues since the 1990s. The recent adjustments of fertility policy after 2015 designed to lessen restrictions on childbearing have received wide attention, yet there have been doubts casted on how much the new policy could boost fertility. The control of parity and timing/spacing has been the key content of China's fertility policy and varied with the evolution of fertility policy, making the fertility parity analysis in China especially pertinent. The analysis of period/cohort level and patterns of fertility since 1949 in China from the parity perspective would help to illustrate the effects of the changing fertility policy on fertility during the period.

1.1. Evolution of fertility policy and its control of parity and timing/spacing

The evolution of China's fertility policy on parity and timing/spacing could be divided into four phases. In Phase 1, from 1949 to the early 1970s, there was neither control of number of children nor timing/spacing of births. Although China piloted its first official family planning program in the early 1950s, the primary focus of the policy was to promote the ideas of birth control and small families without explicit regulation on control of number of children and timing/spacing of births (Jiang & Liu, 2016; Lu & Zhai, 2009; Zhang & Cao, 2006). The policy was interrupted firstly by the Great Famine during the period from 1959 to 1961 and then by the early years of Cultural Revolution in the late 1960s.

In Phase 2, during the 1970s, there was control of the timing/spacing of birth orders one and two as well as the restrictions on third and higher birth orders. In the early 1970s, China resumed its nationwide fertility policy with the campaign slogan "later, longer, fewer" (wan xi shao), referring to later marriage, longer birth interval, and fewer number of children. By a later marriage, the minimum age of later marriage was set at 23 years old for women and 25 years old for men in rural areas and 25 for women and 28 for men in urban areas. By a longer birth interval, the minimum interval between the first birth and second birth was set at 3 years in 1978. By fewer children, the maximum number of children was initially three children for rural couples and two for urban couples, but two children for all couples since 1977 (Bongaarts & Greenhalgh, 1985).

In Phase 3, from 1980 to the early 2010s, the policy-allowed number of children was one child (or two or three in certain cases) and the stipulations of timing/spacing of births were also applied. The rigid one-child policy, under which every couple was allowed to have only one child, except very special circumstances, was implemented nationally in 1980. In the early stages of the implementation of the one-child policy, there were only a few circumstances in which a second child was allowed, mostly for couples in rural areas. The proportion of couples who were allowed to have a second child of the total number of couples was no more than 10% (Lu & Zhai, 2009). This rigid one-child policy was revised first in 1984 and then in 1986 by allowing more couples to have a second child but limiting third and higher-order births as well as unauthorized second births due to the strong resistance from residents in rural areas with widespread traditional values of large family and strong son preferences (Greenhalgh, 1986). From 1984 on, some rural couples were allowed to have a second child under certain conditions. The policy was further modified in 1988 to a "1.5-child policy": Couples in major rural areas were allowed to have a second child after a certain interval after their first child if that first child was a girl. This adjusted version of the one-child policy lasted from the mid-to-late 1980s until the end of 2013 (Zhao, 2015). If all couples follow fully the fertility policy, there would be 63% of them ending up with only one child in the late 1990s (Gu, *et al.*, 2007). However, the actual proportion of women having only one child estimated from the 2017 China Fertility Survey data was much lower. The cohort cumulative fertility rate was 1.6 – 1.7 for women aged 35–44 in 2017 who entered childbearing age in the late 1990s and early 2000s (Chen & Duan, 2019), with only 41% of them ending up with one child. Exemptions to the one-

child rule often came with a timing/spacing requirement, stipulating a minimum of age at second births or/and 4 or 6 years between the first and second birth. While from the beginning of the 21st century, restrictions on the timing/spacing have been gradually lifted. By the end of 2013, 18 provinces (autonomous regions and municipalities) had abolished controls on the interval between births (Zhang, *et al*., 2016).

In Phase 4, from 2014 to the present, both the control of parity two and the birth interval restrictions were gradually removed. At the end of 2013, the Chinese government implemented selective two-child policy, allowing couples where either wife or husband is a singleton to have the second child (Basten & Jiang, 2014). In 2015, the fertility policy was further adjusted to universal two-child policy, allowing all couples to have two children (Zeng & Hesketh, 2016). The Chinese government is now encouraging the birth of children with its new "three-child" policy accompanied by supportive measures, launched in 2021. The 2021 amendment provides general principles; the details of how these new family planning measures are to be implemented are left, as with the previous ones, to the discretion of respective provincial governments (Attané, 2022).

1.2. Debate on effects of fertility policy in China

Debates about the effects of fertility policy on China's fertility have come with the evaluation of fertility policy and have been ongoing for many years. As one of the most controversial policies in history, debate has raged over the positive and negative effects of the one-child policy. The importance of the one-child policy for fertility transition is controversial (Zhang & Cao, 2006). China's family planning policy has been claimed to have been effective, based on the evidence of the various estimates at different times of hundreds of millions of averted births and the decline in the fertility rate (Goodkind, 1992, 2017; Yang, *et al*., 2000; Zhao, 1991). However, these assertations have been contested with claims that the "later, longer, fewer" policy of 1973 played a critical role in driving down the fertility rate, and that the role of the one-child policy and its descendants from 1980 on was much less significant (Gietel-Basten, *et al*., 2019), and others argue in particular that the importance of the family planning program on fertility transition should not be overstated, especially from the 1990s (Zhao & Chen, 2011).

Since the policy relaxation with the selective two-child policy in 2013 and the universal two-child policy in 2015, a debate has been under way on the need to review the effectiveness of the relaxation of fertility policy. Under the two-child policy, the focus of academic and policy debate has been on whether the adjustments to fertility policy have significantly affected fertility, and how much China's fertility will increase under the new policy. After the implementation of selective two-child policy in 2013, some researchers argued that the policy was ineffective based on the fact that far fewer couples than expected have applied for permission to have a second child. Other researchers argued that the effect of the policy has been largely in line with the expectation based on the substantial increase in births after the implementation of selective two-child policy. They suggested that the reason for the low proportion of eligible couples who submit the application to have a second child was that the decision to have a second child takes time and the application did not happen in a short time (Zhai, *et al*., 2021). The implementation of universal two-child policy led to a rapid shift in scholarly attention to the new policy. The increases in the newborn and fertility rate in 2016, particularly for the second births, suggest that there has been a positive effect of the universal two-child policy in the short term (Shi, *et al*., 2018; Song, 2017; Yuan & Gao, 2017). While they may be based on different population projections resulting from the use of different data sources and assumptions, studies suggest that the universal two-child policy will affect fertility rates and thus slow population aging, but with only a moderate and temporary effect (Wang & Ge, 2016; Zeng & Hesketh, 2016; Zhang, *et al*., 2019). However, after the accumulative effect runs out, the number of births and fertility has fallen sharply since 2018. The downward trend in number of births and fertility was not effectively reversed even by the implementation of the three-child policy in 2021. Recent studies have consistently found that a large proportion of couples do not want to have a second child even they are allowed to (Feng, 2018; Jin, *et al*., 2016). The latest survey data from the National Bureau of Statistics show that China's fertility intention is only 1.8, which is significantly lower than the replacement level and lower than that of developed low-fertility countries (Yu, *et al*., 2021).

1.3. Current study

Fertility trends in China, and in particular the trends by different birth orders, are closely related to the fertility policy. In this paper, we, therefore, investigate the interrelation between period/cohort level as well as patterns of fertility since 1949 and fertility policy from the parity perspective.

Despite a large body of studies assessing the levels of and trends in overall fertility, there has been limited research on fertility by parity, especially after the 1980s. Based on reliable data sources and different fertility measures, the research on China's fertility levels in the 1970s and 1980s has provided valuable information for our understanding of fertility and the policy effects in these two decades. However, different beliefs about the credibility/quality of population survey data since the 1990s have led to a wide

divergence in scholars' understanding of fertility levels and trends in China. Estimations of TFR directly obtained from census or sample survey data are lower than those obtained based on adjusted census data or other data sources. Some scholars suggested that the underreporting of births is greater for the second and higher orders because births do not conform to the policy restriction, such as births with insufficient intervals or even over-born, are more likely to be underreported (Wang, 2003; Zhang & Su, 1995). Accordingly, the existing literature on fertility by parity has focused on a specific period, particularly the early years.

The period TFR has been the most common measure of the fertility level due to its simplicity and wide availability (Bongaarts & Feeney, 1998; Ma, *et al*., 1986a; McDonald & Kippen, 2007). However, the period TFR is hard to reveal the accurate effects of fertility policy. The period TFR is not able to distinguish a change in timing (or tempo) of cohort fertility from a change in the level (or quantum) of cohort fertility (Schoen, 2004). The period TFR is regarded as biased or distorted by tempo effects. That is, estimates of TFR are depressed during years when women delay childbearing and inflated in years when childbearing is accelerated (Bongaarts & Feeney, 1998). More specifically, under the interference of various period factors, the estimates of parity-specific TFR sometimes exceed one child per woman (e.g., Whelpton, 1945, 1954; Yao, 1995). For instance, the TFR for the first births was >1 in many Western countries in the 1940s and in China in the early 1980s, implying that women on average have more than one first birth, which is not interpretable (Ma, *et al*., 1986a; Rallu & Toulemon, 1994).

