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Sex-Ratio-at-Birth Imbalances and the Sex Ratio at Marriage in Korea[1)]

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From the early 1980s to 2007, spanning about thirty years, Korea's sex ratio at birth remained higher than the natural ratio, having first exceeded it in the 1970s. This study arose out of concerns that those born during these years of imbalanced sex ratios at birth could, upon reaching reproductive age, engender imbalances in the sex ratio at marriage. For the analysis, I calculated the sex ratio of the current unmarried population, the hypothetical matching index for the unmarried population, and Schoen's (1983) S-index. The results reveal that imbalances in the sex ratio at birth, while nonexistent in the early 1990s, worsened from the mid-2000s onward, to the extent that by 2021 there were 19.6 percent more unmarried men than unmarried women nationwide. Over the years, imbalances in the sex ratio at marriage have become much more severe in non-capital areas than in the capital region.

Introduction

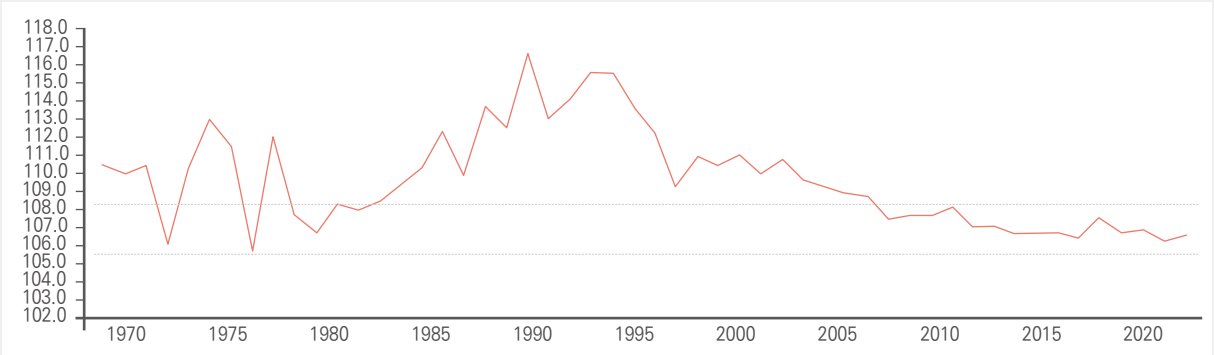
In the 1970s, Korea first saw its sex ratio at birth exceed the natural ratio. For several years starting in the late 1980s, the sex ratio at birth remained significantly higher than the natural ratio. Then, in the mid-1990s, it began trending downward, gradually falling within the range of the natural ratio by 2007. Sex-ratio-at-birth imbalances are generally conditioned by three factors: son preference; the increasing

1) The article is a reworking of part of *Marriage Characteristics and Policy Implications According to Sex Ratio Imbalance at Birth,* a KIHASA research project published in 2023, authored by Sungho Cho et al.

demand to choose a child's sex during a period of declining birthrates in the context of family planning; and the availability of technologies enabling sex selection.[2] These three conditions have led to sex-ratio-at-birth imbalances since the early 1980s. Notably, these imbalances have become more severe for higher-parity children, likely as a result of the need growing for families to choose a boy child as the number of children they can have comes closer to its limit. For example, the sex ratio at birth in 1990 for third or higher-parity children was 193.7 males to 100 females. A high sex ratio at birth means a male surplus or a female shortage, which may lead to an imbalance in the sex ratio among men and women of reproductive age. This suggests that Korea's sex ratio at birth, which remained above the natural ratio for over thirty years to 2007, is likely to continue significantly impacting the sex ratio at marriage for years to come, considering the time until the last of those born during these years reach reproductive age.

Intuitively, an exhaustive one-to-one matching seems feasible only if a balanced sex ratio is attained, given that marriage in monogamous societies involves a union between a man and a woman. However, even with a balanced sex ratio, a complete one-to-one correspondence is unlikely because men and women have preferences for age, personality, looks, and other factors in their choice of a marriage partner. Furthermore, given that the natural sex ratio results in 104 to 107 baby boys for every 100 baby girls, it is conceivable that those born during a period of sex-ratio-at-birth imbalances, as they reach reproductive age, will lead to a surplus of males (or a shortage of females) in the sex ratio at marriage. Sex-ratio-at-birth imbalances—skewed toward either boys or girls—are also known as 'marriage squeeze,' a topic that has drawn a great deal of research attention worldwide. However, research on sex ratio imbalances and their cumulative effects in Korea remains limited. In this article, I analyze the impact of Korea's sex-ratio-at-birth imbalances on the sex ratio at marriage among men and women of reproductive age.

