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Women's Education, Employment, and Cost of Family Formation: A Structural Analysis of Fertility Decline in Korea

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Abstract

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Keywords

growth, fertility, gender equality, human capital accumulation, marriage, Korea

JEL Classification

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ABSTRACT

This study examines the factors underlying the sharp decline in marriage and fertility rates by integrating microdata analysis with a structural macroeconomic model. Drawing on 25 years of individual-level panel data from the Korean Labor and Income Panel Study, it employs discrete-time survival models to examine how individual and regional factors influence the incidence of first marriage and childbirth. The findings show that rising educational and marriage-related expenses significantly reduce the likelihood of marriage, whereas increased female labor force participation and escalating child education costs are associated with lower probabilities of childbirth. These empirical patterns motivate a dynamic overlapping-generations model with endogenous family formation, human capital investment, and intra-household bargaining. The model incorporates gender-based differences in partner matching and household labor, which influence time allocation and marriage utility, particularly for college-educated women. Simulation results indicate that rising marriage and child-rearing costs have been the primary drivers of declining family formation since 1990, while increases in women's education have played a modest role. The findings further suggest that a package of targeted policies—such as childcare and education support, marriage-cost subsidies, and gender-equalizing reforms in households and the labor market—could raise the fertility rate from 0.75 to around 1.2, a level comparable to that of other low-fertility advanced countries.

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1. Introduction

Over the last few decades, rapid economic development in the Republic of Korea (hereafter, Korea) has coincided with a sharp decline in marriage and fertility rates, posing considerable demographic and economic challenges. While economic growth has improved living standards, it has also introduced complex trade-offs at both individual and family levels. Rising incomes, expanded educational opportunities for women, and persistent traditional gender norms have reshaped marriage and childbearing decisions, especially for women. Consequently, Korea has experienced a sharp decline in family formation over the past three decades. The country's total fertility rate (TFR) declined from 1.76 in 1992 to 0.72 in 2023, the lowest worldwide (Figure 1), while the proportion of married women aged 25–49 dropped from 92.1% in 1990 to 68.9% in 2020.

[Insert Figure 1 here]

This study examines the factors driving the decline in marriage and fertility rates in Korea, focusing on how economic incentives, traditional gender norms, and institutional barriers shape individual decisions regarding family formation. Specifically, it examines the role of rising educational attainment among women, escalating marriage and child-rearing costs, and persistent gender inequality within households and the labor market in contributing to these declines. It also considers the extent to which government interventions effectively reverse or mitigate these trends.

This study integrates an empirical analysis with a structural macroeconomic model. The empirical analysis draws on household- and individual-level data from the Korean Labor and Income Panel Study (KLIPS), a nationally representative longitudinal survey covering over 13,000 individuals from 1998 to 2022. It documents stylized facts on marriage, fertility, education, labor market participation, rising family formation costs, and gender norms in Korea. Discrete-time hazard models of first marriage and childbirth are employed to examine how individual-level characteristics—including education, employment status, and income—and regional-level factors—such as housing prices, private education costs, and gender imbalances in education—influence marriage and fertility decisions.

These empirical findings motivate the construction and calibration of a structural macroeconomic model. The model incorporates key mechanisms such as gender-specific opportunity costs, marriage market search frictions, and intra-household inequality in time allocation and bargaining power. It is used to analyze how economic and social changes over the past 30 years have shaped marriage and fertility behaviors. In addition, the model simulates the effects of policy interventions, including childcare and education subsidies and transfers that reduce marriage costs, as well as structural reforms targeting gender inequality to evaluate their demographic and macroeconomic impacts.

The model features overlapping generations with endogenous decisions on marriage, fertility, labor supply, and human capital investment. It builds on foundational work in the economics of fertility and marriage (Becker, 1981; Becker & Barro, 1988; Becker & Lewis, 1973; Doepke et al., 2023; Smith, 2006), as well as macroeconomic models linking gender, human capital, and long-run growth (Agénor, 2017; Galor & Weil, 1996, 2000; Kim et al., 2016; Kitao & Nakakuni, 2023; Lagerlof, 2003). The model incorporates key asymmetries across gender and education, capturing how traditional gender norms and increasing female educational attainment jointly shape spousal search costs, marriage probabilities, and the disutility of unequal household arrangements, particularly among college-educated women. Intrahousehold bargaining determines the allocation of time between market work, caregiving, and child investment, reducing marriage utility when roles remain unequally divided. By embedding these micro-level frictions within a dynamic macroeconomic framework, the model provides a unified approach for studying how economic change and persistent social norms jointly shape family formation and growth.

Persistent gender norms and inequalities in both the household and labor market continue to shape family behavior (Myong et al., 2021; Raymo et al., 2015). Despite rising female labor force participation, women continue to bear the bulk of unpaid domestic and childcare work, reflecting not only entrenched social expectations but also weaker bargaining power within households. These norms are compounded by institutional barriers such as rigid workplace structures, limited parental leave, and insufficient public childcare support. In addition, Korea’s strong cultural aversion to non-marital childbearing, reflected in an out-of-wedlock birth rate of just 3.9%, further binds fertility to marriage. Collectively, these factors create a high-opportunity-cost and low-support environment for family formation, particularly among highly educated women.

This study makes three key contributions to the literature. First, it advances research on fertility rates—particularly recent work on Korea’s persistently low fertility (Chang et al., 2024; Hwang, 2023; Kim et al., 2024; Myong et al., 2021; Raymo et al., 2015)—by combining microdata analysis with structural macroeconomic modeling. Using survival analysis, key factors influencing marriage and childbearing decisions are identified. These empirical findings are incorporated into a structural macroeconomic model to quantify their demographic and macroeconomic implications. While earlier studies have examined Korea's fertility decline, to the best of the authors' knowledge, no study has linked cohort-based survival analyses to structural modeling.