This study aims to evaluate China's fertility by parity since 1949 using multiple sources of data and by adopting multiple fertility measures, including period TFR by parity, period parity progression ratios (PPPRs), period parity-progression-ratio-based total fertility rate (PPTFR) by parity, cohort parity progression ratio (CPPR), and cohort cumulative fertility rate (CCFR) by parity as well as its decomposition. This enables us not only to assess the fertility dynamics by parity over the past 70 years but also to identify the possible effects of the changing fertility policy during the period. Performing this analysis is especially interesting given the recent adjustment in the family planning policy. The results are expected to provide important insights into fertility by parity in China by further comparing the parity distribution in China with other low- fertility settings.

2. Data and methods

2.1. Data sources

Multiple sources of data are used in this research. The fertility data of China mainly come from national population censuses performed in 1982, 1990, 2000, 2010, and 2020; the 1% national intercensal population sample surveys conducted in 1987, 1995, 2005, and 2015; national one- per-thousand annual sample surveys of population change from 1982 to 2020; and national retrospective fertility sample surveys conducted in 1982, 1988, 1992, 1997, 2001, and 2017. These population censuses and population sample surveys collected detailed information on age-parity-specific fertility rates, age at first marriage, and age when children were born for Chinese women. These data allow us to establish the historical fertility levels and patterns by parity. The availability of the Human Fertility Database allows us to compare fertility by parity in China with that in other low-fertility societies.

Considered the widely established fact of varying degrees of birth under-reporting in censuses and surveys since the early 1990s, this paper made an effort to adjust the estimates of period fertility rate from 2000 to 2020 based on the number of births published by China's National Bureau of Statistic (NBS). First, it estimated the age-specific number of women aged 15–49 from 2000 to 2020 based on the 2010 census. Second, with the assumption that the age-specific fertility schedules are accurate in the census/population sample survey data, it decomposed the births published by NBS into the different ages of women of childbearing age. It is worth noting that the NBS updated the number of births from 2011 to 2020 based on the 2020 census. Third, it obtained the adjusted estimates of age- specific fertility rate based on census/sample survey data. The adjusted estimates based on the 2017 China Fertility Survey followed the same process. Due to the possible significant overestimate of NBS-published births in the 1990s, we are not able to adjust the estimates of period fertility rate in the 1990s applying the same strategy (Chen, 2016; Zhao & Chen, 2011).

2.2. Methods

The main aim of the study is to examine the aggregate level of fertility by parity in China. Besides the most commonly available measure, the conventional TFR by parity, the study includes multiple measures of fertility: PPPR, PPTFR, CPPR, and CCFR. PPTFR provides more stable and consistent estimates than conventional TFR because they control not only for age but also for parity. CCFR provides a straightforward measure of the fertility of real groups of women and has been championed as the most appropriate measure to analyze fertility (Ryder, 1986).

The definitions and calculations of TFR and CCFR are well known, while those of PPTFR are more complex. The definitions of PPTFR can be understood by the way in which their calculation improves compared with TFR, whose calculation controls for women's age only. The construction of PPTFR further takes parity into

consideration, showing the total fertility rate of a population that is calculated based on age-parity-specific fertility rates (Rallu and Toulemon, 1994). The calculation of PPTFR requires the use of parity progression ratios and life tables. Supplementary information 1 presents a full description of the calculation process and formula for PPTFR. Detailed calculation methods can also be found in relevant literature (Feeney, 1983; Feeney & Yu, 1987; Ma, *et al.*, 1986b; Rallu & Toulemon, 1994).

Guided by the previous study on decomposition of cohort fertility in low-fertility countries (Zeman, *et al.*, 2018), this study also explores how parity progression ratios varied across cohorts and the contribution of changing parity progression ratios to the overall change in completed cohort fertility in China. The specific decomposition process is presented in supplementary information 2.

3. Results

3.1. Period TFR by parity and ages at the first and second births

Figure 1 plots the TFR and parity-specific TFR for Chinese women from 1949 to 2020 based on all datasets we used for this research. China has experienced a dramatic fertility transition between the 1950s and 1990s. Fertility in China fell to replacement level in the early 1990s and has remained low for almost three decades since then. The fertility transition in China can be roughly divided into four stages (Chen, 2003; Lu & Zhai, 2009): Pre-transitional fertility during the 1950s and 1960s; rapid fertility decline or first fertility transition in the 1970s; buffered fertility in the 1980s; and continued low-fertility or second fertility transition from the 1990s.

Fertility by parity shows different characteristics in different stages of China's fertility transition. In the first stage, TFR stabilized at a high level of about six in the 1960s due to the socioeconomic development and people's living being restored from a protracted war since the founding of the People's Republic of China. TFR in China fell sharply during the Great Famine from 1959 to 1961, with the lowest level of fertility of 3.29 children per woman during this period. The TFR recovered to 6.02 in 1962 and 7.46 in 1963 soon after the Great Famine and then fluctuated at around six children per woman in the late 1960s. In the 1950s and 1960s, the fertility for parities one and two fluctuated at around one, while fertility for parity three and above fluctuated at around four, except the period of Great Famine. The changes of fertility and fertility by parity were mainly resulted from the structure of childbearing age of women. The traditional fertility attitudes and low level of social development were the main forces to maintain the high level of fertility at the first stage.

In the second phase, the TFR in China has declined continuously and rapidly in the 1970s, plummeting from 5.71 children per woman in 1970 to 2.73 in 1979 due to the nationwide "later, longer, fewer" fertility policy launched in the early 1970s. By parity, the decline of fertility of third birth and above was substantial, falling steeply from 3.90 in 1970 to 1.18 in 1980. While the decline of fertility for parity one and parity two was modest during the same period, with the first-birth fertility rate declining from 0.96 to 0.67 in 1975, then increasing to 0.86 in 1979, and with the second-birth fertility rate declining from 0.90 in 1970 to 0.61 in 1977, then slightly rising to 0.68 in 1979. Due to the fertility policy during this period, there was a significant monotonic decline of fertility for parity three and above and a corresponding delay in the births for parities one and two. Accordingly, the decline in the second-birth fertility rate was related to the delay of the age at second birth, rather than a real decline of the level of second-birth fertility.

In the third phase, the TFR hovered between 2.20 and 2.86 in the 1980s, with two significant "rebounds" in 1982 and 1986, respectively. The second-birth fertility reversed from a downward trend in the 1970s to an upward trend in the 1980s. Affected by the one-child policy, the fertility for the second birth fell to its lowest level ever since the founding of the People's Republic of China, with a level of 0.59 in 1980, but it then fluctuated upward, reaching a peak of 0.86 in 1987 during this phase. Over the same period, the fertility rate for the first birth continued to be > 1 throughout the 1980s, with a peak level of 1.3 in 1982. The fertility rate for the third child and above showed a fluctuating downward trend, with a level of around 0.81 in 1981 and 1982, and then declining to 0.57 in 1987.

The fluctuant and even the rebound TFR was related to the reverse of the postponement trend in the ages at marriage and childbearing of young cohorts as well as the "compensation" of delayed childbearing of the old cohorts in the 1970s. This superimposed effect of childbearing for early and older cohorts offsets the decline in cohort fertility to some extent. The fertility rate for parity one continued to be > 1, which is a reflection of this superimposed effect. There were two main reasons for the reverse of postponement of women's marriage and childbearing in the 1980s. First, the new marriage law launched in 1980 set the legal age of marriage for women at 20 years old, which was 3 years lower than that regulated by the fertility policy in the 1970s, leading to an advance of marriage for women (Zha & Ji, 1984). Second, the household contract responsibility system in the context of economic reform, which was widely implemented in rural areas during this period, contributed to the tendency of rural residents to get married and to give births early. This was due to the