[Figure 1] Sex-ratio-at-birth trends: 1970~2021



Note: Straight lines in blue indicate the range of the natural ratio (104–107).

Source: Population Trends Survey. 1970~2021. National Statistics Portal. Statistics Korea. Sex ratio at birth for each year, retrieved on March 6, 2022. https://kosis.kr/statHtml/statHtml.do?orgId=101&tblId=INH_1B8000F_01&conn_path=I3

2) Guilmoto, C. Z. (2009). The sex ratio transition in Asia. *Population and Development Review*, 35(3), 519–549.

Unmarried population, unmarried rate, and sex ratio, by cohort

Using 2020 as the reference year, I estimated the population of unmarried individuals, the unmarried rate, and the sex ratio among those born between 1970 and 2000. The unmarried rate of the 1970 cohort, aged 50 in 2020, was 16.4 percent for men and 7.2 percent for women. For the 1980 cohort, the unmarried rate was 30.4 percent for men and 17.3 percent for women. Almost half (48.5 percent) of men and 29.1 percent of women in the 1985 cohort were unmarried. Official statistics from Statistics Korea found the age at first marriage in 2020 to be 33.2 years for men. However, considering that 58.3 percent of the 1987 cohort, for example, were unmarried at age 33 in 2020, the actual age at first marriage might be higher. This is because the 58.3 percent of men born in 1987 who remained unmarried in 2020 were excluded from the age-at-first-marriage estimates. Furthermore, if a proportion of those unmarried marry later, they would be older than 33 years of age at their first marriage. The sex ratio declined over time, from 229.8 for the 1970 cohort to 181.0 for the 1980 cohort, and further to 144.6 for the 1990 cohort. This suggests that the tendency to remain unmarried is more pronounced among men than among women.

[Table 1] Unmarried population, unmarried rate, and sex ratio, by cohort, with 2020 as the reference year

Cohort year	Unmarried population (person)		Unmarried rate (%)		Sex ratio
	Men	Women	Men	Women	
1970	72,018	31,335	16.4	7.2	229.8
1975	90,803	43,827	23.6	11.6	207.2
1980	125,861	69,531	30.4	17.3	181.0
1985	149,268	87,906	46.5	29.1	169.8
1990	261,903	181,154	79.7	61.3	144.6
1995	357,433	299,153	98.5	93.3	119.5
2000	325,426	302,737	100.0	100.0	107.5

Source: Population and Housing Census (1970–2000). Statistics Korea. National Statistics Portal. Population by administrative region/surname/age/marital status, retrieved on May 10, 2023.

Hypothetical one-to-one matching of the unmarried population

I attempted to measure the proportion of unmarried individuals remaining unpaired after a hypothetical one-to-one matching procedure. The cohort-specific sex ratios observed earlier pertained only to individuals of the same age. However, real-life matching (marriage) between men and women does not exclusively occur between individuals of the same age. Here, I calculated a hypothetical matching index that accounts for the real-life 3-year age difference between men and women at marriage.

Equation (1) defines a hypothetical matching index *I* defined as:

$$I = \frac{\sum_{n=20}^{49} (X_n - Y_{n-3})}{\sum_{n=20}^{49} (X_n)}$$ (1), where X represents the unmarried male population at age n, and Y_{n-3} represents the unmarried female population at age n-3. This index measures the sum of the differences in population numbers between men at age n and women at age n-3, where n ranges from 20 to 49, divided by the sum of the male population numbers from age 20 to age 49[3]. A positive value of I indicates an excess of men compared to women, while a negative value indicates the opposite.

The calculated *I* values reveal that although the female population exceeded the male population from 1985 to 1990, men have since significantly outnumbered women. Overall, the *I* values indicate a substantial surplus of unmarried men compared to unmarried women. Thus, despite accounting for the 3-year age difference at marriage, a large segment of unmarried men remains unpaired. The unmarried rate for the population aged 20 to 49 was 11.2 percent, resulting in a net surplus of 1,226,823 men.

3) For women, the corresponding age range would be 17~46.

