Trends in Cohort Fertility Level in China

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Abstract

The continuous decline in the number of births in China has attracted considerable scholarly and policy attention. Using data from the 2017 China Fertility Survey and adopting a cohort-based approach, this study calculates the average number of children ever born (CEB) by birth cohort. It analyzes fertility postponement and recuperation by birth order and employs decomposition techniques to assess the contributions of changes in age-parity-specific progression ratios, urban-rural population structure, and educational structure to cohort differences in average number of CEB at given ages between cohorts. The results reveal that the average number of CEB by age 29 has declined across cohorts, and the decline in number of CEB is more evident among rural and less-educated women. A later age at first marriage is associated with lower CEB by a specific age. Fertility postponement has intensified in more recent cohorts, while recuperation at later reproductive ages has weakened. Decomposition analysis shows that the decline in first and second births is largely explained by reduced age-parity-specific progression from childlessness to the first birth at younger reproductive ages. The overall reduction in average number of CEB is largely attributed to shifts in the urban-rural composition and the rising educational attainment of women. Among more educated women, the impact of declining progression to first births on overall reduction of CEB has increased over time.

Keywords: Cohort fertility; Children ever born; Postponement; Decomposition

1 Introduction

The number of births and the period fertility level in China have continued to decline. In 2020, there were 12 million births (OLG, 2022), falling to just 9.02 million in 2023 (NBS, 2024). China's period fertility has remained persistently low, with the total fertility rate (TFR) at 1.3 in 2020 and estimated at approximately 1.0 in 2023 – dropping below the lowest-low fertility level. However, the period TFR is a problematic indicator, as it is sensitive to changes in the timing of childbearing (Bongaarts and Feeney, 1998). In the context of continued postponement of marriage and childbearing among Chinese women, the period TFR is biased by tempo effects and does not accurately reflect the underlying fertility level.

From a cohort perspective, fertility has also declined. The average number of children ever born (CEB) by ages 45–49 declined from 5.37 for women born in 1933–1937 to 1.84 for the 1961–1965 cohort (Yang et al., 2022), and further to 1.59 for the 1971–1975 cohort (OLG, 2022). Several studies have estimated CEB for women aged 45–49 using census data (Yang et al., 2022), analyzed cohort parity progression ratios and cohort fertility rates across seven provinces using the 2017 China Fertility Survey (Wang et al., 2019), and assessed lifelong childlessness using census data (Jiang et al., 2023; Chen, 2023). While these studies offer valuable vignette of cohort fertility at specific points in time, they do not provide a systematic longitudinal analysis of trends and structural changes in cohort fertility.

Recent years have witnessed substantial shifts in China's cohort fertility, driven by delayed marriage and childbearing, declining progression to higher-order births, and structural changes in urban-rural composition and educational attainment. This paper addresses these gaps by undertaking a comprehensive examination of cohort fertility dynamics in China. First, we describe trends in the average number of CEB by birth cohort, disaggregated by urban-rural residence, educational attainment, and age at first marriage. Second, we analyze patterns of fertility postponement and recuperation across cohorts and by birth order, examining their impact on average number of CEB. Third, we analyze how changes in age-parity-specific progression ratios explain cohort differences in average CEB at given ages. Finally, we apply a decomposition approach to evaluate the contributions of changes in urban-rural composition, educational structure, and residence-education-specific fertility levels to the overall differences in cohort fertility outcomes.

The key contributions of this paper are threefold: (1) We perform an age-parity decomposition of differences in average number of CEB between cohorts using the stepwise replacement method. (2) We develop a demographic decomposition approach to assess the effects of structural shifts – particularly changes in urban-rural residence and educational attainment – on cohort fertility differences. (3) We provide a systematic and detailed account of cohort fertility among Chinese women born between 1957 and 1987, offering new insights into the evolving demographic landscape.

The remainder of the paper is structured as follows: Section 2 introduces the demographic and institutional context of fertility in China. Section 3 reviews the literature on the determinants of cohort fertility. Section 4 outlines the data and methodology. Section 5 presents the empirical findings, and Section 6 conclude with a discussion of the findings.

2 The Chinese Context

China has experienced a dramatic fertility transition over the past decades. During the 1950s and 1960s, the total fertility rate (TFR) remained above 5.0, but began to decline sharply in the 1970s following the implementation of government-led family planning programs (Gu, 2021). The "Later, Longer, Fewer" policy, introduced in the early 1970s, promoted later marriage and childbearing, longer birth intervals, and fewer children, significantly reducing fertility. This was followed by the enforcement of the One-Child Policy in 1979, which further accelerated the fertility decline (Qin et al., 2018). By the 1990s, China's TFR had fallen below the replacement level, where it has remained. In response, the government introduced the Universal Two-Child Policy in 2016 and the Three-Child Policy in 2021, along with supportive measures. However, these policy relaxations have not produced a sustained fertility rebound. While early declines in fertility were largely policy-driven, the persistently low fertility since the mid-1990s is increasingly attributed to socioeconomic and cultural factors (Zhao and Zhang, 2018; Zheng, 2024).

In recent decades, reproductive behavior in China has changed markedly. These changes are characterized by delayed marriage and childbearing, declining fertility, and reduced fertility intentions. The mean age at first marriage for women rose from 22.15 years in 1990 to 27.95 years in 2020 (OLG, 2022), while the mean age at first birth increased from 23.43 years in 1990 to

27.22 years in 2020 (Zhang and Sheng, 2023), reflecting a continued postponement of family formation. Correspondingly, cohort fertility has declined: the average number of children ever born per woman fell from 5.37 in 1982 to 1.84 in 2010 (Yang et al., 2022), and further to 1.59 in 2020 (OLG, 2022). Notable, fertility intentions have remained low despite the implementation of the Two-Child and Three-Child policies. Many women cite high economic and time costs, as well as practical challenges, as barriers to realizing their fertility desires (Yang et al., 2024). Recent national surveys report only limited positive responses to the government's fertility support measures (Zhang et al., 2022).

Fertility trends in China vary significantly by urban-rural residence and educational attainment. Since the early 2000s, rapid urbanization has transformed the country's demographic landscape: the share of the urban population rose from 36.22% in 2000 to 63.89% in 2020 (OLG, 2022). Attitudes and behaviors regarding childbearing differ between urban and rural women. Urban women are more likely to postpone marriage and childbirth or remain childless, influenced by higher living costs, more competitive career environments, and evolving family norms. At the same time, China has experienced a substantial expansion in higher education. The number of women with college or higher education increased from 16.87 million in 2000 to 105.36 million in 2020. Rising educational attainment has improved women's socioeconomic status, reshaped life goals, and eroded traditional family-centered ideologies. Survey data suggest that highly educated women born in the 1990s are increasingly inclined to remain childless and show greater acceptance of voluntary childlessness (Yu and Xie, 2022). These developments underscore the growing role of social stratification in shaping reproductive behavior in China.

3 Literature Review

In this section, we discuss the factors contributing to the decline in cohort fertility. Specifically, we examine the role of postponed marriage and childbearing, changes in parity progression ratio, and shifts in women's urban-rural residence and educational structure.