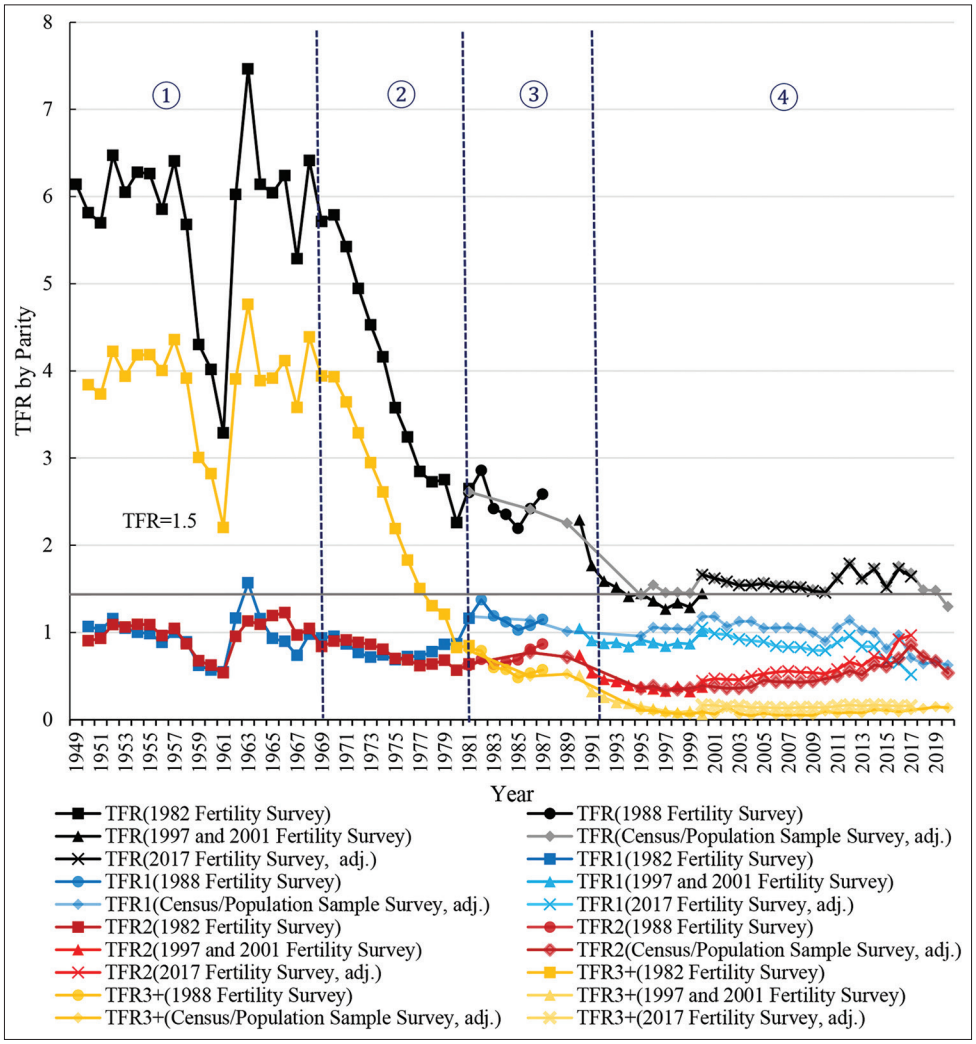

Figure 1. TFR and parity-specific TFR in China, 1949–2020

Sources: The 1982 Fertility Survey: Calculations from 1950 to 1962 made by Yao (1995) and NPFPC and CPDRC (2013), calculations from 1963 to 1981 made by Ma *et al.* (1986b) from the National One-per-Thousand Fertility Survey in 1982; The 1988 Fertility Survey: Calculations made by Yang *et al.* (1991) from the National Two-per-Thousand Fertility Survey in 1988; The 1997 and 2001 Fertility Surveys: Calculations made by Ding (2003) from the National Population and Reproductive Health Survey in 1997 and 2001; Censuses/Population Sample Surveys: Estimations from national population censuses performed in 1982, 1990, 2000, 2010 and 2020, the national one per cent intercensal sample surveys conducted in 1987, 1995, 2005 and 2015, and national one per thousand annual sample surveys of population change from 1982 to 2020 ; 2017 Fertility Survey: Authors' own estimations from the National Fertility Survey in 2017 and the population census conducted in 2020. It should be noted that we adjusted estimations of the Census/Population Sample Survey and the 2017 Fertility Survey from 2000 to 2020 based on the births published by China's National Bureau of Statistics (NBSC, 2022).

fact that family conditions depended to a large extent on the number of family workforce under the system. Both early marriage and childbearing were conducive to increase the number of workforce in the family (Su, 1992). As shown in Figure 2, the average age of women at the first and second births declined markedly in the early 1980s, from the age of 24.82 and 27.51 in 1975 to the age of 23.36 and 26.28 in 1981, respectively. The advance of age of women at first marriage led to a higher fertility rate in the 20–22 age group. The "compensatory" effect is mainly due to the fact that delayed marriage and childbearing in the 1970s creating a "deficit" that led to an increase in fertility in the corresponding age group in the 1980s (Gu, 1991; Zha & Ji, 1984). Other factors contributing to fertility fluctuations in the 1980s include the adjustments and improvements of fertility policies in the mid to late1980s as well as the entry of peak birth cohort of 1963 into reproductive ages (Wu, 2010).

It should also be noted that the fluctuations and increases in the TFR in the 1980s were mainly caused by fertility changes for the parities one and two, while the fertility rate for parity three and above declined. Compared with the first-birth fertility, the second-birth fertility was relatively flat. The reasons include: (1) Most urban women and a small proportion of rural women obeyed to the one-child policy rule and did not progress to their second births and (2) the

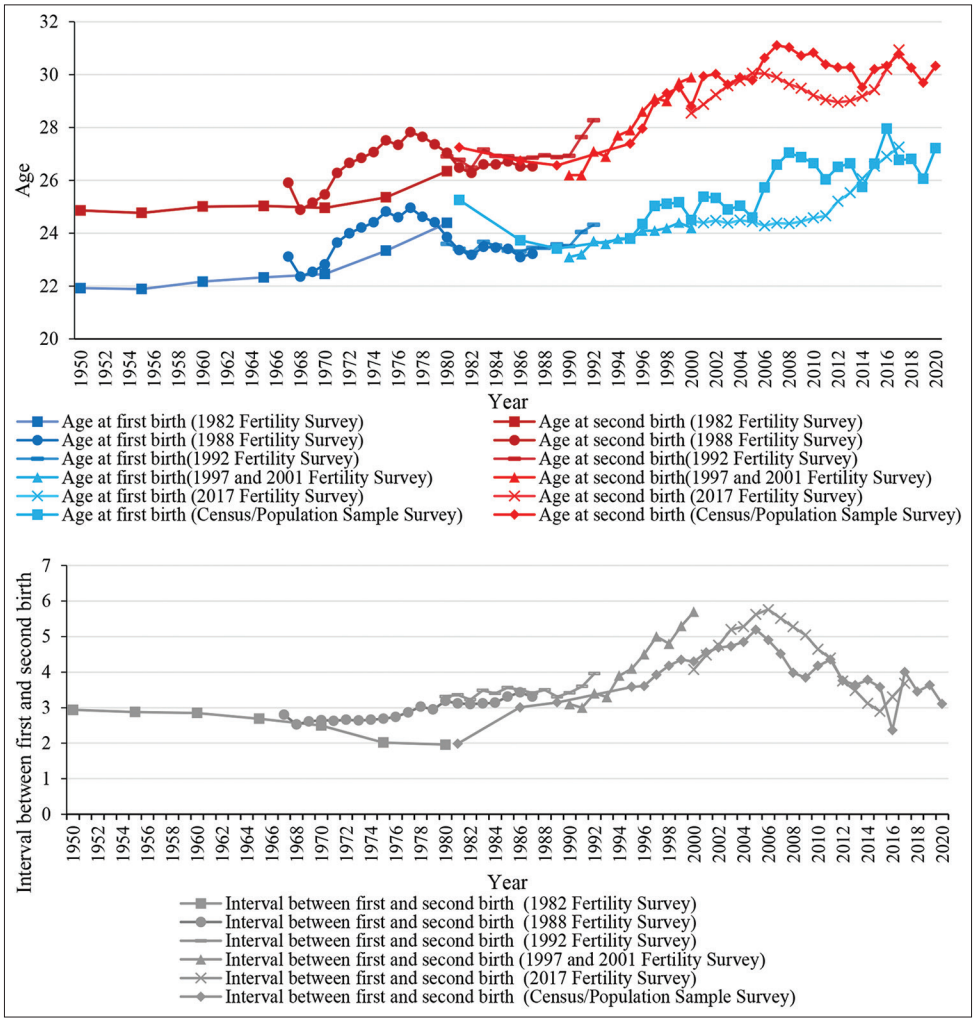

Figure 2. Mean ages at the first birth, second birth, and interval between the first and second birth of Chinese women, 1950 – 2020

Sources: The 1982 Fertility Survey: Calculations made by Liu and Zou (2011) from the National One-per-Thousand Fertility Survey in 1982; The 1988 Fertility Survey: Calculations made by Feeney and Feng (1993) from the National Two-per-Thousand Fertility Survey in 1982; The 1992 Fertility Survey: Tabulations from Statistics of the 1992 Fertility Sampling Survey in China, edited by Jiang (1995); The 1997 and 2001 Fertility Surveys: Calculations made by Ding (2003) from the National Population and Reproductive Health Surveys in 1997 and 2001; Censuses/Population Sample Surveys: Estimations from national population censuses performed in 1982, 1990, 2000, 2010 and 2020, and the national one per cent intercensal sample surveys conducted in 1987, 1995, 2005 and 2015, and the national one per thousand annual sample surveys of population change from 1982 to 2020; The 2017 Fertility Survey: Authors' own estimations from the National Fertility Survey in 2017.

interval between the first and second births of women who were allowed to have second births increased, especially between 1985 and 1987. The increase in the interval between the birth of the first child and the second child further delayed women's age at the second child, which led to a reduction in the period fertility rate of the second birth (Ding, 2003).