[Table 2] Population remaining unpaired after hypothetical one-to-one matching, 1985~2020 (in number and rate)

Age	1985	1990	1995	2005	2010	2015	2020
20	7,407	34,190	80,477	62,272	30,552	96,526	95,954
25	-4,663	-15,620	18,391	51,325	34,411	17,574	64,092
30	-30,777	7,195	-6,284	26,199	52,244	41,904	7,231
35	-6,317	-12,232	19,332	24,220	30,140	67,214	38,113
40	-50,482	-13,728	-26,893	-13,443	21,211	45,394	62,687
45	2,671	-42,422	-10,508	5,086	-10,586	31,042	39,367
49	-25,484	22,507	-16,852	-69,987	51,066	-42,953	42,868
Net total unmarried (A)	-298,303	-203,512	102,887	536,546	618,179	915,131	1,226,823
Total unmarried men 20~49 years of age (B)	9,278,558	10,662,380	11,407,083	11,944,101	11,470,878	11,439,785	10,939,274
Unmarried rate (A/B)	-3.2	-1.9	0.9	4.5	5.4	8.0	11.2

Note: Selected ages are listed; data for 2000 is excluded (unpublished).

Schoen's S-index[4]

Schoen's S-index (1983), which reflects the sex ratio of the unmarried population and age-specific marriage rates, mirrors the cohort-specific sex ratio imbalances observed and shares characteristics with the hypothetical matching index.[5] The S-index can be expressed as:

$S = \frac{\gamma - \beta}{1 - \sqrt{\gamma \cdot \beta}}$ (2), where γ and β each denote the lifetime unmarried rate as presented in marital status life tables for women and men, respectively. This leads to equations (3) and (4):

$$\gamma = \exp(-\sum_{y=15}^{w} {}^{f}W(\bullet, y)) = \exp(-\sum_{y=15}^{w} \frac{\sum_{x=15}^{w} c(x,y)}{{}^{f}p_y}) \quad (3)$$

$$\beta = \exp(-\sum_{x=15}^{w} {}^{m}W(x, \bullet)) = \exp(-\sum_{x=15}^{w} \frac{\sum_{y=15}^{w} c(x,y)}{{}^{m}p_x}) \quad (4)$$

, where $c(x,y)$ represents the number of first marriages for men at age x and women at age y, ${}^{m}p_x$ is the midyear unmarried male population at age x, and ${}^{f}p_y$ is the midyear unmarried female population at age y. The notations ${}^{m}W(x, \bullet)$ and ${}^{f}W(\bullet, y)$ each represent the first marriage rate for men and women, respectively. Then, letting $\omega = 49$, as 49 is generally held to be the maximum age until which women stay reproductive, we have $(1 - \sqrt{\gamma \cdot \beta})$, the denominator of

4) Schoen, R. (1983). Measuring the Tightness of a Marriage Squeeze. Demography, 20(1), 61–78.

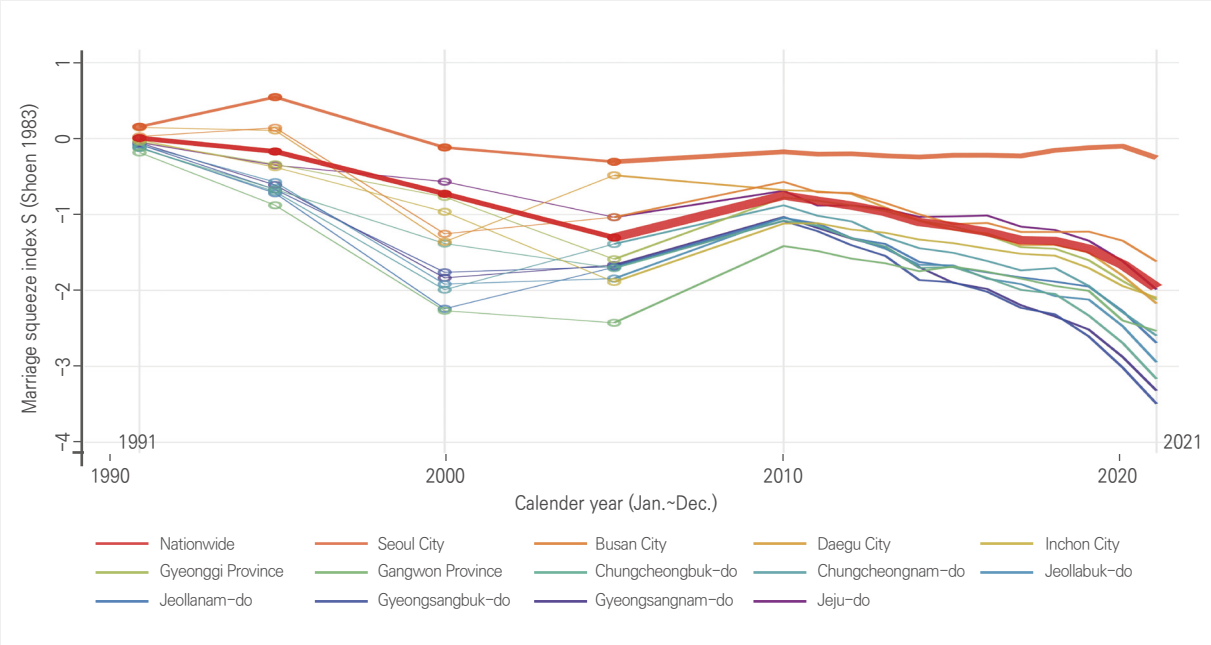
5) Anzo, S. (1985). Measurement of the Marriage Squeeze and its Application. *The Journal of Population Studies,* 8, 1–10.