Second, it contributes to the structural modeling literature by introducing a gender-disaggregated framework that jointly determines marriage, fertility, labor supply, and economic growth. The model embeds key asymmetries, including intra-household bargaining, unequal childcare responsibilities, and gender gaps in labor market participation. Unlike existing structural models focused on Korea (e.g., Kim et al., 2016; Kim et al., 2024; Myong et al., 2021), this study explicitly incorporates marriage market frictions, intra-household bargaining, and time allocation constraints, showing how these forces simultaneously influence family decisions, human capital accumulation, and long-run growth.

Third, a macroeconomic model is used to evaluate a range of policy interventions—childcare and education support, marriage-related cost subsidies, and gender-equalizing reforms in households and the labor market—and to quantify their effects on marriage, fertility, labor force participation, and economic growth. The findings indicate that a coordinated policy package can substantially increase marriage and fertility rates. However, these gains may be accompanied by trade-offs: increases in female labor force participation are accompanied by declines in male participation. In addition, reduced parental time investment in child education could slow human capital accumulation and long-run per capita output growth.

The remainder of this paper is structured as follows. Section 2 provides an overview of the key stylized facts and empirical findings from the estimation of discrete-time hazard models. Section 3 presents the structural macroeconomic model, while Section 4 describes the calibration process and the baseline steady-state equilibrium. Section 5 reports the simulation results of several experiments evaluating the impact of government policy initiatives and counterfactual economic and social changes on marriage, fertility rates, and economic growth. Section 6 offers the conclusions.

2. Marriage and Childbirth in Korea: Stylized Facts and Micro-Level Evidence

This section presents descriptive trends and micro-level empirical findings on marriage and childbirth decisions in Korea, providing an empirical foundation for the structural macroeconomic model developed in the following section.

2.1. Stylized Facts on Marriage, Fertility, and Gender Norms

This subsection presents a set of stylized facts and empirical patterns on long-term trends in fertility, marriage, educational attainment, gender disparities in employment, and the rising economic costs associated with family formation in Korea. It also highlights the persistent influence of gender norms, such as the unequal division of household labor and preferences for educational hypergamy, which help explain why highly educated women face greater constraints and higher opportunity costs in forming families. These empirical patterns provide a macro-level context for discrete-time hazard models of first marriage and childbirth and motivate several key features of the theoretical model developed in later sections.

A. Declining Fertility and Delayed or Forgone Marriage

TFR, which is the average number of children a woman aged 15–49 is expected to have, has steadily declined in Korea (Figure 1). It remained above the replacement level of 2.1 until 1983 and declined to 1.6 by 1990. It remained around 1.2 in the early 2010s before dropping to 0.72 in 2023, with a marginal rebound to 0.75 in 2024.

This decline in fertility rates reflects both a decreasing marriage rate and fewer children being born to married couples. As in many other industrialized economies, Korea has experienced significant shifts in marriage patterns in recent decades. The average age at marriage increased from 24.8 for women and 25.4 for men in 1990 to 31.5 and 34.0, respectively, in 2022. During the same period, the share of total births to women in their teens and twenties declined sharply, from 82.1% in 1990 to 18.5% in 2022 (Statistics Korea, 2024). The proportion of unmarried individuals has risen markedly across different age groups (Figure 2). This trend was most pronounced among younger cohorts: 87.4% of individuals aged 25–29 remained unmarried in 2020, compared with 39.7% in 1990. Even among those aged 45–49, the share of never-married individuals increased significantly, from just 0.7% in 1990 to 15.2% in 2020. Since the vast majority of births in Korea occur within marriage, this sharp rise in non-marriage has been a key driver of the fertility decline.

[Insert Figure 2 here]

[Insert Figure 3 here]

In addition, married couples reported having fewer children: the average number of children born to married women dropped from 3.0 in 1990 to 2.1 in 2020 (Figure 3). This reduction in completed fertility and family size among married women likely reflects not only shifting preferences but also delayed marriage, which shortens the reproductive window and increases the opportunity costs of motherhood.

B. Educational Expansion and Its Impact on Marriage and Fertility

Korea's rapid socio-economic development has profoundly reshaped family formation, driven largely by dramatic gains in educational attainment, particularly among women. By 1980, universal lower secondary education had achieved a 100% gross enrollment rate. By 2000, the gross enrollment rate at the upper secondary level exceeded 90% for both sexes. Tertiary education also expanded rapidly, with gross enrollment rising from 11% in 1980 to 24% in 1990, and reaching 75% by 2023.

The expansion of educational access extended to girls as well, with opportunities improving markedly over time. As the gender gap in upper secondary education enrollment narrowed, female participation in tertiary education rose sharply during the 1990s (Figure 4). Women's tertiary enrollment rates in Korea rose from 19% in 1990 to 68% in 2010, reaching 77% by 2023. In 1990, the female enrollment rate was only 72% of the male rate, but by 2010 it had increased to 96%. These gains in gender equality in educational opportunities significantly enhanced women's educational attainment: the average years of schooling for females aged 25–64 increased from 8.9 in 1990 to 13.5 in 2015, compared with an increase from 10.9 to 13.9 among men (Barro & Lee, 2013; Statistics Korea, 2024).

