Using Decomposed Total Fertility Rate (TFR) to Understand the Drivers for the Decline of TFR in Singapore

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Introduction

Singapore's resident total fertility rate[1] (TFR) has been on a declining trend for the past three decades, falling to a historic low of 0.97 in 2023 (Chart 1). This is also the first time the resident TFR has dropped below 1.0, which means that on average, each female is having fewer than one child.

In Singapore's context, most births occur within marriage. One major reason for the decline in TFR is the increasing proportion of females in the prime child-bearing age groups choosing to remain single.

CHART 1

SINGAPORE'S RESIDENT TOTAL FERTILITY RATE
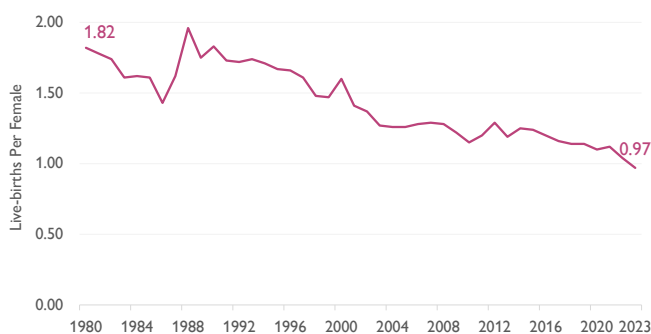
In addition to singlehood, this article aims to examine how the fertility patterns of married females in Singapore have contributed to this decline in TFR. Data analysed in this article are derived from administrative sources and annual household surveys[2].

Decomposition of TFR

The official TFR refers to the average number of live-births per female and is derived based on Equation (1)[3]. It can theoretically be decomposed into two components[4] : (i) Marital Fertility Rate and (ii) Proportion of Married Females.

In Singapore's context, it is reasonable to assume that all births are to married females as births to unmarried females are not common.

$$TFR = 5 \times \sum_{x=15-19}^{45-49} \frac{Live\ Births_x}{Female\ Population_x} \qquad \text{EQUATION (1)}$$

$$= 5 \times \sum_{x=15-19}^{45-49} \left(\frac{Live\ Births_x}{Married\ Female\ Population_x} \times \frac{Married\ Female\ Population_x}{Female\ Population_x} \right)$$

$$= 5 \times \sum_{x=15-19}^{45-49} (Marital\ Fertility\ Rate_x \times Proportion\ of\ Married\ Females_x)$$

1 Refers to the average number of live-births each female would have during her reproductive years if she was subject to the prevailing age-specific fertility rates in the population in the given year.

2 Annual households surveys refer to the Census of Population, General Household Survey and Comprehensive Labour Force Survey.

3 For more information on how the official TFR is computed, refer to the infographic.

4 The method of decomposition into components is an established method used by researchers to allocate changes in population indicators over time into its components. See Lee-Jay Cho and Robert D. Retherford, 'Comparative analysis of recent fertility trends in East Asia', in International Population Conference, Liege, 1973, vol. 2, pp. 163-181; Evelyn M. Kitagawa, 'Components of a difference between two rates', Journal of the American Statistical Association, vol. 50, No. 272 (December 1955), pp. 1168-1174; and Shigesato Takahashi, 'Demographic Investigation of the Declining Fertility Process in Japan', The Japanese Journal of Population, vol. 2, No. 1 (March 2004), pp. 93-116.

Since 1990, data trends for the two time-periods - 1990 – 2005 and 2005 – 2023 were observed to be different.

From 1990 to 2005, there was a relatively large decline in the marital fertility rates, particularly among ages 25 – 34 years as illustrated by the gap between blue and orange lines in Chart 2.

In contrast, the marital fertility rates were higher in 2023 compared to 2005 for most age groups.

The drop in the proportion of married females among those in their 20s and 30s between 2005 and 2023 was also more pronounced than the drop between 1990 and 2005 (Chart 3).