the S-index, for an ever-married rate for both men and women at age 50, assuming no imbalances in the sex ratio at marriage. Here, $1-\beta$ and $1-\gamma$ capture the ever-married rates for men and women, respectively, as presented in first-marriage life tables. It follows that if $1-\beta < 1-\gamma$ then $S < 0$, signifying an imbalance in the sex ratio at marriage for men. The larger the absolute value of a negative S-index measure, the more severe the marriage squeeze for unmarried men. Conversely, any $S > 0$ suggests a marriage squeeze for unmarried women, with the index value indicating the magnitude of the marriage squeeze.

Our S-index values suggest that while there was little imbalance in the sex ratio at marriage in 1991, from the mid-2000s onward, the demographic structure became increasingly skewed to such an extent that it became impossible for more than 10 percent of the male population to find a marriage partner. For instance, by 2005 the S-index had dropped from around zero in 1991 to -0.13, indicating that men were 13 percent less likely to find a marriage partner. This implies that, considering marriage patterns and the sex ratio of the unmarried population, the male unmarried population is estimated to outnumber the female unmarried population by about 13 percent.

A characteristic feature of the S-index for Korea is that among all the municipalities observed, Seoul has a highly balanced sex ratio at marriage. Since 2005, Seoul's sex ratio at marriage has even shown a tendency toward decreasing imbalance, whereas the rest of the country has exhibited the opposite trend. The marriage squeeze for men in all these areas other than Seoul, especially in Busan, Daegu, and Inchon, became severe throughout the 1990s until the mid-2000s, eased a bit thereafter, and then, from 2010 on worsened again even to a greater extent. Upon closer look, while the S-index values for most of the 13 cities and provinces studied moved along trajectories similar to the national average, the gap between the maximum and minimum values has widened markedly in the first half of the 2000s and, after narrowing somewhat for a few years, expanded even further from the second half of the 2010 onward, reaching 32.4 percentage points in 2021.