3.1 Postponement of first marriage and childbearing

The postponement of marriage is one of the most significant determinants of declining fertility. In several Western countries, such as the United States and those in Scandinavia, fertility levels have remained relatively high despite delays in marriage, due in part to the rise of nonmarital childbearing (Smith, 2019). However, many East Asian societies – including China – continue to link childbearing closely with marriage. In these contexts, later marriage is associated with a reduction in the number of births (Lee et al., 2020; Yang et al., 2022; Kwon and Sohn, 2023). Delayed marriage shortens the reproductive window, leads to postponed first births, and reduces the likelihood of subsequent childbearing. According to census data, the decline in the proportion of married women accounted for up to 40% of the fertility decline in China between 1990 and 2000 (Jiang et al., 2019). Further analysis using fertility survey data suggests that since 2006, the continuous decline in the proportion of married women has increasingly contributed to the downward trend in China's total fertility rate (Li and Zhang, 2021).

The relationship between first birth postponement and completed cohort fertility has also been explored in cross-national studies. The impact of delayed first births on cohort fertility varies across countries. In some cases, although women are delaying first births, cohort fertility has remained stable or declined only slightly due to strong recuperation in second and higher-order births (Sobotka et al., 2011; Castro, 2015; Nitsche and Brückner, 2021). In others, postponement has led to a marked decline in cohort fertility, as recuperation at later reproductive ages has been insufficient (Beaujouan et al., 2023). For example, in South Korea, women born in the 1960s delayed childbirth but most still had approximately two children by the end of their reproductive ages. However, women born in the early-1970s postponed childbearing further, without adequate recuperation, resulting in a decline in cohort fertility to 1.7 children per woman (Hwang, 2023). These findings underscore the importance of understanding the interplay between fertility postponement and recuperation in shaping cohort fertility trends. Despite the growing relevance of these dynamics, research on the postponement and recuperation of childbearing among Chinese women remain limited. In particular, there is a lack of evidence on how these patterns have evolved across cohorts in China.

3.2 Age and parity contributions

Changes in parity progression ratios are a key factor contributing to fertility decline. From a period perspective, lower parity-progression ratios significantly reduce the total fertility rate (TFR). In Russia, for example, a sharp decline in parity-progression ratios led to a rapid drop in fertility between 1989 and 1994 (Andreev et al., 2002). From a cohort perspective, declining progression ratios reduce completed cohort fertility. A cross-national study of 32 low-fertility countries found that for women born between 1940 and 1955, declining progression to third and higher-order births was the main driver of lower cohort fertility. In contrast, for women born between 1955 and 1970, reductions in progression to first and second births were primary contributors (Zeman et al., 2018).

Moreover, both age and parity jointly influence fertility outcomes. While several studies have examined the effect of parity-specific fertility rates, fewer have considered how changes in age- and parity-specific progression ratios affect cohort fertility levels. Yet, this joint perspective is essential to understanding fertility dynamics over time. For instance, the decline in Russia's age-parity-adjusted TFR between 1989 and 1994 was primarily due to fewer second births among women aged 23 to 29 (Andreev et al., 2002). In China, recent evidence shows that reduced progression to first births among women aged 20 to 34 contributes more to fertility decline than reductions in higher-order births (Ren et al., 2024). Therefore, it is necessary to examine how age- and parity-specific fertility behaviors combine to shape cohort fertility. Understanding these interactions is crucial for identifying the demographic mechanisms underlying fertility trends.

3.3 Urban-rural and educational structure

Fertility levels in China vary significantly by women's place of residence, with urban women consistently showing lower fertility than their rural counterparts. In 2020, the proportion of childlessness among women aged 49 was 6.29% in urban areas, 5.50% in townships, and 3.72% in rural villages (Jiang et al., 2023). Urban-rural differences are also evident in the timing of births. Between 1990 and 2020, urban women experienced a more pronounced postponement of peak childbearing, while the peak age-specific fertility rate among rural women declined more rapidly (Zhang and Sheng, 2023). However, more recent studies suggest that the fertility gap between urban and rural areas has narrowed among younger cohorts. This convergence is largely attributed to rising female educational attainment, greater rural to urban migration, and the diffusion of low-fertility norms into rural areas (Li et al., 2024; Zheng, 2024). Moreover, with fertility policies becoming more uniform across regions, it is increasingly important to examine how changes in the urban-rural population structure have shaped cohort fertility trends over time.

Educational attainment is another critical factor influencing cohort fertility. However, research on fertility differentials by education level has yielded mixed results across countries and time periods. In the United States, Zang (2019) reported rising total fertility rates across cohorts for all educational groups, and a declining educational gradient in recent cohorts. Similarly, in South Korea, Denmark, Norway and Sweden, the educational gradient in cohort fertility has nearly disappeared among younger cohorts (Yoo, 2014; Jalovaara et al., 2019). In contrast, other countries such as the Britain and Australia have seen a widening gap in completed fertility by education level (Berrington et al., 2015; Gray and Evans, 2019). In China, the expansion of higher education since the late 1990s has significantly shaped women's reproductive behaviors. Based on data for women born between 1941–1964, Tian (2018) found that the contribution of educational structure to the decline in completed cohort fertility has gradually increased. As China continues to urbanize rapidly and women’s educational attainment rises, it is essential to further investigate how structural shifts in education are driving changes in cohort fertility.

4 Data and Methods

4.1 Data

This study utilizes data from the 2017 China Fertility Survey, which covered a nationally representative sample of 249,946 women aged 15–60. The survey collected detailed information on women’s fertility histories, including the end date and outcome of each pregnancy (live birth, stillbirth, abortion, or miscarriage), thereby providing a comprehensive basis for analyzing cohort fertility patterns among Chinese women. According to post-enumeration quality check, and subsequent data comparison and verification, the dataset is considered to be of high quality (Zhuang et al., 2019).

To ensure the validity of the analysis, we excluded women whose childbearing age was younger than 10 or older than 50, those whose age at first marriage was below 10, and individuals with missing information on age at marriage or childbearing. After applying these filters, the final analytic sample included 249,895 individuals. The survey employed a stratified sampling design with post-stratification weights to ensure population representativeness. These weights were constructed using structural indicators based on household registration information. Therefore, all statistical calculations in this study incorporate these sampling weights to produce nationally representative estimates.

4.2 Methods

From a cohort perspective, we first describe trends in age-specific average number of CEB by cohort, disaggregated by urban-rural residence and education level. Then, we analyze fertility postponement and recuperation by birth order to assess changes in the timing and progression of births across cohorts. Furthermore, using decomposition methods, we examine the effects of changes in age-parity-specific progression ratios, the urban-rural population structure and the educational composition of women, to the overall differences in average number of CEB at given ages across birth cohorts. The detailed formulas are presented below.