In the fourth stage, the second-birth fertility rate for Chinese women showed a rapid decline, falling to a level of around 0.33 by the end of the 1990s. During the same period, the first-birth fertility rate remained stable at 0.84 – 0.91. The trend in the parity-specific TFR for the third child and above also showed a rapid decline in the early 1990s, but remained stable in the late 1990s. Assuming that underreporting of births was more serious for the second child and higher orders, the actual second-birth fertility rate throughout the 1990s was higher than the level shown in Figure 1.

Despite the great differences among estimates of the TFR since 2000 based on different data sources, the rough trends of fertility are relatively consistent. The estimated first-birth fertility rate based on census/sample survey data was higher than that calculated based on the 2017 Fertility Survey data, while the estimates of the fertility rates for the second birth, third birth and above based on census/sample survey data were lower than those estimated based on the 2017 Fertility Survey data. An overall trend from estimates based on different data sources shows that the level of second-birth fertility began to fluctuate upwards after 2000, reaching its peak in 2016 before falling down.

This contrasts with the fluctuating decline in the first-birth fertility and the relative stability of fertility rate for the third birth and above over the same period.

To be specific, the changes in the second-child fertility after 2000 have been influenced by two factors: First, the reduction in the lifetime cohort fertility that has had a negative effect on the second-birth fertility; second, the gradual entry of the first only-child cohort into reproductive age since 2004 as well as the gradual relaxation of fertility policies, including the successive removal of the restriction on interval between first and second birth since 2002, the implementation of selective two-child policy in 2013 and the universal two-child policy in 2015. Due to the relaxation of fertility policies, the proportion of women in reproductive age who are allowed to have a second child has increased, which, in turn, has had a positive effect on the second-birth fertility. It is evident that the positive effect of the latter factor was greater than the negative effect of the former factor. With the removal of the two-child restriction in 2015, the second-birth fertility fell after a timely rise in 2016 and 2017, suggesting that the policy did have a significant but unsustainable "accumulative" effect.

There has been a significant delay in women's age at first and second births and an increase in the interval between the first and second births since the 1990s. This has been resulted from the further intensification of fertility policy in the 1990s as well as the increased opportunities for women to have higher education during this period. Women's age at first birth is closely associated with women's age at first marriage, while their age at second births is associated with both the age at first birth and the interval between the first and second births. The interval between the first and second births maintained around 3 years from the 1950s to the 1970s in the first and second stages of demographic transition, which is close to natural intervals. In the third stage in the 1980s under the one-child policy and its corresponding regulations on birth interval, the interval between the first and second births increased to around 4 years. From the mid-1990s, the interval between the first and second births increased and became higher than 4 years, reaching a peak in 2005–2006, and then declined as birth spacing controls were phased out. The interval remained at around 3 years recently.

3.2. Period fertility schedule by parity

Trends in overall fertility came from changing age-specific fertility. Figure 3 shows age-specific fertility rates by parity in 1970, 1980, 1989, 2000, 2010, and 2016. The fertility schedule of Chinese women saw a transition from a "natural fertility schedule" to a "controlled fertility schedule" with the fertility transition. During the 1950s and 1960s, the age-specific fertility schedule was an unrestricted "natural fertility schedule" (Feng, 1985), characterizing by "early, dense, and numerous" childbearing with women having children throughout the reproductive span (Song & Li, 1991). Following the implementation of "later, longer, fewer" policy in the 1970s and one-child policy in 1980, the age pattern of Chinese women shifted to a "controlled fertility schedule" (Feng, 1985). Since the mid-1990s, the age-specific fertility schedule has been characterized by a steady delay in the age at births and an increasing proportion of second births (Song & Tang, 2017). There was a significant change in the fertility schedule in 2016, with fertility rates of second births being higher than that of first births, which is clearly related to the implementation of universal two-child policy.

The schedule of age-specific fertility shows different characteristics for different parities. There was a pronounced change in age-specific fertility schedule for parity one before and after the start of the 21st century, shifting from a concentrated schedule to a flat one. The shift of fertility schedule for parity three and above occurred even earlier, between the 1970s and 1980s, with substantial declines at nearly all ages. The fertility schedule for parity three and above stabilized ever since the 1990s. Compared with the fertility schedules for parity one and for parity three and above, the changes of fertility schedule for parity two were more complex. In 1970, the peak of age-specific fertility rates for parity two of Chinese women occurred at age 23 with a fertility rate of 0.13, indicating an early childbearing and a higher level for parity two. The 1980s saw a delay in childbearing for parity two, with the peak fertility rate shifting to occur at age 25 with a fertility rate of 0.08. The schedule of age-specific fertility rate for parity two fluctuated in 1989, with the peak age advancing to 24 years. The age-specific fertility rates for parity two in 2000 and 2010 shows a substantial fall at nearly all ages compared to those for 1989. After the implementation of the universal two-child policy, there was a significant increase in age-specific fertility rate for parity two in 2016, especially for women aged 35 years old and above.

It is worth noting that there are differences in the schedules of estimates in 2000, 2010, and 2016 using different data sources. In general, estimates of age-specific fertility scheduled for parity two, parity three and above based on 2017 Fertility Survey data were higher than those obtained from census/sample survey data, while the opposite was true for age-specific fertility rates for parity one.

3.3. PPPRs

Figure 4 shows the PPPRs by parity from 1955 to 2016. The progression ratio to second births in China remained stable at around 0.98 from the 1950s to the late 1960s and

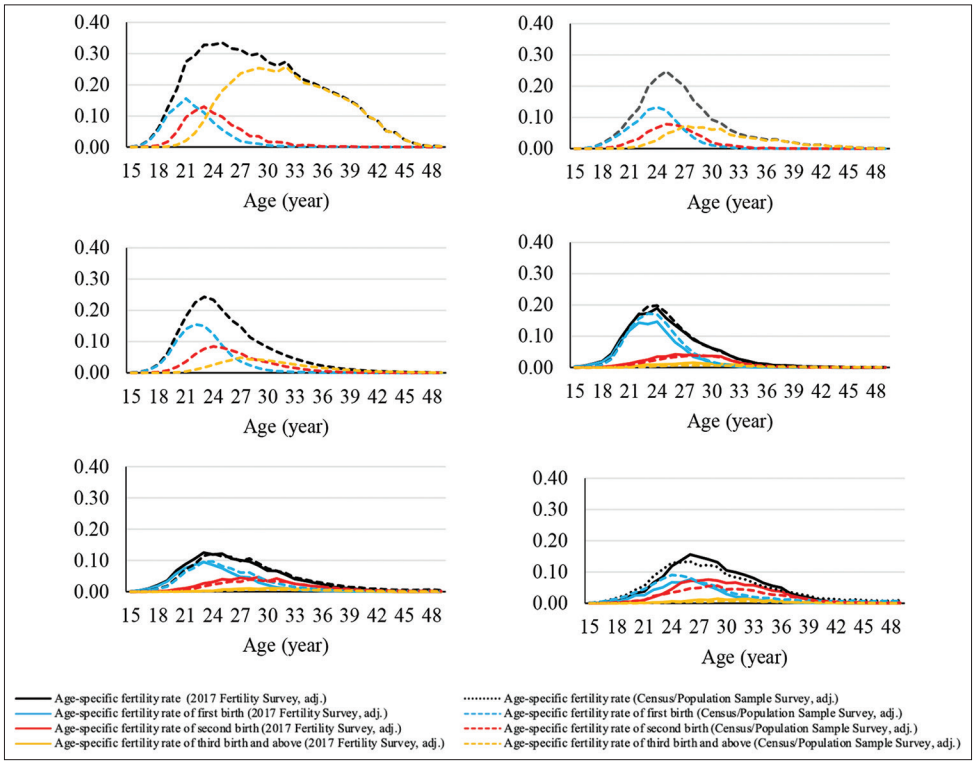

Figure 3. Schedules of total and parity-specific fertility of Chinese women in selected years

Sources: 1970: Tabulates from Fertility Data of China, edited by Yao (1995); 1980: Tabulates from Analysis of the National One-Per-Thousand-Population Sample Survey, edited by Population & Economics Editorial Board (1983); 1989: Tabulations from censuses conducted in 1990; 2000, 2010, 2016: Tabulates from censuses conducted in 2000, 2010, and national one per thousand annual sample surveys of population change in 2016, as well as authors' own estimation from the 2017 Fertility Survey.

declined slightly to 0.96 in 1979. That is, almost all Chinese women who had already had one child would progress to a second child during the 1950s to 1970s, indicating a widespread birth of two children. Since the introduction of the one-child policy in 1980, the progression ratio to second births of Chinese women declined appreciably to 0.80 in 1984 and rebounded slightly from 1985 to 1987 when the fertility policy in rural areas was adjusted and continued to decline afterward. The decline of the progression ratio to second births during this period undoubtedly reflects the impact of the fertility policy. The low level of social development and traditional fertility attitudes might have the opposite effect on the progression ratio to second births during this period, that is, inhibiting this decline. During the 1990s, there was a monotonous and rapid decline in the progression ratio to second births. The rapid decline during this period was partly influenced by the quality of the birth data. Given that the fertility policy was stable, it suggests that socioeconomic development factors played important roles to the decline of progression ratio to second births. The progression ratio to second births remained at around 0.45 in the 2000s, then rose to 0.53 in 2005 as the first generation of only-child entered their reproductive age, and then fluctuated between 0.53 and 0.61 from 2005 and 2015. With the implementation of the selective two-child policy in 2013 and the universal two-child policy in 2015, the progression ratio to second births began to fluctuate upward. In particular, after the universal two-child policy, the progression ratio to second births rose sharply from 0.54 in 2015 to 0.71 in 2016, reaching a peak of 0.74 in 2017.