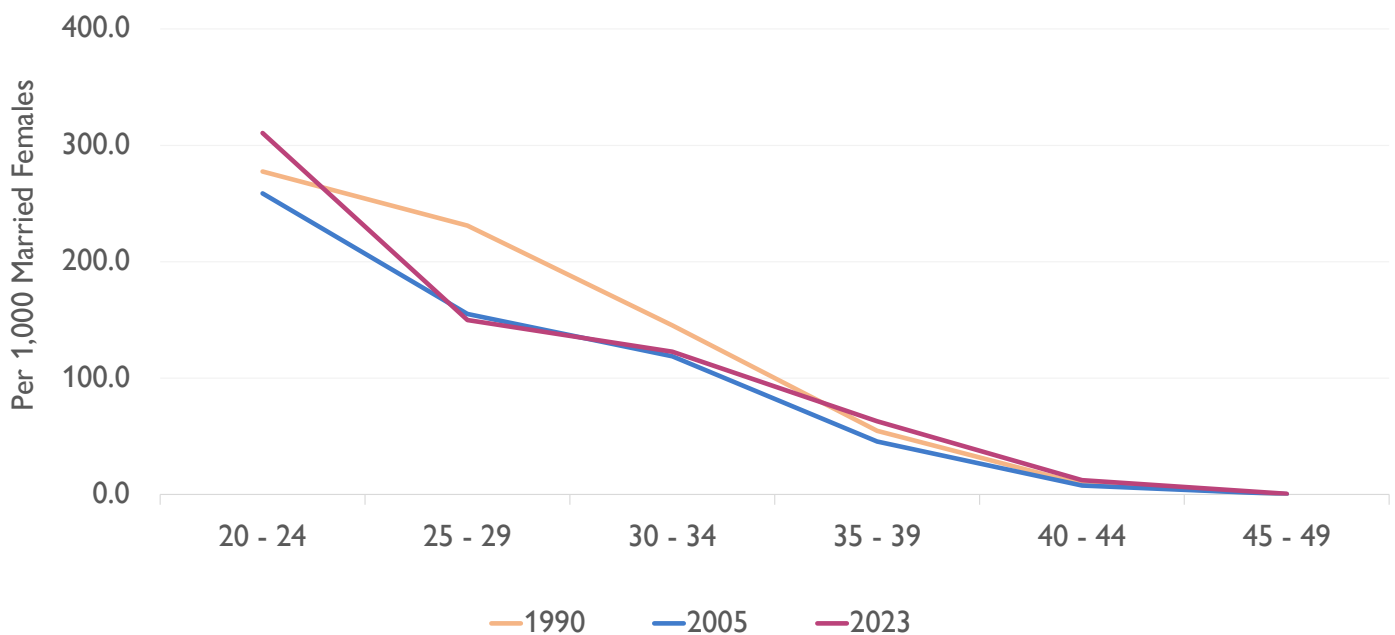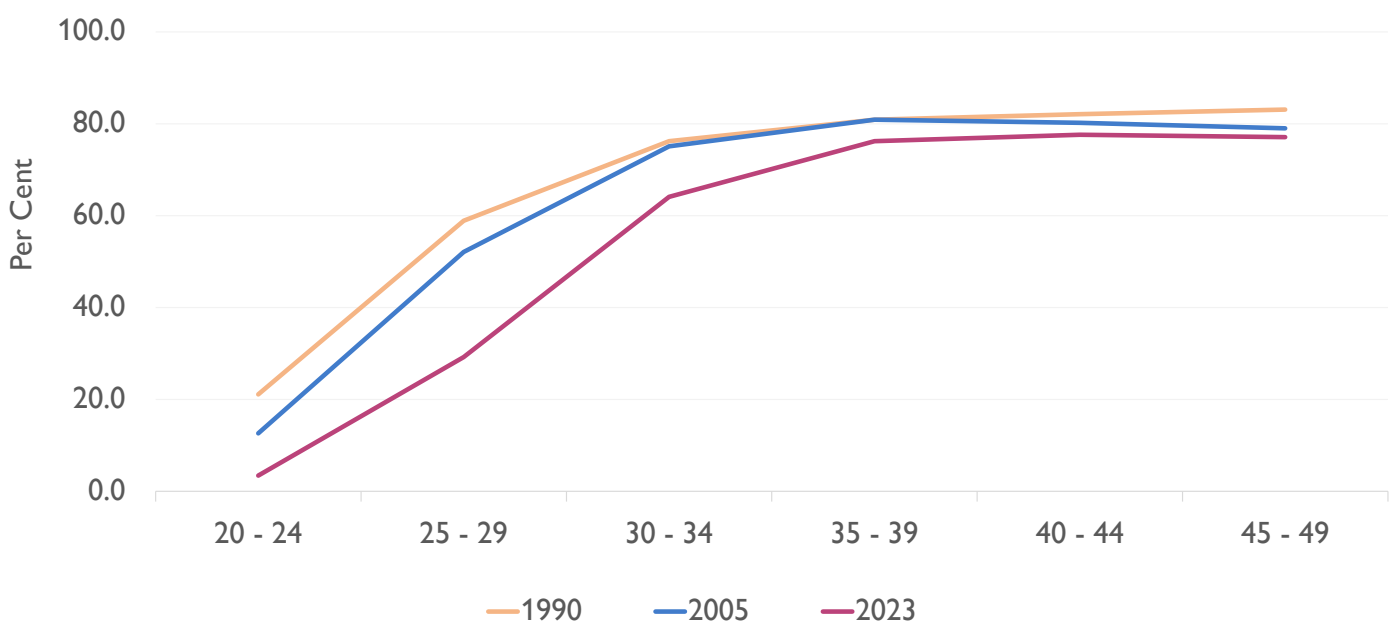**CHART 2   AGE-SPECIFIC MARITAL FERTILITY RATES**