4.2.1 Average number of CEB

Let TP^a denote the total number of women in cohort a, par denote the birth order, $B^a_{par}(x)$ denote the number of births to women in the cohort at age x (i.e., during the age interval $[x, x+1)$), and $\frac{B^a_{par}(x)}{TP^a}$ denote the number of CEB per woman in the cohort at age x by parity. Starting from the minimum childbearing age σ, the average number of CEB for women in the cohort a at age x is denoted as $CEB^a(x)$, where

$$CEB^a(x) = \sum_{par} CEB^a_{par}(x) = \sum_{par} \sum_{j=\sigma}^{x} \frac{B^a_{par}(j)}{TP^a} \tag{1}$$

4.2.2 Fertility postponement and recuperation

Cohort fertility is shaped by two interrelated processes: postponement and recuperation (Frejka, 2011; Sobotka et al., 2011; Beaujouan et al., 2023). *Postponement* refers to a phase in which fertility rates decline at younger reproductive ages, typically due to delayed marriage or childbearing. *Recuperation* refers to a subsequent phase in which fertility rates rise at later ages, compensating – either partially or fully – for earlier delays.

These processes can be measured by comparing the age-specific average number of CEB between a given (observed) cohort and an earlier (benchmark) cohort. If the average number of CEB in the observed cohort is consistently lower than that of the benchmark cohort at the same age, and the difference continues to widen with age, this indicates fertility postponement. When the absolute difference in CEB between cohorts reaches its maximum and then begins to decline with age, it signals the onset of fertility recuperation in the observed cohort.

In this study, we use the 1967 birth cohort as the benchmark rather than the 1957 cohort. The 1957 cohort was significantly affected by the "Later, Longer, Fewer" family planning policy of the 1970s, which raised the average age at first marriage and childbirth. Furthermore, following the revision of the Marriage Law in 1980, a sudden increase in marriage and childbearing occurred among women who had previously been below the legal age (Coale et al., 1991; Wang and Wu, 2013). In contrast, the 1967 cohort represents an earlier cohort that was relatively less affected by these policy shocks, making it a more appropriate reference point for cohort comparisons.

Let m denote the age at the maximum absolute difference in age-specific average number of CEB between the observed cohort a and the benchmark cohort b, then $D^a_{par}(m)$ can be expressed as:

$$D^a_{par}(m) = CEB^a_{par}(m) - CEB^b_{par}(m) \tag{2}$$

The fertility recuperation by parity after the fertility postponement at age n can be expressed as $R^a_{par}(n)$:

$$R^a_{par}(n) = CEB^a_{par}(n) - CEB^b_{par}(n) - D^a_{par}(m) \tag{3}$$

4.2.3 Effect of changes in age-parity-specific progression ratio

Let $q_{par}^{a}(x)$ denote the age-parity-specific progression ratio (APSPR) for women by exact age x with $par-1$ children in cohort a who gave birth to the par order births during the age interval $[x,x+1)$.

Starting from the minimum childbearing age σ, the probability of women being childless by exact age x in cohort a is $\prod_{j=\sigma}^{x-1}\left[1-q_1^a(j)\right]$, the probability of giving first birth at age x for women in cohort a (i.e., during the age interval $[x,x+1)$) is $q_1^a(x)\prod_{j=\sigma}^{x-1}\left[1-q_1^a(j)\right]$. Then, the average number of CEB for first-order births (CEB1) at age ω for the cohort a can be expressed as:

$$CEB_1^a(\omega)=\sum_{x=\sigma}^{\omega}\left\{q_1^a(x)\prod_{j=\sigma}^{x-1}\left[1-q_1^a(j)\right]\right\} \tag{4}$$

The average number of CEB for second-order births (CEB2) for the cohort a at age ω can be expressed as:

$$CEB_2^a(\omega)=\sum_{x=\sigma}^{\omega}\left\{q_2^a(x)\sum_{n=\sigma}^{x-1}\left(q_1^a(n)\prod_{j=\sigma}^{n-1}\left[1-q_1^a(j)\right]\prod_{k=n+1}^{x-1}\left[1-q_2^a(k)\right]\right)\right\} \tag{5}$$

Using the stepwise replacement method, we replace the age-parity-specific progression ratio from childlessness to the first birth (APSPR1) in cohort b under age x by the corresponding APSPR1 in cohort a. The contribution of changes in APSPR1 at age x to the overall difference in the average number of CEB1 at age ω between two cohorts can be expressed as:

$$\delta_1^{a-b}(x)=\prod_{n=\sigma}^{x-1}\left[1-q_1^a(n)\right]\times\left[q_1^a(x)-q_1^b(x)\right]\times\left\{1-\sum_{j=x+1}^{\omega}\left(q_1^b(j)\prod_{k=x+1}^{j-1}\left[1-q_1^b(k)\right]\right)\right\} \tag{6}$$

Similarly, we replace the APSPR1 under age x in cohort a by the corresponding APSPR1 in cohort b, and the result of the replacement by APSPR1 in cohort a is different from that in cohort b. To eliminate the effect of the different directions, the final age-specific components are calculated as an average:

$$\delta_1(x)=\frac{1}{2}\times\left[\delta_1^{a-b}(x)-\delta_1^{b-a}(x)\right] \tag{7}$$

Both the changes in age-parity-specific progression ratios from childlessness to the first birth (APSPR1) and from the first birth to the second birth (APSPR2) have contributed to the average number of CEB2. Based on the stepwise replacement method, replace the APSPR1 in cohort b under age x by the corresponding APSPR1 in cohort a, then replace the APSPR2 in cohort b by the corresponding APSPR2 in cohort a, and eliminate the effect of different results in two directions. The final contributions of changes in APSPR1 and changes in APSPR2 on total difference in the average number of CEB2 between two cohorts at age ω are $\delta_1^{'}(x)$ and

$\delta_2^{'}(x)$, respectively, where the $\delta_1^{'}(x)$ and $\delta_2^{'}(x)$ add up to the total differences in the average number of CEB2 between two cohorts, $\delta_2(x)$.

4.2.4 Effect of changes in urban-rural and educational structures

Let par denote the birth order, i denote the residence of women (urban or rural areas), e denote women's education level, then, the average number of CEB for cohort a can be expressed as:

$$CEB^a = \sum_{par}\sum_{i}\sum_{e}\frac{B^a_{par,i,e}}{TP^a} \tag{8}$$

Let $U_i^a = W_i^a / TP^a$ denote the urban-rural population structure of women in cohort a, $E_{i,e}^a = W_{i,e}^a / W_i^a$ denote the residence-specific educational structure of women in cohort a.

Then, the average number of CEB to women for cohort a at a specific age can be expressed as:

$$CEB^a = \sum_{par}\sum_{i}\sum_{e} U_i^a \times E_{i,e}^a \times F_{par,i,e}^a \tag{9}$$

The difference in the average number of CEB between two cohorts by a specific age can be decomposed as:

$$\begin{aligned} CEB^a - CEB^b = &\sum_{par}\sum_{i}\sum_{e}\left(U_i^a - U_i^b\right)\times\frac{E_{i,e}^a \times F_{par,i,e}^a + E_{i,e}^b \times F_{par,i,e}^b}{2} \\ &+\sum_{par}\sum_{i}\sum_{e}\left(E_{i,e}^a - E_{i,e}^b\right)\times\frac{U_i^a \times F_{par,i,e}^b + U_i^b \times F_{par,i,e}^a}{2} \\ &+\sum_{par}\sum_{i}\sum_{e}\left(F_{par,i,e}^a - F_{par,i,e}^b\right)\times\frac{U_i^a \times E_{i,e}^a + U_i^b \times E_{i,e}^b}{2} \end{aligned} \tag{10}$$

The three terms on the right side of equation (10) denote the contributions of changes in the urban-rural population structure of women, changes in the residence-specific educational structure of women, and changes in residence-education-specific average number of CEB, respectively.