The progression ratio to first births has remained stable at above 0.95 in the second half of the 20th century, except for the period of the Great Famine. Even though the progression ratio to first births has been slowly declining since the beginning of the 21st century, it has remained at 0.90 recently. The decline in the progression ratios to the third and fourth births was earlier and faster than the decline in the progression ratio to the second births, which occurred in the mid-1960s. It should be noted that the progression ratios to third and fourth births declined rapidly from the 1970s onwards, plummeting from 0.89 and 0.87 in 1970, to 0.36 and 0.30 in 1990, respectively, as a result of the "later, longer, fewer" policy that began in the early 1970s and one-child policy in the 1980s. After the 1990s, the progression ratios to the third and fourth births stabilized at around 0.20.

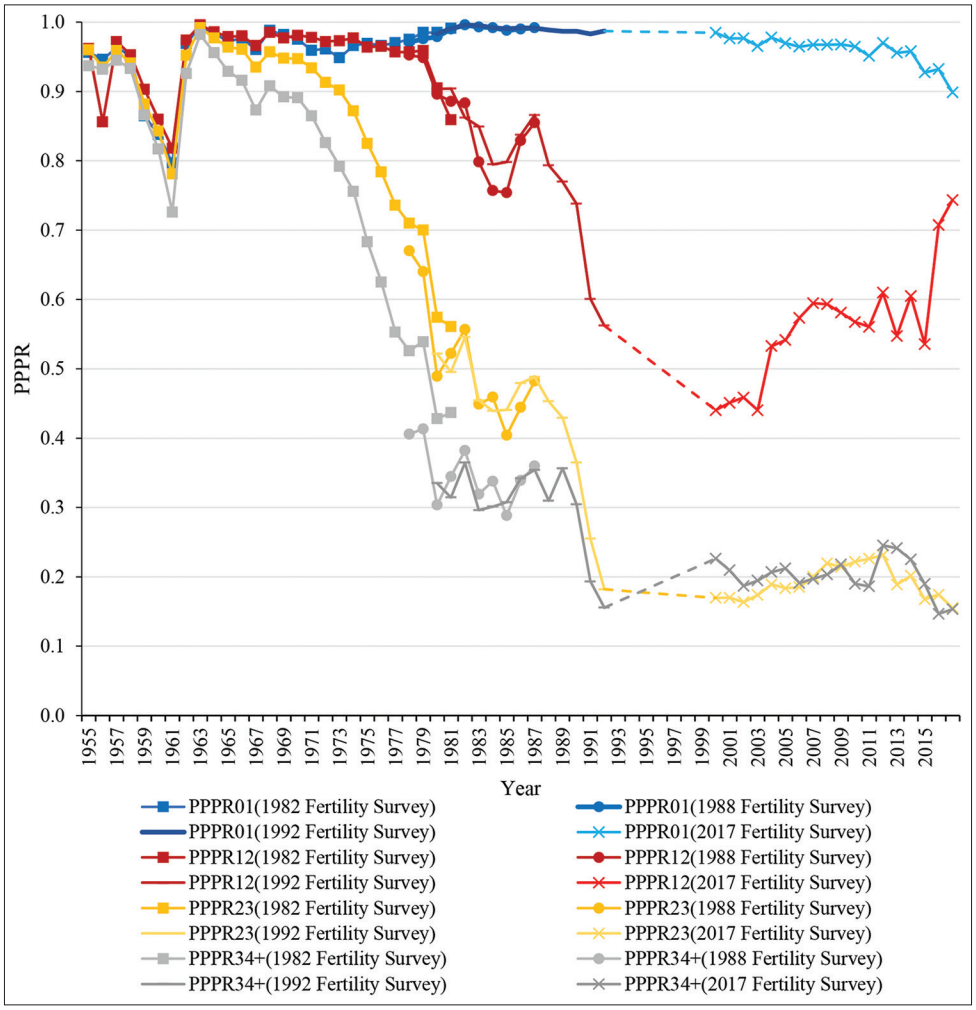

Figure 4. Period parity progression ratios of Chinese women, 1955–2017

Sources: The 1982 Fertility Survey: Calculations made by Feeney and Yu (1987) from the National One-per-Thousand Fertility Survey in 1982; The 1988 Fertility Survey: Calculations made by Yang *et al.* (1991) from the National Two-per-Thousand Fertility Survey in 1988; The 1992 Fertility Survey: Tabulations from Statistics of the 1992 Fertility Sampling Survey in China, edited by Jiang (1995); The 2017 Fertility Survey: Authors' own estimations from the 2017 Fertility Survey.

3.4. Period PPTFR by parity

In Figure 5, we compare the conventional TFR and PPTFR. There are remarkable similarity and difference between the two series. In terms of similarity, the two series show generally similar levels of fertility and move together over most of the period. Regarding the difference, the fertility trend indicated by PPTFR is flatter than that by conventional TFR. Supplementary information 3 presents the values of conventional TFR and PPTFR from 1949 to 2020.

By stages, the PPTFR is lower than the conventional TFR in the 1950s and early 1960s in the first stage, especially after the recovery from the Great Famine in 1962, but higher than the conventional TFR since the mid-1970s in the second stage. The conventional TFR tends to exaggerate the decline in fertility during this period, compared with those based on parity progressions (Feeney & Yu, 1987). In the third stage, the PPTFR is flatter than the conventional TFR again, showing a gap between the two series when the conventional TFR rebounded in 1982, 1986, and 1987, respectively. The conventional TFR suggests a reverse of fertility decline in the early 1980s, with the TFR rising substantially from 2.25 children per woman in 1980 to 2.65 in 1981. The PPTFR, however, appears to show continued decline of fertility, falling from 2.70 in 1980 to 2.65 in 1981. In the fourth stage, the conventional TFR showed a decreasing trend since the beginning of 21st century and a recovery with fluctuation from 2010 onwards.

Figure 6 shows the PPTFR by parity from 1955 to 2016. PPTFR for parity one is equivalent to PPPR to the first births. The PPTFRs for parity two and for parity three and above are flatter than the conventional TFRs for parity two and for

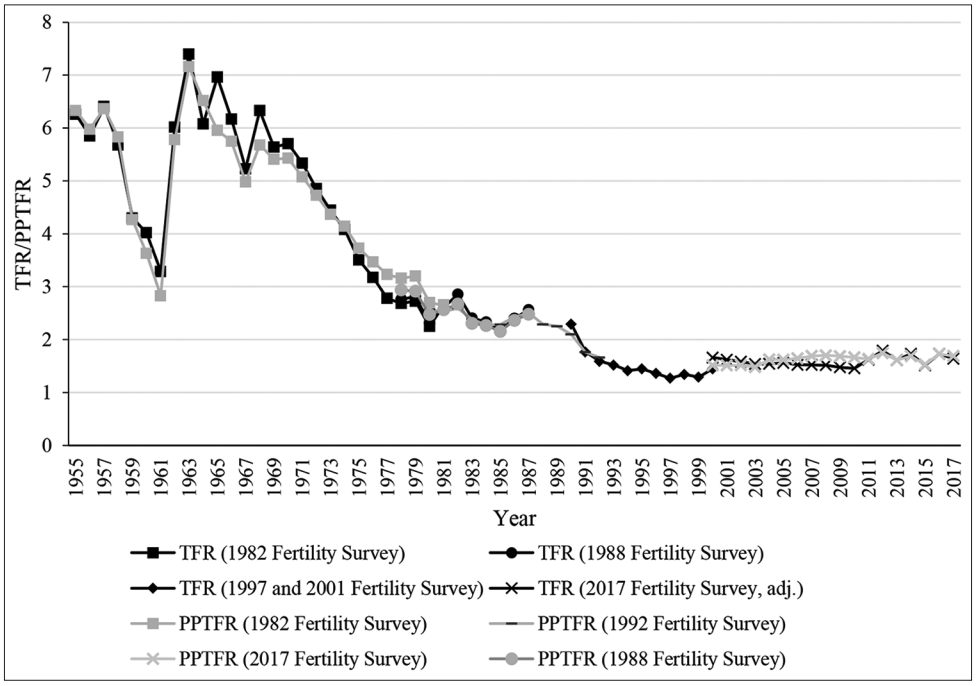

Figure 5. TFR and PPTFR in China, 1955–2017

Sources for TFR estimations: The 1982 Fertility Survey: Calculations from 1950 to 1962 made by Yao (1995) and NPFPC and CPDRC (2013), calculations from 1963 to 1981 made by Ma et al. (1986b) from the National One-per-Thousand Fertility Survey in 1982; The 1988 Fertility Survey: Calculations made by Yang et al. (1991) from the National Two-per-Thousand Fertility Survey in 1988; The 1997 and 2001 Fertility Surveys: Calculations made by Ding (2003) from the National Population and Reproductive Health Surveys in 1997 and 2001; Censuses/Population Sample Surveys: Estimations from national population censuses performed in 1982, 1990, 2000, 2010 and 2020, the national one per cent intercensal sample surveys conducted in 1987, 1995, 2005 and 2015, and national one per thousand annual sample surveys of population change from 1982 to 2020 ;The 2017 Fertility Survey: Authors' own estimations from the National Fertility Survey in 2017 and the population census conducted in 2020. It should be noted that we adjusted estimations of the 2017 Fertility Survey from 2000 to 2020 based on the births published by China's National Bureau of Statistics (NBSC, 2022).

parity three and above, correspondingly. The effects of fertility policy on fertility are evidently shown in the significant decline of PPTFR for parity three and above in the 1970s, the decline of PPTFR for parity two in the 1980s and 1990s, and the fluctuation upward of PPTFR for parity two in the 2010s.