[Insert Figure 4 here]

Educational transformation in Korea has had a profound influence on marital and fertility patterns. Younger generations of highly educated women are more likely to delay marriage or remain unmarried. Table 1 illustrates that in 1990, marriage and fertility rates varied significantly based on educational level. Among women aged 25–49 with junior college, university, or higher degrees, 79.8% were married, with an average of 1.77 children. In contrast, 98.2% of women with only primary education or lower and 96.5% with a lower secondary school diploma were married, with average numbers of children of 4.18 and 2.43, respectively.[1]

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[1] Table 1 presents data on the average number of children among married women aged 15 and above, as comparable data disaggregated by educational attainment for women aged 25–49 are available for 1990, but not for 2020. In 1990, the average number of children among married women aged 25–49 was 2.22 overall, and 3.07, 2.27, 1.80, and 1.57 for women with primary,

Similar negative associations between women's educational attainment, marriage, and fertility were observed in 2020. Notably, the marriage rate among college-educated women aged 25–49 dropped to 63.6%, compared with 93.0% for women with only primary education or lower and 91.5% for those with a lower secondary school diploma. These shifts coincided with a sharp increase in the share of women holding college degrees or higher, from 11.9% in 1990 to 72.0% in 2020, alongside a steep decline in those with primary or lower secondary education, from 48.9% to 1.2%. The growing share of highly educated women, who tend to have lower marriage and fertility rates, has contributed significantly to the overall decline in these rates. In addition, marriage rates have declined across all educational groups, with the steepest decline observed among college graduates, further reinforcing the downward trend in fertility rates.

[Insert Table 1 here]

Compositional analysis indicated that approximately two-thirds of the decline in marriage rates between 1990 and 2020 can be attributed to differences in marriage rates across educational groups, along with dramatic shifts in the population distribution across these groups. These differences reflect the underlying factors that make college-educated women more likely to delay or forgo marriage compared to their non-college-educated counterparts, including the higher opportunity costs of childbearing and child-rearing, as well as the greater time and effort involved in partner selection. The remaining one-third of the decline in marriage rates is explained by changes within educational groups over time. Collectively, these patterns highlight the dual role of education, which reshapes the pool of marriageable individuals while simultaneously altering the incentives and constraints that shape family formation.

While educational expansion has contributed to declining marriage rates, fertility conditional on marriage has remained relatively stable across educational groups over time. Table 1 illustrates that once married, women with secondary or tertiary education did not significantly reduce the number of children they had between 1990 and 2020. Women with higher secondary education had an average of 1.90 children in 2020 compared to 1.83 in 1990, whereas women with college or university degrees maintained an average of 1.7 children over the same period. This suggests that the decline in fertility rates among married women

lower-secondary, higher-secondary, and college (or higher) education, respectively. This suggests that among married women with at least a secondary education, the average number of children is similar when comparing the full adult group (15 and over) to the subset aged 25–49.

was driven primarily by shifts in the overall educational composition of the female population rather than by changes in fertility behavior within individual educational groups.

C. Female Labor Market Participation and Gender Constraints

Rapid economic growth has expanded employment opportunities, particularly for women. Figure 5 illustrates the life-cycle employment rates by sex for 2000 and 2023, indicating substantial increases in female employment across all age groups. The overall female labor force participation rate rose from 48.8% in 2000 to 55.6% in 2023, driven largely by the growing share of highly educated women and their greater participation compared to less-educated women (Table 2).

[Insert Figure 5 here]

[Insert Table 2 here]

Women's labor market participation significantly shapes their marriage and fertility decisions. After marriage, women typically assume primary responsibility for household chores and childcare, while also facing rigid workplace structures that hinder work–life balance. Employment rates exhibit an M-shaped pattern, with a significant drop in the 30s owing to career interruptions related to marriage or childbirth, followed by a rebound in the 40s. The decline during childbearing years is especially pronounced in Korea and Japan, where traditional gender roles remain deeply entrenched despite rising female labor participation.

Despite considerable progress toward gender equality in the workforce, substantial gender gaps persist in labor market participation. Figure 5 shows that female employment rates lag considerably behind male rates across all age groups, except among those aged 24–29. Table 2 further demonstrates that Korean women have lower employment rates across all educational levels. Additionally, women are more likely than men to work part-time rather than full-time, and continue to face persistent wage inequality. The gender wage gap, measured as the ratio of women's to men's median wages, narrowed over time but remained substantial, increasing from 0.53 in 1992 to 0.71 in 2025 (OECD, 2024). These labor market barriers, especially during prime childbearing years, directly influence marriage and fertility decisions, particularly among highly educated women facing high opportunity costs.

D. Rising Marriage-related and Child-Rearing Costs

Alongside rising personal incomes, Koreans have faced escalating marriage-related costs, such as weddings and housing, as well as child-rearing expenses, particularly private education, which impose a significant financial burden on young individuals and couples. Marriage expenses are considerably high in Korea, where wedding ceremonies are typically held in commercial venues and newlyweds typically set up independent households, incurring substantial costs for housing deposits (under the *Jeonse* system), furniture, and appliances. This shift, coupled with rising housing prices, has significantly increased the cost of family formation.[2] Between 2003 and 2022, average apartment prices grew by 3.04% nationwide and by 3.3% in the Seoul metropolitan area, exceeding the average annual consumer price inflation rate of 2.45% (Statistics Korea, 2024).

The rising cost of education has also imposed significant financial pressure on Korean parents, who typically enroll their children in expensive private tutoring services during the preschool, primary, and secondary school years (Anderson & Kohler, 2013; Hwang, 2023; Kim et al., 2024). A strong societal emphasis on academic achievement has further driven the demand for such services, as parents seek to enhance their children's chances of admission to prestigious universities. From 2007 to 2022, average household spending on private education per child grew by 4.12% annually nationwide and by 4.94% in Seoul, consistently outpacing inflation (Statistics Korea, 2024).