5 Results

5.1 Overall trend of cohort fertility level

5.1.1 Average number of CEB by specific ages

Over time, the average number of CEB has declined. As shown in Figure 1a, there is a declining trend in the average number of CEB across birth cohorts, with the exception of the 1961 and 1962 cohorts. While average CEB by ages 49 and 39 remained relatively stable across earlier cohorts, both metrics show a significant decline in later cohorts. By age 29, average CEB increased slightly for earlier birth cohorts before declining among those born after the mid-1970s, with a modest rebound for cohorts born after 1982.

Rural women consistently had higher average number of CEB than urban women. Figure 1b shows that the average number of CEB by age 29 declined for both urban and rural women, with a sharper decline observed among rural women. Among urban women, CEB fell from 1.21 in the 1957 cohort to 0.96 in the 1987 cohort (a decline of 0.25), while among rural women, it dropped from 2.01 to 1.61 (a decline of 0.4). By age 39, the CEB for urban women decreased from 1.44 to 1.32, while for rural women it declined more substantially from 2.42 to 1.94.

Women with lower educational attainment had higher fertility levels than those with higher education. Figure 1c shows that among women with lower education, CEB by age 29 initially increased across cohorts, then declined sharply, followed by a slight rebound. For women with higher education, the average number of CEB declined steadily after the 1962 birth cohort. By age 39, both educational groups experienced an overall decline in CEB.

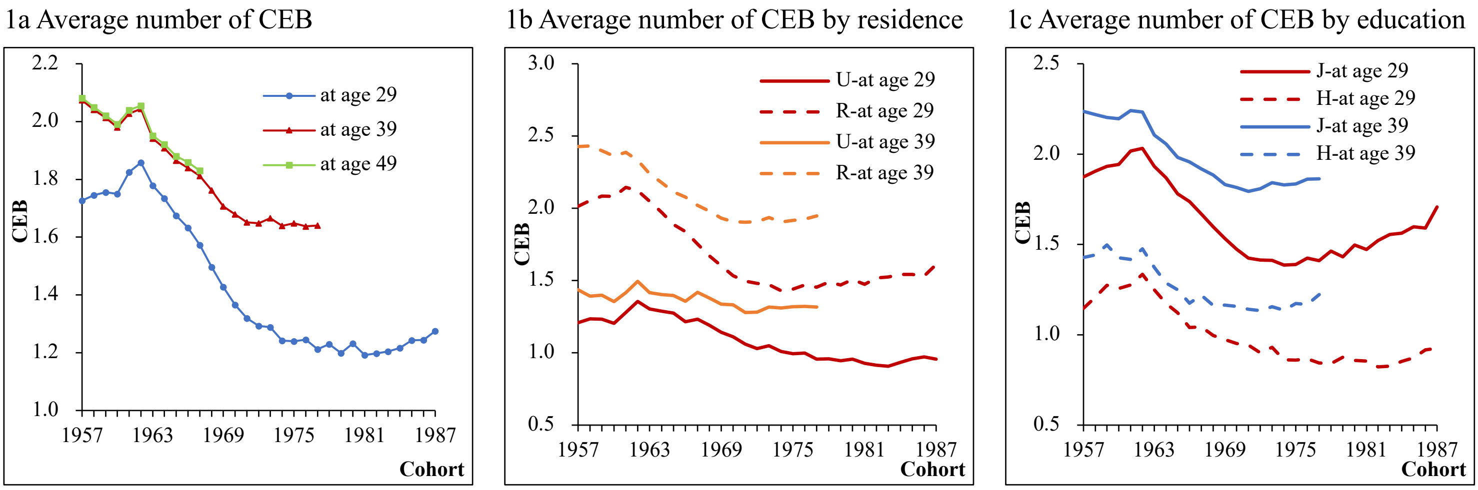

Fig. 1 Average number of CEB by birth cohort

Note: U and R represent Urban and Rural areas respectively, J and H represent Junior middle school or below and High school education or above respectively.

5.1.2 Age-specific average number of CEB

Figure 2 shows that the age-specific average number of CEB declined across cohorts. While women born in 1962, 1967, and 1972 had slightly higher CEB at younger ages compared to the 1957 cohort, their CEB at older reproductive ages was lower. The overall trend suggests that later cohorts accumulate fewer children over time.

In terms of parity-specific trends, Figure 3a demonstrates that the average number of first-order births (CEB1) declined across cohorts. However, despite the decline, most women still had at least one child by the end of their reproductive years, reflecting near universal entry into motherhood. A notable divergence is observed in second-order births. As shown in Figure 3b, the average number of second births (CEB2) began to increase among cohorts born after 1972. This modest rebound suggests a delayed but sustained progression to second births in more recent cohorts.

For third and higher-order births, as shown in Figures 3c and 3d, the average number of CEB generally declined across cohorts, except for women born in 1982 and 1987. Compared to earlier cohorts, women in these two groups had fewer first births but more second and third births than the 1977 cohort. This reversal reflects a decline in first-birth fertility but a corresponding increase in higher-order births, likely influenced by adjustments to China's fertility policies.