[Figure 2] S-index for regions in Korea, 1991~2021

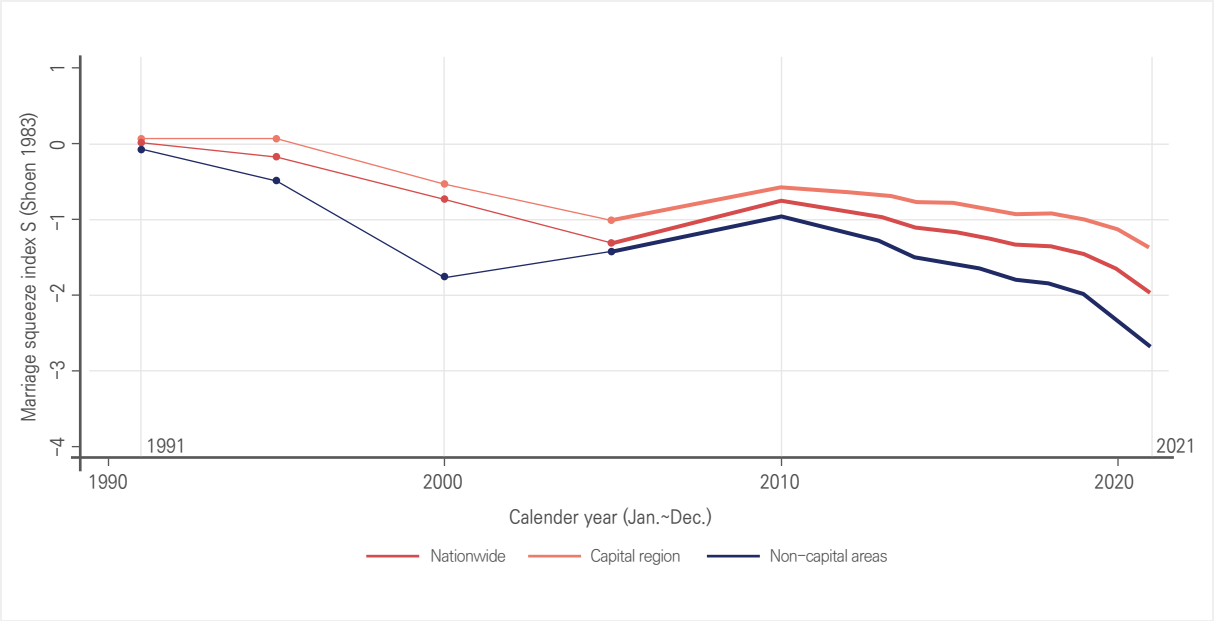


Note: Respondents are 2,000 primary child rears who were or had been in receipt of child benefits for their children at the time of the survey.

Source: So-Young Lee et al. 2023. The Child Allowance as a Policy Response to Demographic Change in Korea. KIHASA.

As the issue of local hollowing-out becomes prominent with increasing youth migration to the capital region, it is worthwhile to compare the S-index between the capital region and non-capital regions. The S-index values calculated in this study indicate that sex-ratio-at-marriage imbalances in the capital region were less severe than the national average. In contrast, non-capital areas showed a greater imbalance than the national average. Our time series analysis reveals that the S-index for the non-capital regions dipped below zero during the period between 1991 and 2000, increased thereafter until 2010, and has since trended downward further away from zero. Regarding the capital region, while Seoul showed little imbalance in the sex-ratio-at-marriage, as mentioned above, the marriage squeeze worsened persistently for Inchon, a neighboring city, and for Gyeonggi-do, the surrounding province, thereby lowering the region-wide average.

[Figure 3] S-index for the capital region and non-capital areas, 1991~2021



Note: Gwangju Metropolitan City (1986–) is included in Jeollanam-do; Daejeon Metropolitan City (1989–) and Sejong Special Self-Governing City (2012–) are included in Chungcheongnam-do; Ulsan Metropolitan City (1995–) is included in Gyeongsangnam-do.

Sources: Population Trends Survey (1991~2021). Statistics Korea. National Statistics Portal. Marriage. Retrieved on June 5, 2023; Population and Housing Census (1985~2020). Statistics Korea. National Statistics Portal. Population by administrative region/surname/age/marital status. Retrieved on May 10, 2023.

The S-index for 2021 suggests that there were 19.6 percent more unmarried men than unmarried women nationwide. Seoul showed little imbalance in the ratio of unmarried men to unmarried women. Sex-ratio-at-marriage imbalances were nowhere so severe as in Gyeongnam and Gyeongbuk provinces, where unmarried men outnumbered unmarried women by over 30 percent. In addition, sex-ratio-at-birth imbalances were at their most pronounced in these regions, compared to the rest of the country, throughout the 1980s and 1990s.

[Table 3] Korea's S-index for 2021

Region	S index
Nationwide	-0.196
Seoul City	-0.025
Busan City	-0.162
Daegu City	-0.217
Inchon City	-0.210
Gyeonggi-do	-0.212
Gangwon-do	-0.253
Chungcheongbuk-do	-0.317
Chungcheongnam-do	-0.260
Jeollabuk-do	-0.295
Jeollanam-do	-0.269
Gyeongsangbuk-do	-0.349
Gyeongsangnam-do	-0.332
Jeju-do	-0.199

Source: Population Trends Survey (1991~2021). Statistics Korea. National Statistics Portal. Marriage, Retrieved June 5, 2023; Population and Housing Census (1985~2020). Statistics Korea. National Statistics Portal. Population by administrative region/surname/age/marital status. Retrieved on May 10, 2023.