Figure 6 illustrates how these costs are related to fertility, exhibiting a strong negative association between TFR and two key costs—real apartment prices and per-child private education spending—across 31 regions in 2020.[3] The regions are classified into a capital city, six metropolitan cities, 14 large cities with populations exceeding 500,000, the city of Sejong, and nine provinces.[4] Considerable regional disparities in fertility rates can be observed; metropolitan cities such as Seoul and Incheon exhibit low TFR, whereas provinces, such as Jeonnam and Jeonbuk, tend to have relatively higher rates. Sejong has the highest TFR,

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[2] According to a 1997 survey by the Korea Consumer Agency, the average wedding cost per couple was KRW 36.8 million, rising to KRW 75.4 million when housing was included—equivalent to 35 months of the average urban worker's salary. These costs were significantly higher than in the US (4.8 times monthly salary) and Japan (3.3 times). Since the 1990s, marriage costs have outpaced income growth, and a large share of these expenses is often borne by the parents.

[3] Refer to Online Appendix A for details on how real apartment prices and per-child private education expenditures were constructed.

[4] Refer to Footnote 2 in Online Appendix A for the classification of the regions.

likely because most of its residents are civil servants employed in government positions, which offer relatively stable job security and a better work–life balance.

[Insert Figure 6 here]

Figure 6a illustrates the negative relationship between TFR and apartment prices. Seoul stands out as an extreme case with the lowest TFR and highest apartment prices. In contrast, Sejong records the highest TFR despite ranking among the regions with the highest apartment prices. Figure 6b highlights a similar pattern for private education spending; regions such as Seongnam and Seoul combine high costs with low fertility, while Sejong maintains the highest fertility rate despite incurring the highest per-child education expenditure.

Rising economic burdens from housing and private education compound the already substantial financial and opportunity costs of family formation, particularly for highly educated individuals who face higher career trade-offs and invest more intensively in their children.

E. Gender Norms and Family Formation

Despite substantial advancements in women's educational attainment and labor force participation, traditional gender norms continue to exert a strong influence on family formation and intrahousehold dynamics in Korea. After marriage, women are largely expected to assume primary responsibility for housework and childcare regardless of their employment status.

According to the Organisation for Economic Co-operation and Development Time Use Database (OECD, 2025), Korean women aged 15–64 spend an average of 215 minutes per day on unpaid household labor, such as childcare, cooking, and cleaning, compared with only 49 minutes for men. This imbalance places a dual burden on women, who must navigate both professional and caregiving responsibilities, often at the expense of career advancement and personal well-being.

Despite an increase in dual-earner households, societal expectations continue to demand that mothers fully dedicate themselves primarily to childcare. Survey data underscore the persistence of conservative gender norms. According to the World Values Survey (Haerpfer et al., 2022), 64.7% of Korean respondents agreed or strongly agreed with the statement, "When a mother works for pay, the children suffer," more than double the rate in the United States (30.7%). This belief is prevalent among Koreans aged 18–53, with no significant gender differences; however, support is notably lower among unmarried and college-educated women. For example, only 52.7% of unmarried college-educated women agreed with the statement compared to 69.3% of their married counterparts, highlighting a growing divergence in gender role attitudes by marital status and educational attainment.

This disconnect between evolving aspirations and traditional norms generates significant role conflict for women, particularly those with higher education. The expectation to prioritize caregiving responsibilities despite professional accomplishments imposes a psychological burden, often leading to delayed or forgone marriage and lower fertility. These pressures are intensified by inflexible workplace structures and limited institutional support, reinforcing Korea's distinctive "M-shaped" pattern of female employment—with a steep drop during childbearing years and only partial recovery thereafter (Figure 5).

Educational attainment plays a critical role in shaping marriage patterns. Strong preferences for educational homogamy or hypergamy, where women seek partners with equal or higher levels of education, reduce the pool of potential spouses for highly educated women, thereby raising the costs of spousal search (Mare, 1991; Park & Smits, 2005). According to KLIPS (1998–2020), 87.2% of college-educated women married men with a college degree or higher, compared to 62.5% of college-educated men. This asymmetry contributes to delayed marriage or non-marriage, particularly among highly educated women who seek partners supportive of gender-equal domestic roles and compatible with personal and professional aspirations. Indeed, the marriage rate among university-educated women aged 25–49 declined from 80.5% in 1990 to 60.6% in 2020, even as their share of the population increased (Table 1). These patterns reflect the broader gendered opportunity costs associated with family formation, shaped by both institutional constraints and persistent cultural expectations.

These findings motivate the model's explicit incorporation of gender-specific search frictions, unequal intrahousehold time allocations, and higher marriage and fertility reservation thresholds among college-educated women. In particular, the model captures the opportunity costs arising from asymmetric caregiving burdens and labor market penalties associated with childbirth.

2.2. Determinants of Marriage and Childbirth: Evidence from Panel Microdata

To motivate the model's key mechanisms, the determinants of marriage and childbirth are estimated using longitudinal data from KLIPS spanning 25 waves from 1998 to 2022. It is a nationally representative panel survey of 5,000 urban households and 13,317 individuals aged 15 and older, providing detailed information on both individual characteristics and household-level variables.

Individual-level data are augmented with regional indicators, including average apartment prices, private education expenditure per child, and the ratio of college-educated women aged 20–44 to men aged 25–49. These variables capture the key dimensions of the costs associated with marriage and child-rearing, as well as spousal search frictions arising from imbalances in the marriage market.

The analysis draws on two distinct samples. For first marriage, the sample is restricted to never-married individuals aged 18–53, yielding 81,337 person–year observations for 7,616 unmarried individuals across 25 survey waves. For childbirth, the sample consists of ever-married women in the same age range, comprising 22,803 person–year observations for 2,114 married women across the survey waves. Online Appendix A presents further details on the sample construction, variable definitions, and summary statistics.