3.5. Changes in CCFR and CPPR

There was a broadly monotonic downward trend in cohort cumulative fertility in China between women born in 1926 and 1977, except for a slight "rebound" in women born in 1961 and 1962. The average cohort cumulative fertility declined from about five children per woman in the late 1920s and early 1930s birth cohorts to around 1.7 children per woman in the 1970s birth cohorts (Table 1). The cohort cumulative fertility for parity one has remained stable at a level of 0.98 and above children per woman among all birth cohorts. A decline in the cohort cumulative fertility for parity two occurred first in the 1940s birth cohorts, declining from 0.96 children per woman in the early 1940s birth cohorts to 0.90 children per woman in the early 1950s birth cohorts, then declining rapidly to 0.66 children per woman in the 1960s birth cohorts, and finally declining to 0.57 children per woman in the early 1970s birth cohorts. The decline in cohort cumulative fertility for parity three and above emerged in earlier birth cohorts and to a greater extent than that for parity two. To be specific, the cohort cumulative fertility for parity three and above falling from 3.19 in 1930 birth cohort to 1.04 in 1950 birth cohort, further to 0.40 in 1960 birth cohort, and to < 0.20 in 1970 birth cohort.

As, shown in Figure 7, progression ratios to first births remained relatively stable and close to one among different birth cohorts of women. Accordingly, the dynamics of progression ratios from the first to second births were similar with cohort fertility for second births. Progression ratios to second births in women born during 1926 – 1951 remained above 0.9, showing a downward trend from the 1945 birth cohort. There was a large decline of progression ratios to second births between the 1951 and 1957 cohorts, followed by a "rebound" during 1960 and 1961 birth cohorts with a level around 0.7, fluctuated and declined thereafter, with the progression ratio to second births stabilizing at around 0.57 for the 1970–1977 birth cohorts.

Table 2 displays the contributions of changes in parity progression ratios to the first, second, third and later births in fertility changes of 1930, 1950, 1970 and 1977 births cohorts. The fertility decline in women born between 1930

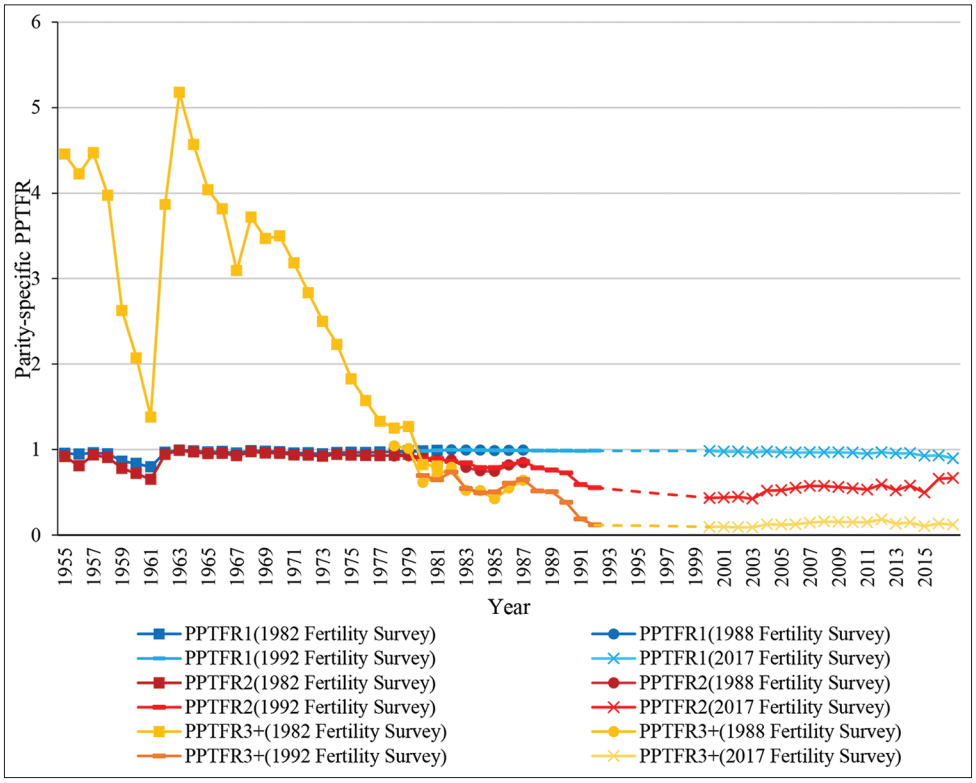

Figure 6. Parity-specific PPTFR in China, 1955–2017

Sources: The 1982 Fertility Survey: Calculations made by Feeney and Yu (1987) from the National One-per-Thousand Fertility Survey in 1982; The 1988 Fertility Survey: Calculations made by Yang et al. (1991) from the National Two-per-Thousand Fertility Survey in 1988; The 1992 Fertility Survey: Tabulations from Statistics of the 1992 Fertility Sampling Survey in China, edited by Jiang (1995); The 2017 Fertility Survey: Authors' own estimations from the 2017 Fertility Survey.

and 1950, from 5.10 to 2.93, was primarily driven by the decreasing transition to higher-order births. Specifically, the progression ratio to first births in 1950 cohort was slightly higher than that in 1930 cohort, contributing 0.09 to the fertility decline between 1930 to 1950 cohort. The progression ratios to the second births and third birth contributed −0.22 and −2.04 to this fertility decline, respectively. The fertility decline in the cohorts born between 1950 and 1970, from 2.93 to 1.75, was mostly due to falling progression ratio to second and higher orders. The contributions of progression ratios to the second and third births were −0.70 and −0.48, respectively.

3.6. The unique Chinese pattern of configurations of parity-specific fertility

Figure 8 shows TFR and parity-specific TFR in China, Japan, the U.S., Canada, and Czechia, 1949 – 2020, which confirms what we have discussed above. It is evident that fertility policy in China plays an important role in shaping the dynamics of fertility, especially for parity two and higher orders.

Figure 9 further shows that the progression ratio to first births for Chinese women was the highest among those countries except for the period of Great Famine from 1959 to 1961, while the parity progression ratio to second births was the lowest and parity progression ratio to third births was at a low level since the 1990s. It is worth noting that Chinese women's second-child fertility has been higher than those of Japan and Czechia since 2000 and was the highest during 2012 – 2017. Given that the parity progression ratio to second births was the lowest during this whole period except 2016 and 2017, the recent high level of second-child fertility of Chinese women is largely due to China's high parity progression ratio to first births.

In terms of cohort fertility, compared with those in developed low-fertility societies, the fertility levels of the 1940s and 1950s birth cohorts in China were higher, whereas the fertility levels of the 1970s birth cohorts were at the middle level. The CCFR for women in the 1970 cohort in China is 1.75, which is higher than those in East Europe (1.64), German-speaking countries (1.64), South Europe (1.57), and East Asia (including only Korea and Singapore, 1.68), and lower than those in Central Europe (1.86), West Europe (1.93), North Europe (2.00), and English-speaking non-European countries (2.05).