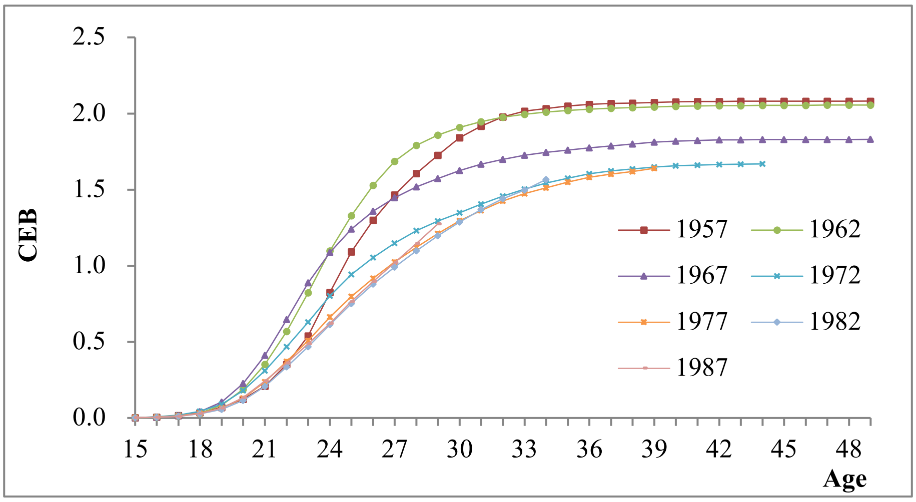

Fig. 2 Age-specific average number of CEB

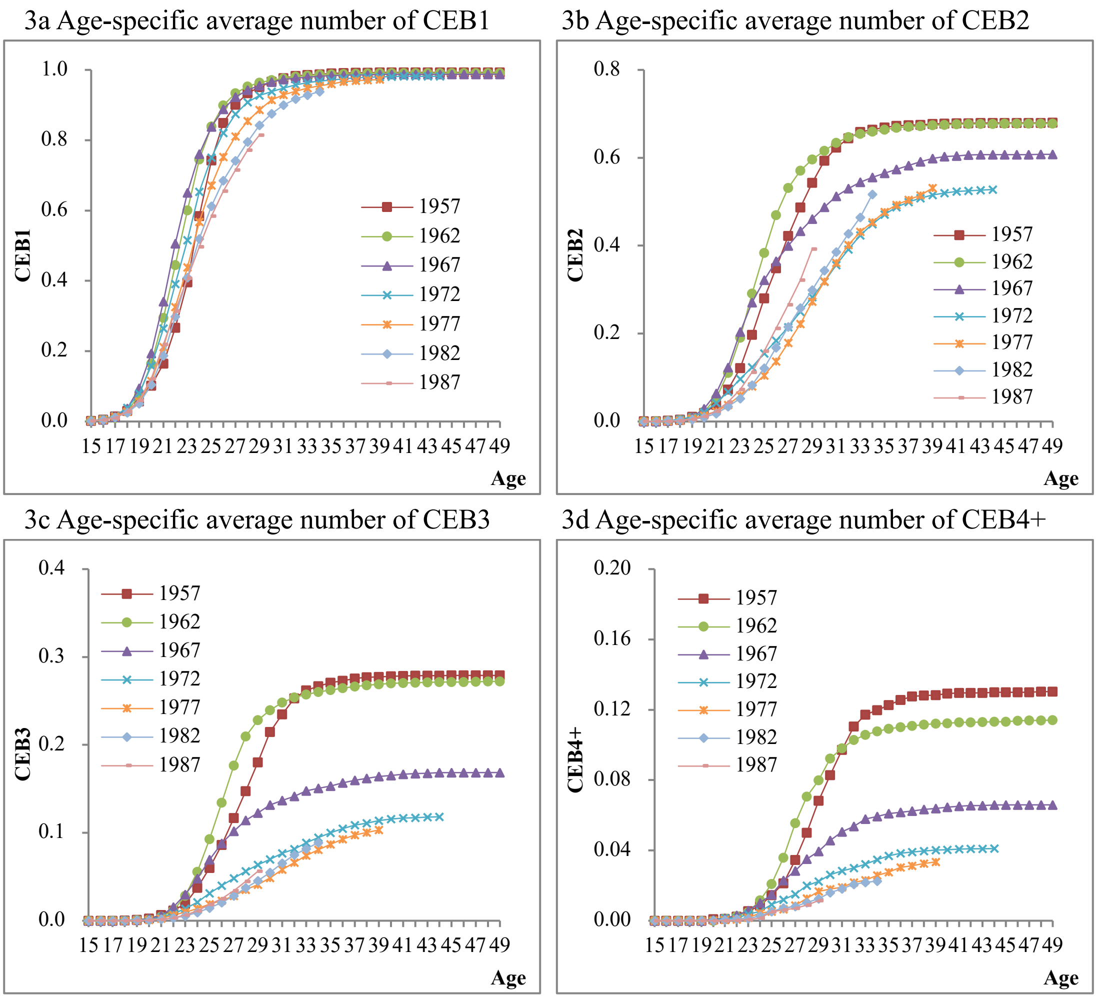

Fig. 3 Age-specific average number of CEB by parity

5.1.3 Average number of CEB among married women

Later age at first marriage is associated with lower average number of CEB at a specific age after marriage, and this effect intensifies across cohorts. Figure 4 shows that, in each cohort, women who married at age 20 had an average CEB exceeding 1.7 within 20 years of marriage (i.e., by age 40), whereas those who married at age 30 had an average number of CEB below 1.3 within 10 years of marriage. Within each marriage-age group, the average CEB declined across cohorts. Among women who married at age 20, average CEB by age 40 declined from 2.32 in the 1957–1961 cohort to 1.73 in the 1972–1976 cohort. Among women who married at age 30, it declined from 1.15 to 1.00 between the same cohorts. Across all cohorts, who married later consistently had fewer children than those who married earlier.

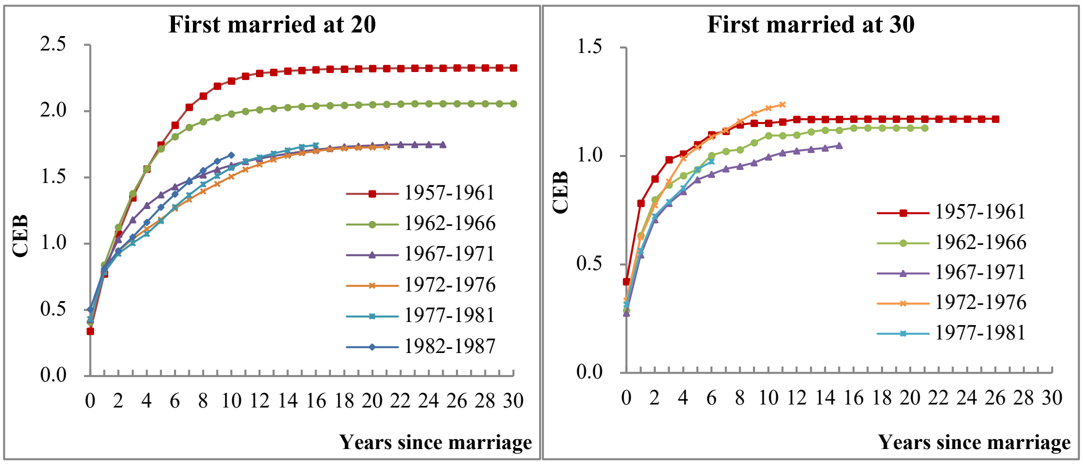

Fig. 4 Average number of CEB by years since first marriage

5.2 Fertility postponement and recuperation

The postponement of first births has increased progressively across birth cohorts. As shown in Figure 5a, compared to the 1967 cohort, the earlier birth cohorts exhibited lower age-specific numbers of CEB1. In later cohorts, the differences in CEB1 initially widened – reaching a peak absolute value at older ages – before narrowing modestly, indicating partial recuperation. Notably, the timing of recuperation has shifted later in life, and the extent of catch-up has diminished, as reflected by the smaller decline in differences after the peak. These trends point to both a continued delay in first births and a weakening of recuperation, suggesting an increasing prevalence of permanent childlessness in more recent cohorts.

Postponement trends are also evident for second and higher-order births. As shown in Figures 5b, 5c, and 5d, the 1957 and 1962 cohorts had slightly lower average CEB2 and CEB3 at younger ages compared to the 1967 cohort, but surpassed the 1967 cohort at later ages – indicating successful recuperation. In contrast, later cohorts (born after 1967) consistently show lower age-specific number of CEB2, CEB3, and CEB4+, reflecting a sustained decline in higher-order fertility with limited or no recuperation. An exception is observed for the 1982 and 1987 cohorts, which show slight increases in CEB2 and CEB3 compared to the immediately preceding cohorts. This may reflect a weakening in the postponement of second and third births, possibly influenced by policy relaxations. However, overall recuperation of higher-order births has declined over time, and much of the postponement in later cohorts remains largely uncompensated.