Discrete-time hazard models were estimated to assess the determinants of first marriage and childbirth. Following Fukuda (2013) and Chang et al. (2024), a complementary log–log (CLL) specification was adopted to account for the asymmetric distribution of transition probabilities over time. The baseline hazard is modeled as a quadratic function of age, and covariates include lagged income and employment status, education, parental homeownership, and regional-level controls such as child education costs, housing prices, and the sex ratio of college-educated adults. For childbirth analysis, the timing of marriage was controlled by including a dummy variable for the marriage year and the preceding year, allowing for control of pre-marriage conditions that may influence childbirth decisions differently from those arising after marriage.

Table 3 presents the estimated probabilities of first marriage by sex. The likelihood of marriage increases with age but begins to decline after the mid-30s. Education plays a significant role in determining the incidence of the first marriage. As shown in Column (2), school enrollment is significantly and negatively associated with women's likelihood of marriage, suggesting that academic commitments tend to delay marital decisions. Interestingly, the relationship between educational attainment and marriage likelihood differs by sex; higher education increases the probability of marriage for men but reduces it for women. This pattern is consistent with previous studies suggesting that highly educated women often prioritize career aspirations over marriage. It may also reflect the greater time Korean women spend searching for compatible partners.

[Insert Table 3 here]

Income is a significant and positive determinant of marriage for both sexes, as shown in Columns (1) and (2), whereas employment status shows mixed results. For men, employment is negatively associated with marriage, while the effect is not statistically significant for women. Parental homeownership is positively associated with men's likelihood of marriage, consistent with traditional post-marital living arrangements.

The association between regional apartment prices and marriage likelihood also differs by sex. For women, higher apartment prices significantly reduce the probability of marriage, suggesting that increased financial burden contributes to delayed family formation. In addition, the regional ratio of college-educated women to men is negatively associated with the likelihood of marriage for both sexes, highlighting the role of search frictions and educational imbalances in the marriage market.

Table 4 presents the estimation results for the likelihood of first childbirth among married women. The probability of childbirth increases with age, peaking around 26, before declining. Educational attainment plays a significant role in fertility decision-making. As shown in Column (1), women with junior college or university education are more likely to have their first child than those with a high school education or less. This pattern may reflect that women who delay childbirth for educational reasons tend to have children shortly after marriage.

[Insert Table 4 here]

Employment status exhibits a strong negative association with childbirth, likely reflecting the opportunity costs of child-rearing for employed women and the challenges of balancing work and family life in Korea. Women's individual income is not a significant determinant of childbirth, whereas household income and homeownership positively influence fertility, underscoring the importance of household-level economic security. Financial assets are not significantly associated with childbirth.

Finally, region-specific child education expenses are significantly and negatively associated with the likelihood of first childbirth, suggesting that perceived financial burdens associated with raising children may discourage fertility.

An additional survival analysis was conducted using two distinct cohorts, an "older" cohort (born 1969–1983) and a "younger" cohort (born 1984–1998), to examine generational shifts in marriage and fertility patterns. The main findings are consistent across both cohorts. However, for younger women, the negative effects of college education and housing prices on marriage appear more pronounced, whereas the positive effects of household income on childbirth are stronger. Tables A3 and A4 in Online Appendix A present the full results.

These empirical observations directly motivate several key features of the macroeconomic models. In particular, the asymmetric effects of education on marriage by gender support the assumption that college-educated women face systematically higher spousal search costs in the marriage market, especially under conditions of educational imbalance and greater disutility from prevailing gender norms within the household. The strong positive association of household income and homeownership with both marriage and childbirth underscores the role of financial stability and housing resources in family formation, consistent with the model's structure in which marriage and fertility entail both opportunity costs and direct expenditures. The negative effect of private education costs on fertility supports the inclusion of child-rearing and educational investment in the household utility function. Additionally, the negative association between female employment and childbirth underscores the importance of incorporating time-allocation constraints when modeling mothers' labor supply and fertility decisions.

Collectively, the stylized facts and empirical results from the microdata analysis of marriage and childbirth inform the model's specifications of spousal search costs, fertility timing, and household decision-making under binding financial and time constraints.

3. The Macroeconomic Model

A dynamic general equilibrium model with overlapping generations was developed to examine how marriage, fertility, and gender inequality interact with economic incentives and constraints. Individuals progress through three stages—childhood, adulthood, and retirement—being born in period t-1, entering the labor market in period t, and retiring in period t+1. During adulthood, they make key decisions regarding family formation, savings, and investments in the next generation. While all adults share the same innate ability and labor endowment, they differ in their likelihood of forming families and in education and labor market outcomes.

The model follows the structure of de la Croix and Doepke (2003), Kim et al. (2016), and Agénor (2017) while introducing several innovations motivated by the empirical patterns documented in Section 2.

A key feature of the model is the endogenous marriage decision, influenced by education, search frictions, gender norms, and intra-household dynamics. The model also incorporates asymmetries in how men and women experience the costs and benefits of marriage and childbearing, particularly for college-educated women, who face higher spousal search burdens and greater disutility from unequal household arrangements. Time and financial constraints shape fertility and human capital transmission, respectively. These household-level behaviors are embedded within a macroeconomic environment that includes production, savings, and government policy.

This framework enables the analysis of how socio-economic changes, gender norms, and economic constraints jointly shape long-run demographic and economic outcomes in a context such as Korea, characterized by ultra-low fertility, high educational attainment, and growing gender inequality concerns.

3.1. Marriage

Marriage brings happiness, but also entails significant costs, including spousal search costs, such as the time and effort involved in meeting, dating, and choosing a partner, and marriage-related expenses, encompassing wedding and household setup costs.