CHART 3   PROPORTION OF MARRIED FEMALES BY AGE GROUP

Note: Breakdowns in Charts 2 and 3 are not analysed for the 15-19 years age group as the married female population is small within this age group.

Key Findings

Period 1 - From 1990 to 2005: Decline in Marital Fertility was a Greater Contributor for the Drop in TFR

Applying the TFR decomposition formula, Chart 4 shows the decline in marital fertility contributed to 62 per cent of the decline in TFR, while the decline in the proportion of married females accounted for the remaining 38 per cent.

Analysing further by age group, the main factors for the drop in TFR were the decrease in marital fertility among females aged 25 – 34 years, which contributed to approximately 55 per cent of the decline in TFR, and the decrease in the proportion of married females among those aged 20 – 29 years, which contributed around 32 per cent of the decline.

These are consistent with the overall trends among females in Singapore who were delaying marriage or remaining single.

CHART 4   PERCENTAGE OF DECLINE IN TFR OVER 1990 - 2005 ATTRIBUTABLE TO CHANGES IN THE PROPORTION OF MARRIED FEMALES AND MARITAL FERTILITY

■ Due to Change in Proportion of Married Females   ■ Due to Change in Marital Fertility
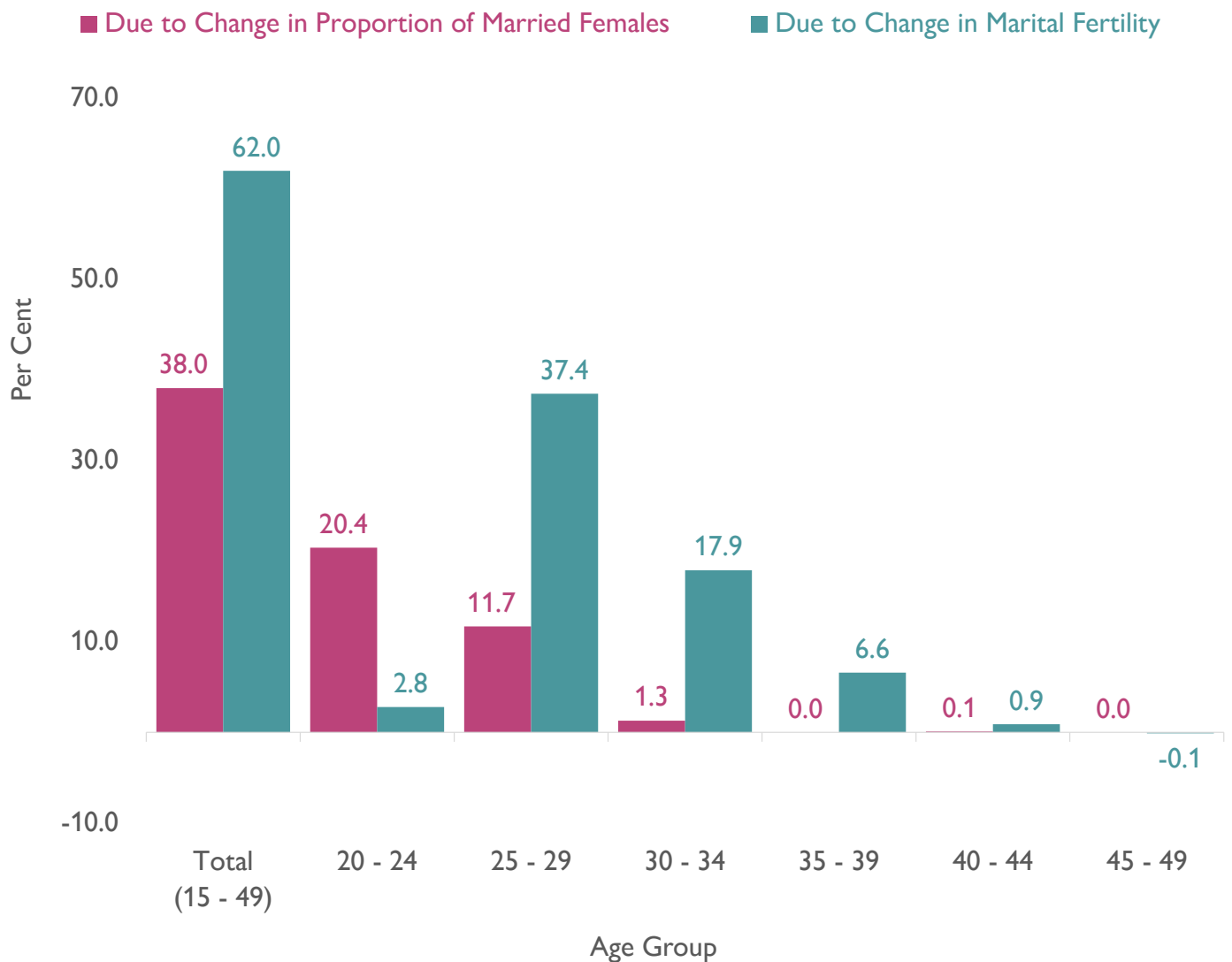
Note: Breakdowns in Chart 4 are not analysed for the 15-19 years age group as the married female population is small within this age group.

Period 2 - From 2005 to 2023:
Decline in TFR was Mainly due to Decline in the Proportion of Married Females

Unlike the 1990 – 2005 period, marital fertility was higher in 2023 compared to 2005 across most age groups, except those aged 25 – 29 years. This had a positive effect (45 per cent) on the TFR but was more than offset by the larger drop in the proportion of married females, leading to an overall decline in the TFR (Chart 5).

Overall, the decline in TFR could be mainly attributed to the fall in the proportion of married females aged 20 – 34 years over the period.

The changes in marital fertility, which decreased for females aged 25 – 29 years but increased for females aged 35 – 39 years, reflect the trend of females marrying and giving birth at an older age. It does not necessarily represent an increase in the average number of children per married female at the end of their childbearing years – this number is still decreasing.