Table 1. Cohort cumulative fertility rates of Chinese women, born in 1926–1977

Cohort	CCFR	CCFR1	CCFR2	CCFR3+	Cohort	CCFR	CCFR1	CCFR2	CCFR3+
1926	4.84	0.96	0.90	2.98	1949	3.08	0.99	0.92	1.17
1927	4.97	0.96	0.91	3.09	1950	2.93	0.99	0.90	1.04
1928	5.05	0.97	0.92	3.16	1951-1957	-	-	-	-
1929	5.09	0.97	0.93	3.19	1958	2.11	0.99	0.67	0.44
1930	5.10	0.97	0.93	3.19	1959	2.07	0.99	0.66	0.42
1931	5.14	0.98	0.94	3.23	1960	2.05	0.99	0.66	0.40
1932	5.12	0.98	0.95	3.20	1961	2.11	0.99	0.68	0.43
1933	5.09	0.98	0.95	3.16	1962	2.10	0.99	0.70	0.41
1934	5.03	0.98	0.95	3.09	1963	2.01	0.99	0.67	0.35
1935	4.93	0.98	0.96	2.99	1964	1.99	0.99	0.67	0.33
1936	4.84	0.98	0.96	2.90	1965	1.95	0.99	0.66	0.30
1937	4.75	0.99	0.96	2.80	1966	1.93	0.99	0.66	0.28
1938	4.62	0.99	0.96	2.68	1967	1.89	0.99	0.64	0.27
1939	4.50	0.99	0.96	2.55	1968	1.83	0.99	0.62	0.23
1940	4.37	0.99	0.96	2.42	1969	1.78	0.99	0.59	0.20
1941	4.25	0.99	0.96	2.30	1970	1.75	0.99	0.57	0.19
1942	4.15	0.99	0.96	2.20	1971	1.73	0.99	0.56	0.18
1943	4.03	0.99	0.96	2.08	1972	1.73	0.99	0.56	0.18
1944	3.91	0.99	0.96	1.96	1973	1.73	0.99	0.57	0.18
1945	3.74	0.99	0.96	1.79	1974	1.73	0.98	0.57	0.17
1946	3.55	0.99	0.96	1.61	1975	1.72	0.98	0.56	0.17
1947	3.39	0.99	0.95	1.45	1976	1.72	0.98	0.56	0.18
1948	3.23	0.99	0.94	1.31	1977	1.70	0.98	0.56	0.16

Sources: Authors' own estimations from the 1990 census (1926 – 1950 cohorts) and the 2017 Fertility Survey (1958 – 1977 cohorts).

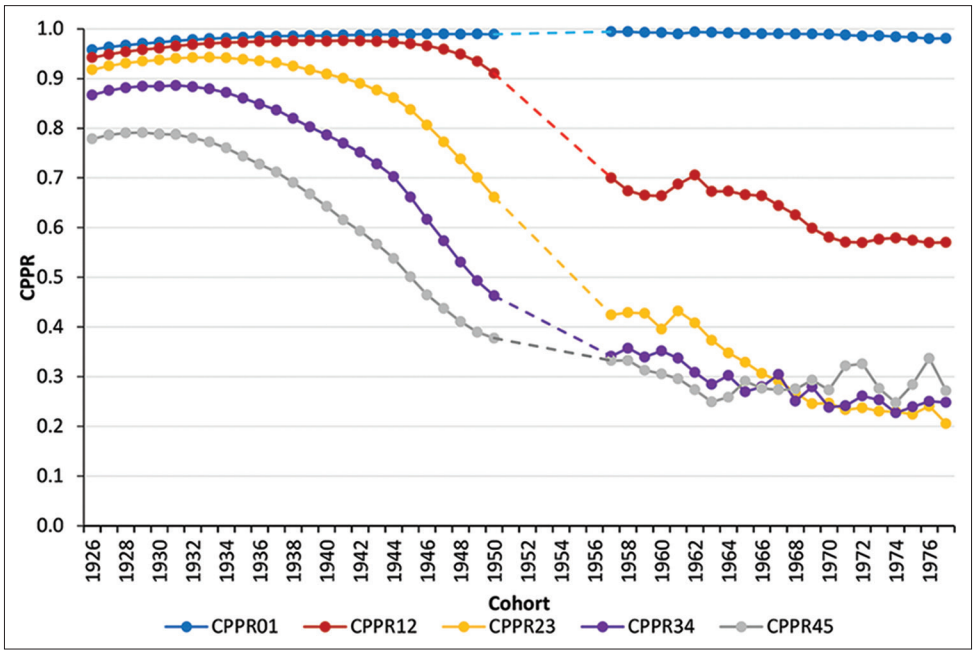

Figure 7. Cohort parity progression ratios of Chinese women, 1926–1977

Sources: Authors' own estimations from the 1990 census (1926 – 1950 cohorts) and the 2017 Fertility Survey (1958 – 1977 cohorts).

Table 2. Decomposition of changes in cohort cumulative fertility across cohorts

Cohort	dPPR01	dPPR12	dPPR23	Changes in CCFR
1930–1950	0.09	−0.22	−2.04	−2.17
1950–1970	0.00	−0.70	−0.48	−1.18
1970–1977	−0.01	−0.01	−0.03	−0.05

Sources: Authors' own estimations from the 1990 census (1926 – 1950 cohorts) and the 2017 Fertility Survey (1958 – 1977 cohorts).

The configurations of parity-specific fertility can vary greatly, even when summing up to similar cohort fertility levels. Zeman *et al.* (2018) have categorized the different configurations of parity progression ratios corresponding to a completed cohort fertility of 1.6 children per woman into "benchmark," "high childlessness," "one-child pattern," "stopping at two," and "polarized pattern" (Table 3). Compared to these patterns, the combination of configuration of parity-specific fertility in China is markedly different. The results of the 2017 Fertility Survey show that the fertility of women born in 1982 – 1983 is around 1.62 children per woman, with the progression ratios to the first, second, and third births at levels of around 0.95, 0.57, and 0.20, respectively. The "universal" nature of childbearing is evident in China with a proportion of childlessness < 5%. The progression ratio to first birth is higher than that in any other low-fertility developed country. Yet, progression ratios to second and third births are both low. That is, compared to low-fertility developed countries, the progression ratio to first births in China has a boosting effect on women's cohort fertility, while the progression ratio to the second and third births has the opposite effect. China builds on a unique mode to those based on developed low-fertility societies.

4. Concluding remarks

The fertility level and pattern in China have been shaped by fertility culture, socioeconomic development, as well as fertility policy. The traditional Confucian culture of marriage and fertility as well as low level of socioeconomic development in the 1950s and 1960s were the main reasons that fertility level and pattern for the second births were characterized by "early and universal". The average age at second births was around 25 years old and progression ratios from first to second birth remained stable at over 0.98. The "later, longer, fewer" policy has negligible impact on progression ratios from first to second births. Although there was a delay in the average age of women at second births, the progression ratios from first to second births remain almost unchanged. With the implementation and adjustment of strict restrictions on the parity and timing/spacing of second children in the 1980s, the second-birth fertility rate fluctuated. In contrast to a rebounded second-birth TFR, the progression ratio from first to second births declined. With the gradual removal of the interval between births and the number of births in the past decade or so, the second-birth fertility rate has seen an increase, especially after the implementation of the universal two-child policy in 2015, indicating a significant policy effect. However, the decline in the second-birth fertility rate after 2017 shows that socioeconomic development and changes in the childbearing values have become the main drivers of contemporary second-birth fertility in China, not the fertility policy.

A review of changes in the levels and patterns of second-birth fertility in China since 1949 shows that traditional fertility attitudes and low socioeconomic levels were responsible for high and widespread levels of second birth in the early years, while changes in fertility attitudes toward modernity and rapid economic development have dominated the recent low levels of second-birth fertility. Both the policy of controlling the number and timing/spacing of second child, which began in the 1980s, and the more recent policy of gradually easing the number and timing/spacing of second children have had an impact on the levels and patterns of second-birth fertility. However, the impact of policy relaxation in a low-fertility context has been less sustainable than the earlier control policies that effectively contributed to the decline in fertility for birth order two.

The high second-birth fertility in the recent decade in China, both period and cohort, was more likely to be associated with the universal progression ratio from 0 to 1, while the progression ratio from first to second births was still low. We have good reasons to believe there will be a continued delay of first births and even an increase in lifetime infertility rates which would lead to a decline in the progression ratio to first births, while the short-term "accumulating" effect on second births due to recent policy adjustments would quickly disappear. Until supportive measures are in place and take effect, a decline in second-birth fertility rate will be inevitable.

The configuration of parity-specific fertility in China differs markedly from that in the west. The "universal" childbearing is evident in China, where the progression ratio to first birth is higher than in any low-fertility developed country. In contrast, progression ratios from first to second and from second to third in China are both low since the 1990s. This is related to the internalization of long-standing strict fertility policies and rapid socioeconomic development. As the younger birth cohorts are more likely to be influenced by individualism and their fertility may become more diverse, the progression ratio to first birth is likely to decrease, and it is too early to be seen to what extent the progression ratios from first to second