Marriage formation is modeled as a probabilistic outcome determined by costly search. At the onset of adulthood, individuals begin searching for a partner, attaining either a “married” or “unmarried” status. According to the marriage search model, individuals decide to marry when they encounter a partner whose perceived value exceeds a predetermined reservation value; otherwise, they remain unmarried. A greater willingness to invest in marriage-related costs increases the probability of family formation.

For simplicity, marriage is assumed to be a prerequisite for having children, reflecting the Korean context, where only 3.9% of births occur outside of marriage. Furthermore, decisions about family formation and subsequent household choices are modeled under rational expectations.

Upon entering adulthood, individuals allocate a fraction $\lambda(p_t)$ of their human capital (e_t) to searching for a partner, which determines the probability of a successful match $p_t \in [0,1]$. They maximize expected lifetime utility:

$$W_t = p_t V_M^e(t) + (1 - p_t) V_S^e(t) - M\big(\lambda(p_t)\big) \quad (1)$$

where $V_M^e(t)$ and $V_S^e(t)$ represent the expected lifetime utilities when married or single, respectively, and the term $M\big(\lambda(p_t)\big)$ denotes the search cost function.

The expected utility from marriage $V_M^e(t)$ is determined by intra-household bargaining between spouses. Specifically, married household utility is defined as the weighted average of individual utilities, with bargaining power determined endogenously from relative income and gender norms:

$$V_M^e(t) = \Theta_t V_M^{m,e}(t) + (1 - \Theta_t)\, V_{M,j}^{f,e}(t), \quad j = c, nc \tag{2}$$

where$V_M^{m,e}$ denotes the expected individual lifetime utility for men, assumed to be independent of their education level. In contrast, $V_{M,j}^{f,e}$ represents the expected lifetime utility of women, which varies by education level j, where $j = c$ indicates college-educated women, while $j = nc$ indicates non-college-educated women. The bargaining power of the male $\Theta_t \in (0,1)$ is determined as:

$$\Theta_t = \frac{e_t^m w_t^m}{e_t^m w_t^m + \frac{1}{\gamma} e_t^f w_t^f}, \ \gamma \geq 0 \tag{3}$$

where w_t^m and w_t^f represent the market wages of adult men and women, respectively. The parameter γ captures the extent to which gender norms affect household bargaining. A higher γ reduces the effective weight placed on women's income, reflecting more conservative or patriarchal norms that weaken women's influence over household decisions. When γ=1, bargaining weights correspond to relative income shares. When γ<1, women's income plays a larger role in household bargaining. As Doepke and Tertilt (2019) noted, the equilibrium allocation in the non-cooperative household model resembles a Nash bargaining solution, where the outcome depends on each partner's ability to provide public goods shaped by their outside options and specialization within the household.

The search cost is expressed as the utility cost of foregone consumption (Ehrlich & Kim, 2007):

$$M\big(\lambda(p_t)\big) = \frac{1}{1-\sigma}\left[\big(1 - \lambda(p_t)\big)e_t\right]^{1-\sigma} \quad \sigma > 0 \tag{4}$$

We assume the specific form of λ(p):

$$\lambda(p_t) = \xi p_t^{\varepsilon}, \ \xi > 0, \ \varepsilon > 1 \tag{5}$$

It captures increasing and convex search costs. This cost-based approach to marriage formation shares structural similarities with targeted search models, such as those by Smith (2006) and Cheremukhin et al. (2024), where the effort to locate a desirable match increases nonlinearly with targeting precision or matching intensity.

Optimization involves a two-step backward procedure. First, the expected lifetime utilities V_M^e and $V_S^e(t)$ are maximized conditional on being either a successfully married parent or remaining unmarried and childless. Second, the marriage decision is made based on this optimization.

In line with the foundational framework of the economic theory of marriage, marriage is assumed to yield higher utility than remaining single, as individuals derive additional utility from childbearing, which typically occurs within the context of marriage.

Given the solutions for expected lifetime utilities $V_M^*(t)$ and $V_S^*(t)$, the optimal probability of marriage p_t is determined by maximizing Equation (1) with respect to p_t.[5] For married males, the first-order optimality condition is:

$$V_M^*(t) - V_S^{m*}(t) = [1 - \lambda(p_t)]^{-\sigma} \lambda'(p_t) {e_t}^{1-\sigma} \tag{6}$$

where $V_S^{m*}(t)$ denotes the expected individual lifetime utility for unmarried men. This condition equates the marginal benefit of p_t—the utility differential from being married rather than remaining unmarried—to the marginal cost of p_t, that is, the marginal opportunity cost per unit of human capital. Optimal p_t is positive and unique because the term on the right increases with p_t.

Although adult males determine their marriage probability according to Equation (6),[6] females face different expected utilities and marriage-related costs depending on their educational level. In Korea, highly educated women often have higher reservation values. To reduce uncertainty and economic instability after marriage, individuals prefer partners with strong social and financial credentials such as higher education, stable employment, and financial security. As women attain higher levels of education and well-paid jobs, the pool of suitable male partners narrows. Consequently, college-educated women

[5] While this model assumes that both marriage-related decisions and post-marriage household behavior are determined collectively, one could alternatively model marriage-related decisions based on individuals' expected utility—for example, allowing women to compare their anticipated utility from marriage versus remaining single. However, since the household utility function already embeds female preferences via bargaining weights, and the model further introduces a direct disutility term ($\kappa_j \gamma$), as explained in Section 4.2, to capture aversion to family formation under persistent gender inequality—especially among highly educated women—the key qualitative results regarding lower marriage probabilities for this group remain robust to this structural simplification.