CHART 5 PERCENTAGE OF DECLINE IN TFR OVER 2005 - 2023 ATTRIBUTABLE TO CHANGES IN THE PROPORTION OF MARRIED FEMALES AND MARITAL FERTILITY

■ Due to Change in Proportion of Married Females   ■ Due to Change in Marital Fertility
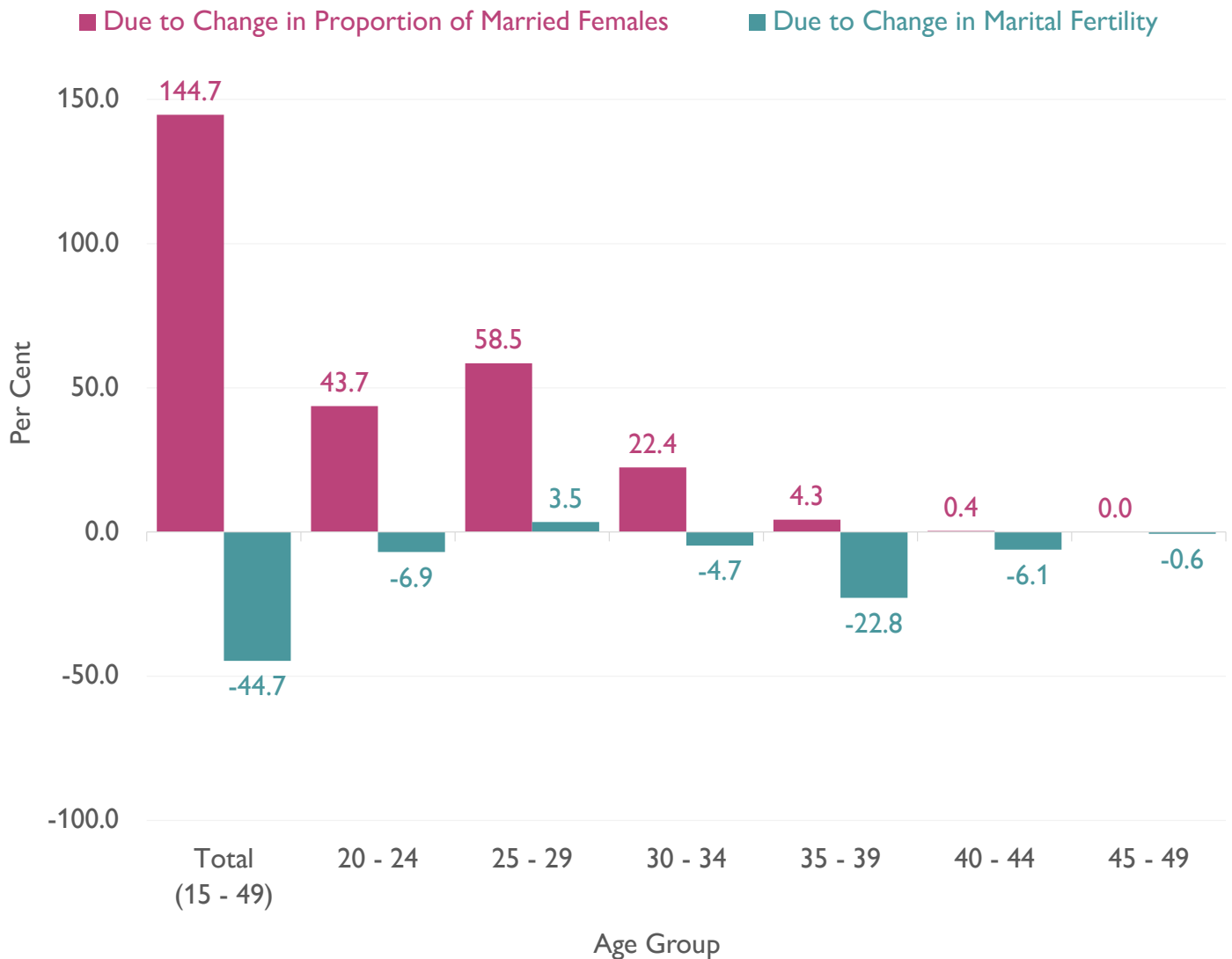
Note: Breakdowns in Chart 5 are not analysed for the 15-19 years age group as the married female population is small within this age group.