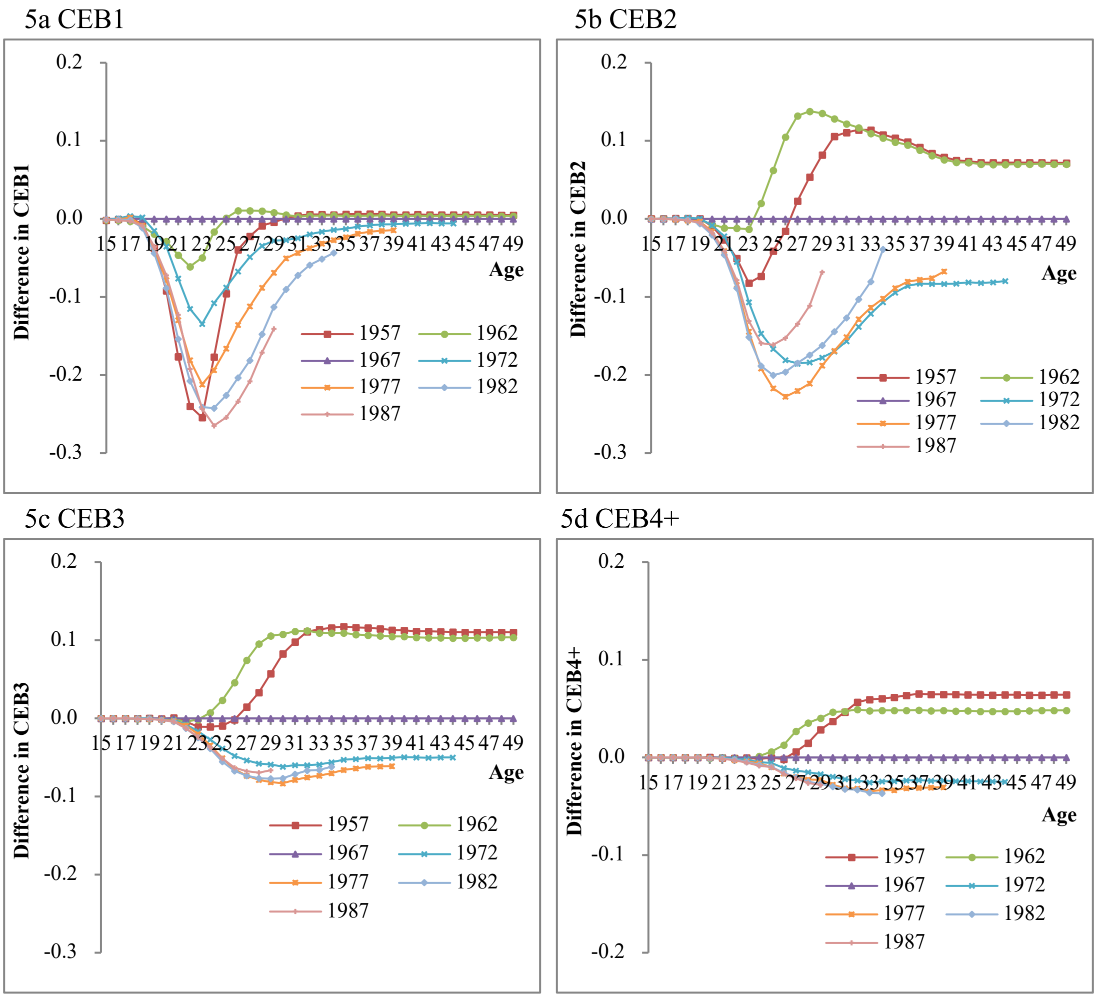

Fig. 5 Fertility postponement and recuperation by birth order

5.3 Effect of changes in age-parity-specific progression ratio

5.3.1 Effect on changes in average number of CEB1

Declines in APSPR1 have also driven the decrease in the average number of CEB1 among later cohorts. As shown in Figure 6, the 1967 birth cohort as the benchmark, the APSPR1 decreased for women in later birth cohorts between ages 18 and 29, leading to a decrease in the average number of CEB1 for these cohorts, with the corresponding APSPR1 being lower across cohorts. The effect of changes in APSPR1 on the total difference in the average number of CEB1 was equal in magnitude but opposite in direction to its impact on the childlessness proportion.

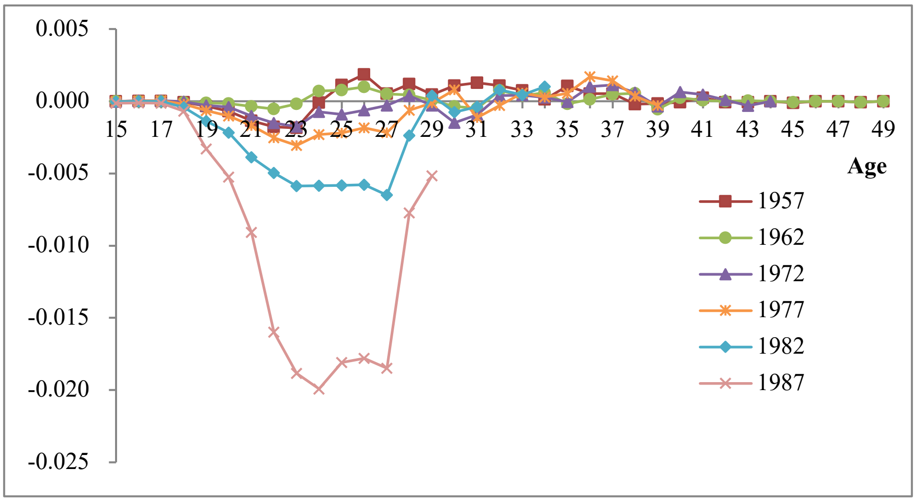

Fig. 6 Components of changes in APSPR1 on changes in cohort average number of CEB1

5.3.2 Effect on changes in average number of CEB2

The decline in the average number of CEB2 across cohorts is primarily driven by the reduction in APSPR1 at younger ages. As shown in Figure 7, using the 1967 cohort as the benchmark, later birth cohorts experienced significant declines in CEB2 largely due to lower rates of progression to first births. This reflects the cascading effect of reduced first births on second-order fertility. Among earlier cohorts, such as the 1957 birth cohort, the average number of CEB2 by age 49 was higher than that of the 1967 cohort. This increase was primarily attributed to change in APSPR2. Decomposition shows that for the 1957 cohort, the decrease in APSPR1 contributed -100.60% to the difference in CEB2, while the increase in APSPR2 contributed 200.60% more than offsetting the impact of first-birth decline. In contrast, among later cohorts, the effect of APSPR1 was greater than that of changes in APSPR2. For the 1977 cohort (by age 39), the decline in CEB2 relative to the 1967 cohort was mainly due to a 109.80% contribution from decreased APSPR1, with a slight increase in APSPR2 contributing −9.80%, resulting a net decline. Similarly, for the 1987 cohort (by age 29), the reduction in APSPR1 contributed 208.21% to the total decline in CEB2, while the increase in APSPR2 contributed −108.21%, indicating that higher-order recuperation was insufficient to counteract earlier delays in first births.