[6] While household utility varies with the spouse's education through the female partner's utility, the expected household utility from the male perspective can be expressed as a weighted average over the female education distribution. Therefore, aggregating over all optimizing males yields the same outcome as solving for a representative male agent.

must invest greater search effort, in both time and resources, in finding a partner meeting their reservation standards, leading to systematically higher search costs. In addition, college-educated women face higher spousal search costs than their non-college-educated counterparts due to their preferences for educational homogamy or hypergamy and the resulting educational imbalances in the adult population. Moreover, marriage-related expenses vary significantly based on educational attainment, and tend to be higher for college-educated women.

It is assumed that both the marriage probability and marriage-related cost terms for unmarried, non-college-educated women follow the same functional form as those for unmarried men. In contrast, college-educated women face higher spousal search costs due to their preference for educational homogamy and the structural imbalance in the marriage market. The probability of a successful marriage for unmarried college-educated women is given by $p_{ct} = p(\lambda,\ \Psi)$ where Ψ denotes the ratio of college-educated women aged 20–44 relative to college-educated men aged 25–49. This captures the demographic imbalance in the matching pool, reflecting the tendency of men to marry later than women owing to factors such as military service and delayed labor market entry. Consistent with search-and-matching theory, the probability of a successful match depends on the relative number of available partners. A higher Ψ implies greater competition among women, reducing match probabilities and raising the marginal cost of achieving a given match probability for college-educated women, thereby increasing their search effort.

Accordingly, the search cost function becomes:

$$\lambda(p_{ct}) = \xi_c p_{ct}^{\varepsilon}\, \Psi^{\omega},\ \ \xi_c > 0,\ \varepsilon > 1,\ \omega > 0 \tag{7}$$

where ω indicates the elasticity of search cost with respect to educational imbalance. A higher ω reflects greater difficulty faced by college-educated women in finding suitable partners, given their matching preferences and social expectations.

The first-order optimality condition for female adults with *j*-level educational attainment is:

$$V_{M,j}^{f*}(t) - V_s^{f*}(t) = [1 - \lambda_j(p_{jt})]^{-\sigma} \lambda_j'(p_{jt})\, e_{jt}^{1-\sigma},\ j = c, nc \tag{8}$$

where $V_s^{f*}(t)$ denotes the expected individual lifetime utility for unmarried women. Under the assumption $\xi_c \Psi^{\omega} > \xi_{nc}$, college-educated women face higher marginal search costs.

In addition, since college-educated women are assumed to experience greater disutility from intra-household inequality than non-college-educated women, their optimal marriage probability p_{ct} would be strictly lower than that of their less-educated counterparts p_{nct}. The average probability of marriage for all adult females is:

$$p_t^e = \psi_c^f p_{ct}^e + (1 - \psi_c^f) p_{nct}^e \tag{9}$$

where ψ_c^f indicates the share of women with college education or higher.

In equilibrium, the ex-ante marriage probability for males p_t (determined via Equation (6)) must equal the average female marriage probability p_t^e (determined via Equations (8) and (9)). This ensures that the number of matches formed equals the number of willing partners on both sides. Therefore, this model mirrors the equilibrium logic of search-and-matching frameworks such as Smith (2006), in which match rates are jointly determined by endogenous search behavior, preferences, and group-specific frictions. In equilibrium, this implies that fewer college-educated women marry not only because of preferences or norms, but also because the structural composition of the matching pool systematically reduces their match probabilities.

3.2 Household Utility and Income

It is assumed that individuals derive utility from marriage and family formation, but the perceived utility of being married is shaped not only by consumption and children, but also by the social context in which marriage occurs. In particular, women may anticipate that marriage entails intra-household inequality driven by prevailing conservative family norms, such as unequal division of labor, reduced autonomy, and limited bargaining power. While these institutional norms apply to all couples, the model allows heterogeneous responses by educational level to reflect differences in values, expectations, or tolerance for inequality.

To capture this, the study introduces a utility penalty from marrying into a gender-unequal institution, borne only by the female spouse.[7] Specifically, the utility of each spouse in a married household over

[7] The structure assumes that the disutility from intra-household inequality, represented by $\kappa_j \gamma$, is fully subtracted from the woman's individual utility. Since married household utility is a weighted average of individual utilities, this disutility enters the total household utility only with a weight of $(1 - \Theta_t)$. This setup is internally consistent and highlights a key implication: women with lower bargaining power—reflected in lower $(1 - \Theta_t)$—experience a smaller share of household utility and are therefore more likely to forgo marriage due to the inequality burden.

lifetime consumption and children is defined as follows:[8]

$$V_M^m(t) = \eta_c \frac{1}{1-\sigma}\left({c_t^M}^{1-\sigma}\right) + \eta_e\left[\frac{1}{1-\sigma}\left(\left(\frac{\pi_c n_t}{2}\right)^{\delta} e_{t+1}^m\right)^{1-\sigma} + \frac{1}{1-\sigma}\left(\left(\frac{\pi_c n_t}{2}\right)^{\delta} e_{t+1}^f\right)^{1-\sigma}\right] + \beta\pi_A\left(\frac{1}{1-\sigma}{c_{t+1}^M}^{1-\sigma}\right) \tag{10}$$

$$V_{M,j}^f(t) = \eta_c \frac{1}{1-\sigma}\left({c_t^M}^{1-\sigma}\right) + \eta_e\left[\frac{1}{1-\sigma}\left(\left(\frac{\pi_c n_t}{2}\right)^{\delta} e_{t+1}^m\right)^{1-\sigma} + \frac{1}{1-\sigma}\left(\left(\frac{\pi_c n_t}{2}\right)^{\delta} e_{t+1}^f\right)^{1-\sigma}\right] + \beta\pi_A\left(\frac{1}{1-\sigma}{c_{t+1}^M}^{1-\sigma}\right) - \gamma\kappa_j V_s^f(t), \qquad j = c, nc \tag{11}$$

where c_t^M (and c_{t+1}^M) represents the total consumption of married households during parents' adulthood (and retirement) at time t (and t+1), respectively;[9] n_t is the number of children (half sons and half daughters); and e_{t+1}^m (e_{t+1}^f) denotes the education level of sons (daughters), which determines the efficiency of male (female) adult workers at t+1. The parameter $\beta = \frac{1}{1+\rho}$ is the time discount factor, where $\rho > 0$. σ^{-1} is the intertemporal elasticity of substitution, π_c is the child survival probability,[10] and π_A is the probability of surviving from adulthood to retirement. The coefficients η_c and η_e represent the relative preferences for consumption and children, respectively. The parameter δ measures the elasticity of parental utility with respect to the (ideal) number of children, conditional on child quality being held constant.