2005 – 2023

Why did the average number of children born to resident ever-married females aged 40 – 49 years decline (Chart 6) even though marital fertility rate increased (Chart 2)?

Average number of children born per ever-married female aged 40 – 49 years (i.e., at the end of their childbearing years) and age-specific marital fertility rate (ASMFR) are two distinct concepts.

Data on average number of children born per ever-married female aged 40 – 49 years are presented in Chart 6 and is derived **based on a stock concept.** It includes all the live-born children each ever-married female of the 40 – 49 years old cohort **has ever given birth to**, as at June of each reference year, including children born before the reference year. It includes children who are currently living with her, those who have set up their own homes and those who are no longer living.

On the other hand, the data on ASMFR presented in Chart 2 is **a period indicator derived based on a flow concept.** It only includes live-births **born in Jan—Dec of the reference year** to females within the specified age group, out of all married females in the same age group.

Due to their conceptual differences, period fertility trends (i.e., derived based on births within the reference year) can differ from trends observed based on a stock concept (i.e., derived based on cumulative births as at the reference year).

The following are observed when comparing the two constructs in 2005 and 2023.

a. The ASMFR of females aged 40 – 44 and 45 – 49 years in 2023 were 12.4 and 0.7 live-births per 1,000 married females respectively. This was higher than the ASMFR of females in earlier cohorts, i.e., those aged 40 – 44 and 45 – 49 years in 2005 which were 7.8 and 0.3 live-births per 1,000 married females respectively.

b. On the other hand, the average number of children born to ever-married females aged 40 – 49 years in 2023 was 1.73, lower than the average number of children born to earlier cohorts of ever-married females who were aged 40 – 49 years in 2005 which was 2.13.

c. Taking the above together, while the more recent cohort of females experienced higher period marital fertility rates between the ages of 40 – 44 and 45 – 49 years compared to those from earlier cohorts, they had fewer children on average at the end of their child-bearing years, possibly due to them having fewer children on average in their earlier ages. This is in line with the trend of females having children later.

d. This explains why, even though the ASMFR of females at age 40 – 49 years might be higher in 2023, the average number of children born to ever-married females at age 40 – 49 years in 2023 is still lower.

CHART 6   AVERAGE NUMBER OF CHILDREN BORN TO RESIDENT EVER-MARRIED FEMALES AGED 40 - 49 YEARS
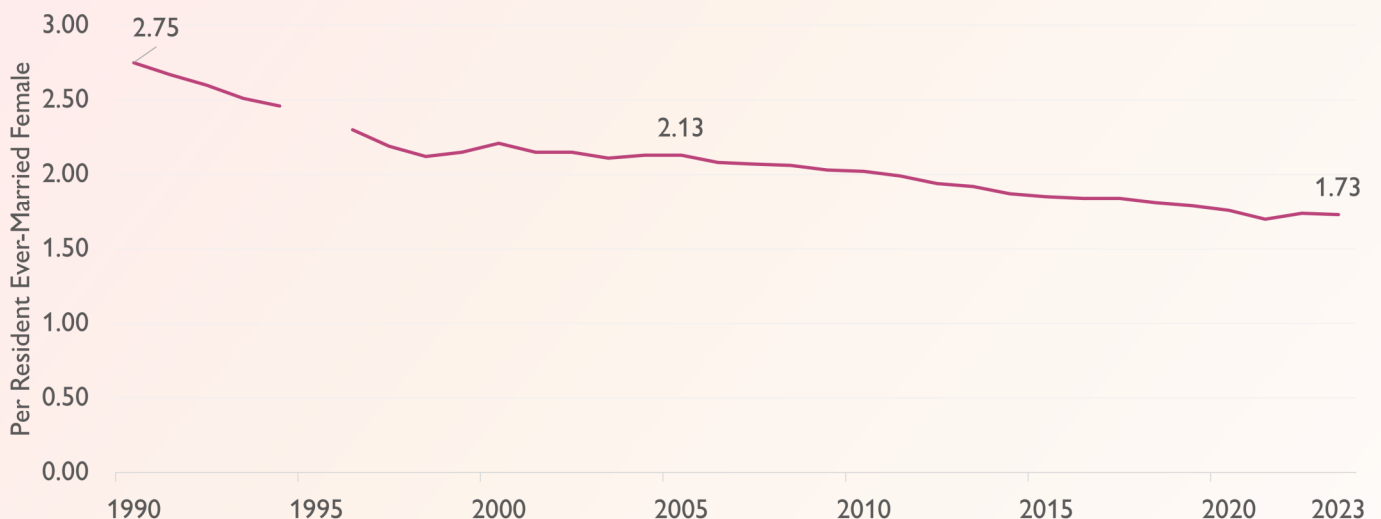
Note: Data for 1995 is not available.