These patterns reveal that the relative influence of APSPR1 and APSPR2 has shifted across cohorts. For earlier cohorts, lower APSPR1 at younger ages was offset by a rapid increase after age 23 and surpassed that of the 1967 birth cohort after age 25. Combined with consistently higher APSPR2 up to age 34, the 1957 birth cohort had a higher average number of CEB2 at age 49 compared to the 1967 birth cohort. In contrast, later birth cohorts showed lower APSPR1 and APSPR2 at younger ages compared to the 1967 birth cohort. Although APSPR2 increased rapidly for the 1987 cohort due to the relaxation of birth policies, APSPR1 remained consistently lower and is expected to increase after age 30.

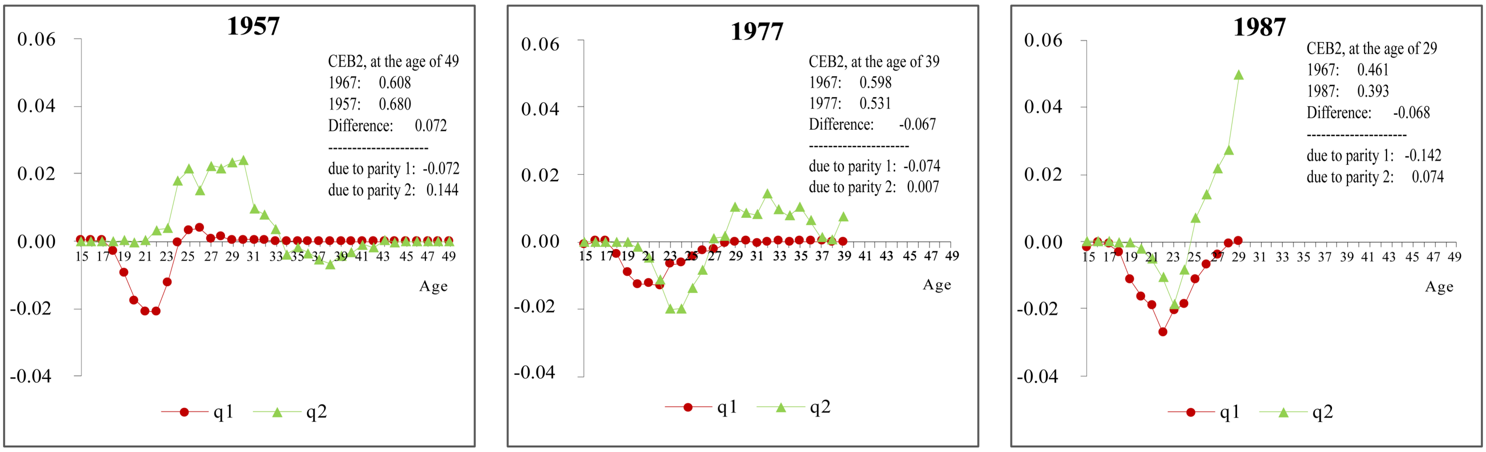

Fig. 7 Components of changes in APSPR1 and APSPR2 on changes in average number of CEB2

Note: q1 represents the effect of changes in APSPR1. q2 represents the effect of changes in APSPR2.

5.4 Effect of changes in urban-rural and educational structures

The impact of changes in educational structure on the reduction in the number of CEB has become more pronounced in later birth cohorts. As shown in Figure 8, the higher average number of CEB in the 1957 birth cohort, compared to the 1967 cohort, was primarily driven by differences in fertility levels across all residence-education-specific groups. In contrast, the decline in CEB among later birth cohorts, relative to the 1967 cohort, was less influenced by subgroup fertility rates and more attributable to changes in the urban-rural population structure and women's educational composition. The later the birth cohort, the stronger the effect of rising educational attainment on the reduction in the average number of CEB.

The impact of changes in the transition to first and higher-order births on average number of CEB varied by residence and education. As shown in Figure 9, the decline in progression to first births contributed more significantly to the reduction in average CEB among urban women in later cohorts. Among women with a high school education or above, the contribution of reduced progression to first births to the decline in average CEB increased over time, compared to women without a high school education.

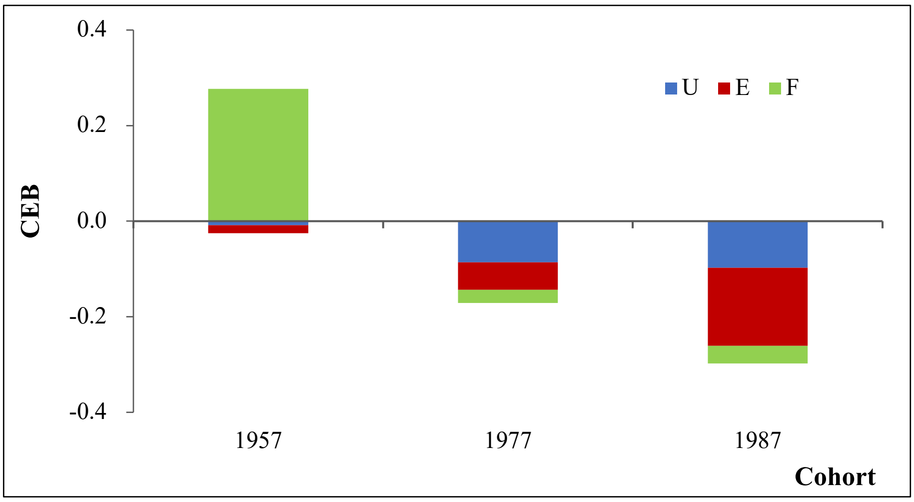

Fig. 8 Decomposition of the change in cohort average number of CEB

Note: U represents the effect of changes in urban-rural population structure. E represents the effect of changes in the educational structure of women in urban and rural areas. F represents changes in residence-education-specific average number of CEB.