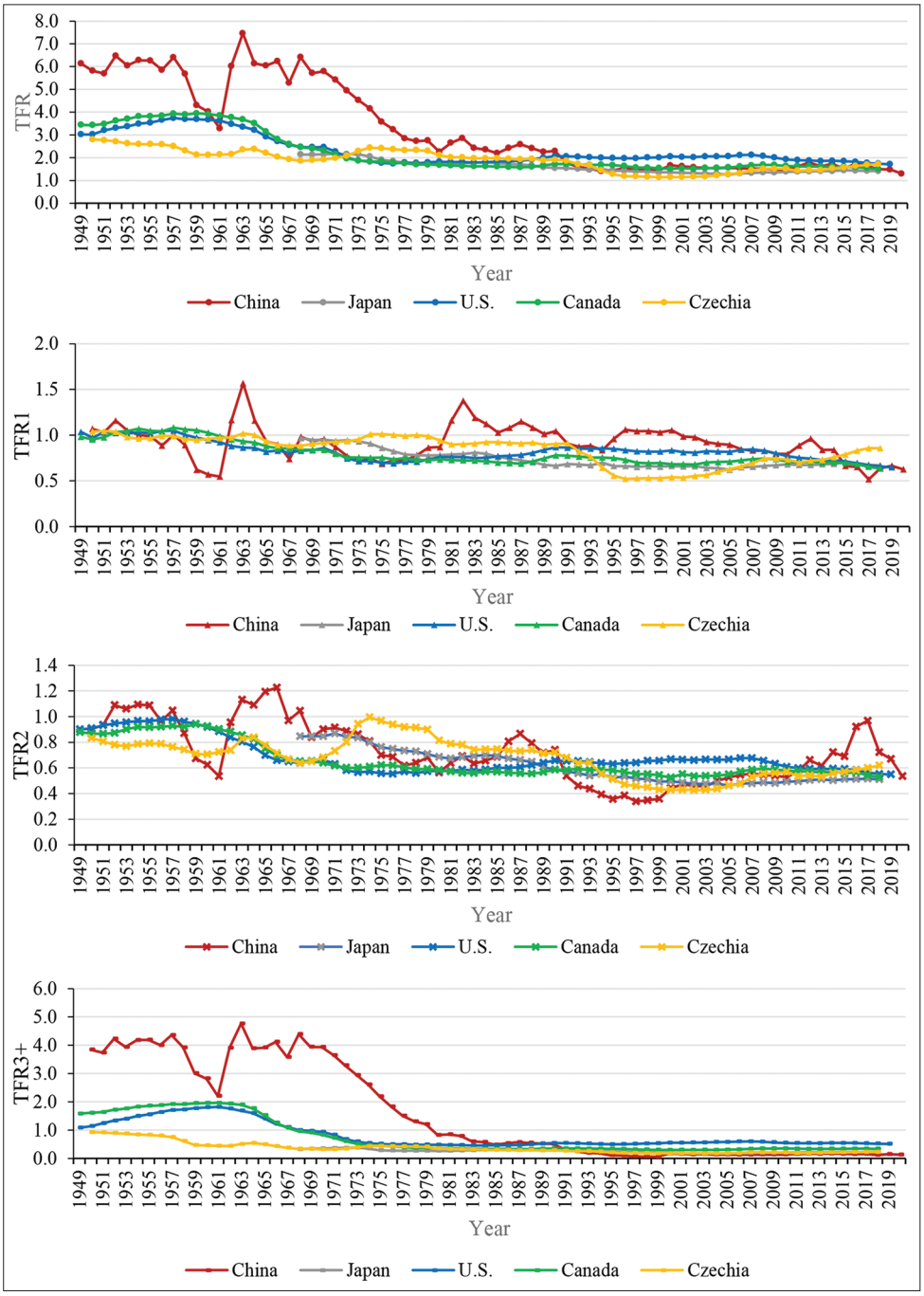

Figure 8. TFR and parity-specific TFR in China, Japan, the U.S., Canada, Czechia, 1949–2020

Sources: China: The 1982 Fertility Survey (1949–1981), the 1988 Fertility Survey (1982 – 1987), the 2001 Fertility Surveys (1990–1994), Censuses/ Population Sample Surveys (1989, 1995–1999, 2018–2020), the 2017 Fertility Survey (2000–2017), and a linear interpolation (1988). Japan, the U.S., Canada, and Czechia: Human Fertility Database.

births and from second to third births would follow the Western patterns, that is, to increase.

This study was limited by the lack of reliable sources of data and was, therefore, unable to estimate the reliable fertility level since the 1990s. Although efforts had been made to adjust estimates of period fertility rate using NBS-published births from 2000 to 2020, the study directly used the face values of data sources in the 1990s. Due to the births underreports in the data sources, the fertility might be under-estimated, especially for fertility of higher orders.

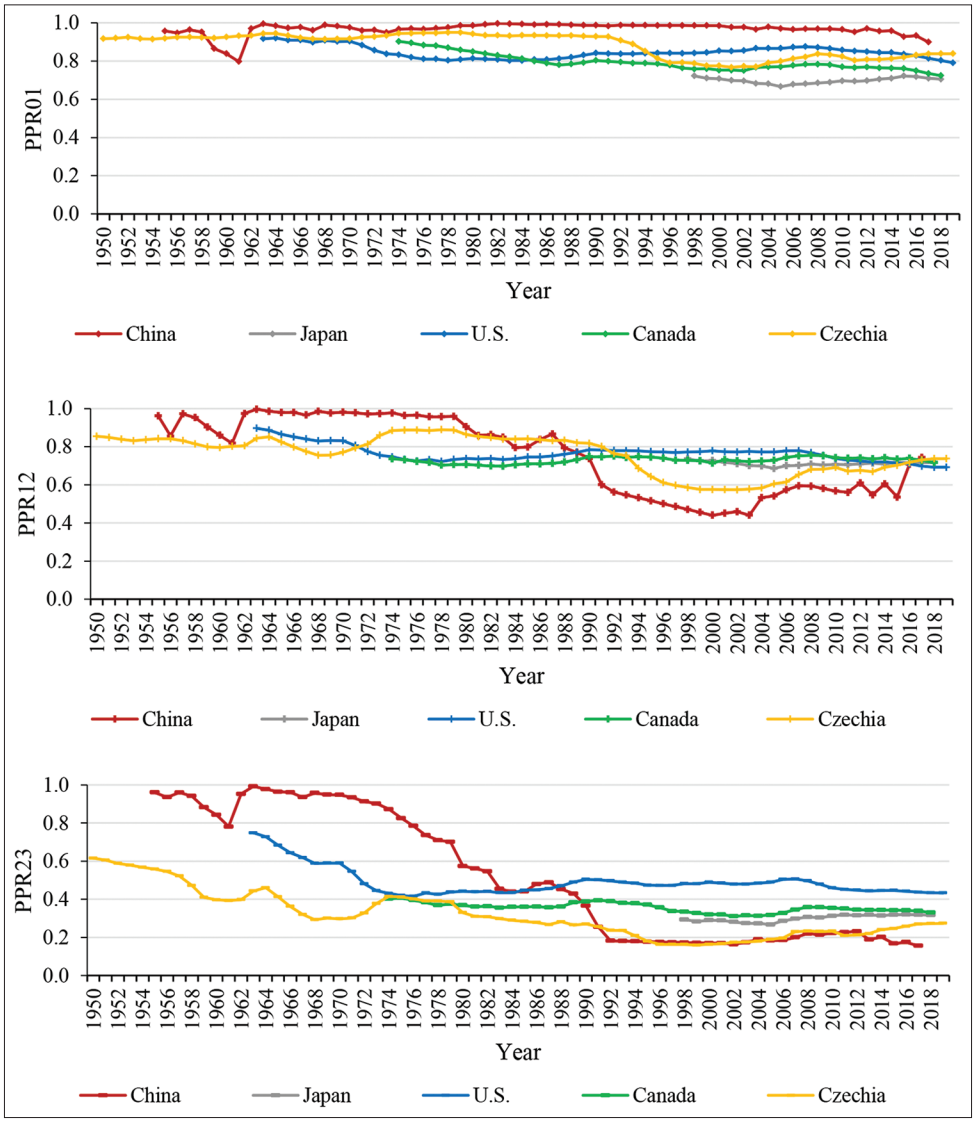

Figure 9. Parity-specific PPPR in China, Japan, the U.S., Canada, Czechia, 1950–2020

Sources: China: The 1982 Fertility Survey (1949–1981), the 1988 Fertility Survey (1982 – 1987), the 2001 Fertility Surveys (1990–1994), Censuses/ Population Sample Surveys (1989, 1995–1999, 2018–2020), the 2017 Fertility Survey (2000–2017), and a linear interpolation (1988). Japan, the U.S., Canada, and Czechia: Human Fertility Database.

Table 3. Different patterns of configurations of parity progression ratios corresponding to a completed cohort fertility of 1.6 children per woman

Patterns of PPR configurations	PPR01	PPR12	PPR23
Benchmark	0.80	0.72	0.30
High childlessness	0.70	0.85	0.37
One-child pattern	0.90	0.55	0.32
Stopping at two	0.85	0.75	0.15
Polarized pattern	0.75	0.68	0.45
Chinese pattern	0.95	0.57	0.20

Sources: The Chinese pattern: authors' own estimations from the 2017 Fertility Survey. All other patterns are estimations made by Zeman *et al.* (2018).

Despite the data limit, this study mainly aims to illustrate the dynamics of fertility by parity rather than to estimate the exact fertility values.

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Conflict of interest

The authors have no conflicts of interest to declare.

Author contributions

Conceptualization: Yuanyuan Duan, Wei Chen
Formal analysis: Yuanyuan Duan
Writing – original draft: Yuanyuan Duan
Writing – review & editing: Wei Chen

Ethics approval and consent to participate

Not applicable as this study involves the analysis of secondary data.

Consent for publication

Not applicable.

Availability of data

Some of the data used in this paper are available to the public: (i) National population censuses: http://www.stats.gov.cn/tjsj/pcsj/; (ii) national 1‰ annual sample surveys of population change: http://www.stats.gov.cn/tjsj/ndsj/; and (iii) Human Fertility Database: https://www.humanfertility.org/cgi-bin/main.php

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