'What If' Scenarios

The finding – decline in marital fertility rate had a greater impact on changes in TFR during 1990 to 2005 is supported by further simulations. If the proportion of married females in 2005 had remained at the 1990 level, simulations suggest that the TFR for 2005 may have been 1.47, higher than the actual TFR of 1.26 (Table 1). In another scenario, if marital fertility rate in 2005 had remained at the 1990 level, the simulations suggest that the TFR for 2005 may have been even higher at 1.60.

TABLE 1
'WHAT IF' SCENARIOS FOR 2005
(BASED ON 1990 LEVELS)

Scenario	1990	2005
Actual Resident TFR	1.83	1.26
If 1990 Proportion Married Prevailed	1.83	1.47
If 1990 Marital Fertility Rate Prevailed	1.83	1.60

In contrast, similar simulations for 2023 suggest that changes in the proportion of married females had a greater contribution to the decline in TFR than marital fertility between 2005 and 2023 (Table 2). If the proportion of married females in 2023 had remained at 2005 levels, simulations show that the TFR may have been 1.43, higher than the actual TFR of 0.97.

On the other hand, if the 2005 marital fertility rate had prevailed, simulations show possibly an even lower TFR of 0.86.

TABLE 2
'WHAT IF' SCENARIOS FOR 2023
(BASED ON 2005 LEVELS)

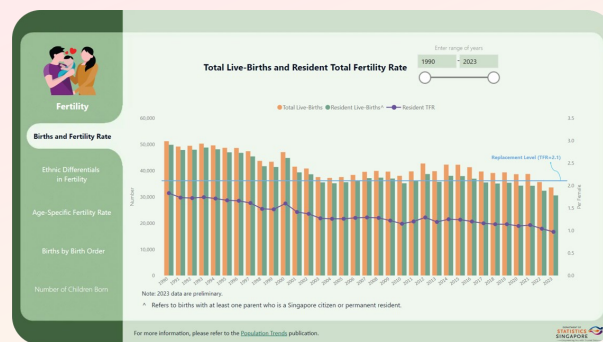| Scenario	2005	2023
Actual Resident TFR	1.26	0.97
If 2005 Proportion Married Prevailed	1.26	1.43
If 2005 Marital Fertility Rate Prevailed	1.26	0.86

Conclusion

Like many developed societies, Singapore's TFR has been on a downward trend. By decomposing the TFR to isolate the impact from the changes in marital fertility and proportion of married females in Singapore, the drivers for the decline in TFR across the different periods can be better understood.

Between 1990 and 2005, the decline in TFR was largely due to a fall in the marital fertility rate. However, between 2005 and 2023, while marital fertility was higher in 2023 compared to 2005 across most age groups, this was more than offset by the larger decline in the proportion of married females, or relatedly increasing prevalence of singlehood.

Check out the Total Fertility Rate Infographic and Fertility Dashboard available on the SingStat Website!

Infographic

Dashboard