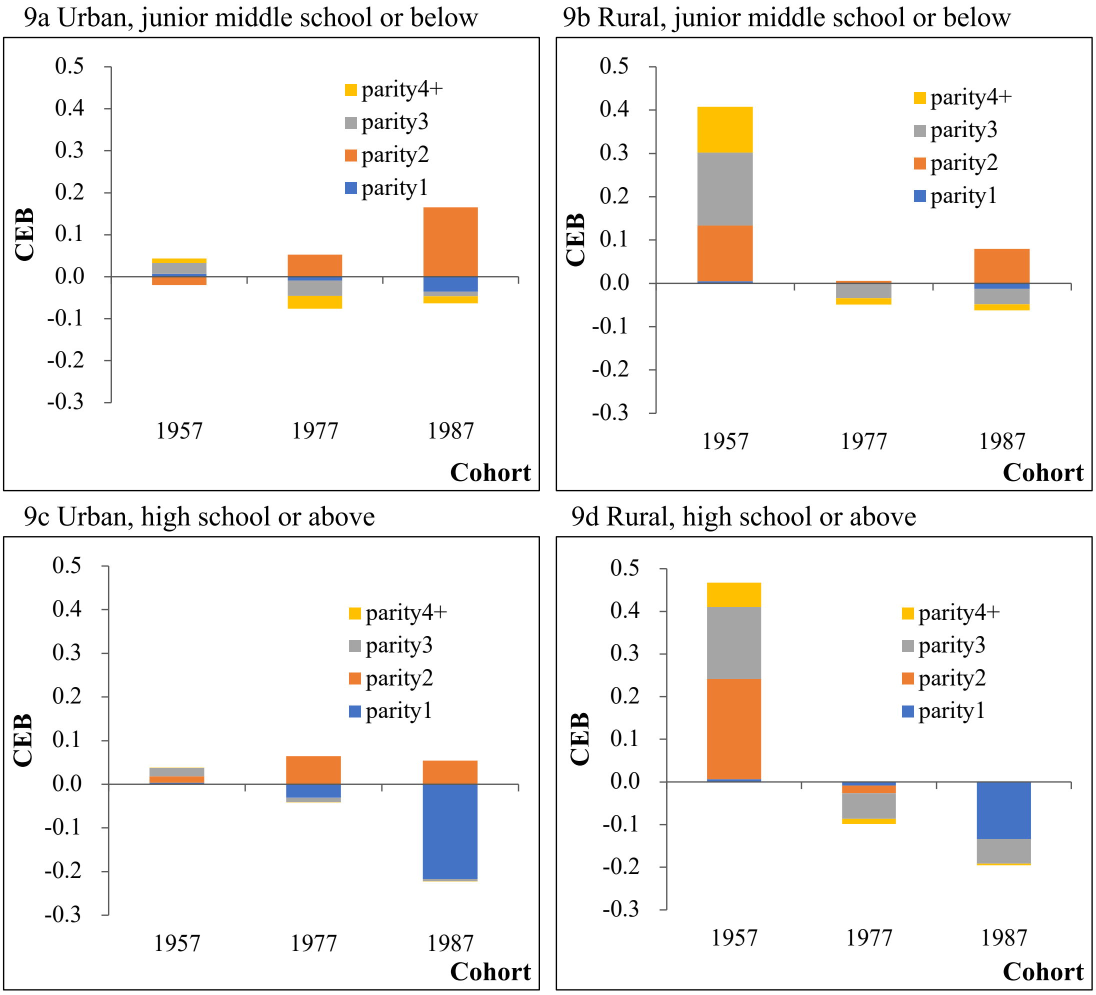

Fig. 9 Parity-specific contributions to change in the average number of CEB across residence and educational categories

6 Conclusion and Discussion

This study, based on a cohort perspective, analyzed trends in average number of CEB among Chinese women born between 1957 and 1987. Drawing on detailed data disaggregated by age, urban-rural residence, and educational attainment, we examined fertility postponement and recuperation patterns and used decomposition methods to assess the contributions of changes in age-parity-specific progression ratios, residence structure, and educational composition to overall shifts in number of CEB across cohorts. The analysis yields the following key conclusions:

The later birth cohorts exhibit lower CEB at specific ages. The average number of CEB by age 29 declined consistently across the 1957–1987 cohorts. The decreasing trend in CEB is sharper among rural, less-educated women. This stratification highlights the interplay between socioeconomic status and reproductive behavior. The number of women who postpone childbearing has been increasing and the number of desirable children has decreased in younger cohorts. In the past, especially in rural areas, traditional childbearing beliefs such as "more children, more happiness" and "having children for support in old age" were more widely accepted. However, with the improvement in women's social status and the shift in childbearing attitudes, there has been a decline in the social acceptance of the necessity for women to have children. With the sub-replacement fertility situation and population aging, the number of women of childbearing age will continue to decline in the future. The age structure of women of childbearing age will become older, the “fertility potential” will decrease, and the risk of a “low fertility rate” will further increase.

A later age at first marriage is consistently associated with a lower number of CEB at specific ages. In Chinese society, where marital childbearing is dominant, delayed marriage inevitably postpones first birth, thereby shifting the average timing of higher-order births to later ages. This delay reduces the likelihood of having second or subsequent children and contributes to a continued decline in completed cohort fertility. The growing pursuit of higher education, professional advancement, and efforts to balance career aspirations with family responsibilities have led more young people – particularly women – to remain single longer, delay marriage, and limit childbearing. However, because female fecundity declines with age, the window for recuperation of postponed first births narrows with time. Consequently, younger cohorts face an increasing risk of permanent childlessness and a reduced lifetime fertility potential.

Fertility postponement has intensified across birth cohorts, while the capacity for recuperation at older reproductive ages has weakened. Compared to the 1967 cohort, later birth cohorts experienced greater delays in initiating childbearing but were less able to fully recover at later reproductive ages. With the exception of the 1982 and 1987 cohorts, delays in second and higher-order births also become more pronounced. Although postponement has resulted in elevated fertility rates at older ages (Lesthaeghe and Willems, 1999), the extent of recuperation varies by birth order. As previous studies have shown, first births often exhibit stronger recuperation at older ages, while third and higher-order births show more limited recovery (Sobotka et al., 2011). Our results indicated that although first birth recuperation remains relatively robust in China, it has weakened in recent cohorts – raising the likelihood of permanent childlessness. Recuperation for second and third births has improved slightly, likely due to recent fertility policy adjustments. However, the recuperation of fourth and higher-order births has weakened, and postponement at these parities remains largely uncompensated.

The cohort fertility trends were strongly shaped by age-parity-specific progression ratios, particularly the transition to first birth (APSPR1). The decline in the number of CEB1 among later birth cohorts were primarily driven by reductions in APSPR1 between ages 15 and 29. These effects became more pronounced over time. While the number of CEB2 were also affected, the decline in the number of CEB2 was largely attributed to earlier decreases in APSPR1 rather than to changes in second-birth progression (APSPR2). Although recent adjustments to China’s fertility policy have raised APSPR2 in younger cohorts, the persistent decline in the progression ratio to first births remained the main driver of declining cohort fertility. Given the foundational role of first births in shaping cohort fertility (Wang, 2021), the total number of CEB is likely to continue falling as younger cohorts reach the end of their reproductive ages.

In addition to progression rations, structural changes in population composition – particularly in education and urban-rural residence – have also influenced cohort fertility patterns. Our results show that the decline in overall number of CEB was more closely associated with changes in the urban-rural and educational composition of women. Notably, the impact of declining progression to first births was particularly pronounced among urban, highly educated women in later cohorts. Urban-rural differences in fertility reflect both policy and behavioral variation. Before the introduction of the universal two-child policy in 2016, urban and rural women were subject to different family planning regulations. Additionally, urban women – due to higher educational attainment and career orientation – tended to marry later and have fewer children. Our decomposition analysis further reveals that changes in educational structure have has a greater impact on declining number of CEB than changes in the urban-rural population distribution. As fertility levels across educational categories stabilize, the increased proportion of women with higher education is expected to exert continued downward pressure on cohort fertility (Lazzari et al., 2021). Women with higher education are more likely to have fewer children by a given age, suggesting that fertility decline may persist as educational attainment increases.

There are some limitations to the study. First, the pregnancy histories used in this study are based on retrospective self-reported data, which may be subject to recall bias – particularly among older respondents. Second, as women in the later birth cohorts had not yet completed their reproductive years at the time of the survey, we are unable to estimate their lifetime fertility or completed number of children ever born.

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