The term γ in Equations (3) and (11) captures the intensity of gender-unequal norms in marriage. The parameter $\kappa_j \geq 0$ reflects female education-specific sensitivity to such norms. Specifically,

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[8] This form of utility is commonly used under the assumption that parents derive direct utility from the characteristics of their children—namely, their number and quality—rather than from the children's utility itself (Becker & Lewis, 1973). An alternative approach would be to model altruistic preferences or intergenerational utility transmission, as in Becker and Barro (1988), which is more suitable for analyzing welfare implications of policies such as education subsidies or intergenerational inequality. However, since this study does not focus on welfare analysis, the current specification is appropriate for its purposes.

[9] In the model, a retired adult does not engage in market production, child education, or child-rearing and derives utility solely from consumption.

[10] The child survival rate refers to the probability of surviving from birth to age five. In Korea, this probability reached nearly 100% by 2023, with a child mortality rate of just 3 per 1,000 live births. This marks a significant improvement from earlier decades: the mortality rate was 99 in 1960, 61 in 1970, and 14 in 1992. The sharp decline in child mortality, along with family planning policies, likely contributed to the steep decline in fertility rates during the 1970s and 1980s.

$\kappa_j V_s^f(t)$ reflects the utility penalty from marrying under a gender-unequal environment, expressed relative to the utility of remaining single. That is, disutility is modeled from intra-household inequality as a proportional loss of utility that a woman would have enjoyed had she remained single. It is assumed that $\kappa_c > \kappa_{nc}$, implying that college-educated women experience greater disutility from intra-household inequality than their less-educated peers. For simplicity, the study sets $\kappa_{nc} = 0$, so that less-educated women remain unaffected by household inequality in terms of utility.

It is assumed that married women allocate their time to three activities: market production, child-rearing, and child education. Formally, the time constraint is:

$$h_t^w + h_t^R + h_t^e = 1 \tag{12}$$

where h_t^w represents the time allocated to market production, h_t^R reflects child-rearing, and h_t^e represents child education. For simplicity, leisure time is set to zero, and home production activities (e.g., cooking, cleaning, caring for children) are bundled into "child-rearing" time.

Each child requires a total of $2v$ units of rearing time, with both parents ideally contributing v each. In practice, however, married women may devote more time to child-rearing (and home production), driven by biological factors—such as pregnancy or breastfeeding—or reduced bargaining power within the household. Accordingly, it is assumed that men allocate less time to child-rearing than women:

$$h_t^{mR} = \theta v \pi_c n_t, \;\; 0 < \theta \leq 1 \tag{13}$$

where h_t^{mR} is the married male adult's time allocated to child-rearing. It is assumed that θ is determined through intra-household bargaining and social norms. The study considers $\theta \leq 1$, reflecting gender inequality at home in Korea. Consequently, the time allocated to child-rearing by the mother is given by $h_t^R = (2-\theta) v \pi_c n_t$.

It is assumed that $2\epsilon_t^e$ is the total time spent on child education, equally divided between the mother and father. The female adult allocates her education time between sons $0 < b < 1$ and daughters $1 - b$. It is also assumed that male adults allocate the same proportion of their time to child education as females.

Therefore, the time constraint faced by married female adults is as follows:

$$h_t^w + (2-\theta) v \pi_c n_t + \pi_c n_t \epsilon_t^e = 1 \tag{14}$$

The married household's budget constraint at t and t+1 is:[11]

$$c_t^M + s_t^M = (1 - \tau_t - x_t)w_t^H$$

$$\pi_A c_{t+1}^M = (1 + r_{t+1})s_t^M + z_{t+1}$$

where $\tau \in (0,1)$ is the tax rate, s_t^M is saving, r_{t+1} the interest rate between t and t+1, and w_t^{H} total gross wage income. x_t denotes the social security contribution, and z_{t+1} is the average level of social security benefits.

Total gross wage income for the married household, w_t^H, is given as:

$$w_t^H = e_t^m h_t^{mw} w_t^m + e_t^f h_t^w w_t^f$$

$$= e_t^m(1 - \theta v \pi_c n_t - \pi_c n_t \epsilon_t^e)w_t^m + e_t^f(1 - (2 - \theta)v\pi_c n_t - \pi_c n_t \epsilon_t^e)w_t^f \quad (15)$$

where $h_t^{mw} = 1 - h_t^{mR} - h_t^{me}$ is the time allocated by the male to market production. In this expression, $e_t^m h_t^{mw}$ and $e_t^f h_t^w$ measure labor supply by married male and female adults in efficiency units, respectively, and w_t^m and w_t^f indicate the market wages for male and female adults.

The married household maximizes the utility from marriage, $V_M(t)$, in Equation (2), which is determined by intra-household bargaining between spouses, with respect to $c_t^M, c_{t+1}^M, \epsilon_t^e$, and n_t, subject to the constraints. The first-order conditions for c_t^M and c_{t+1}^M imply that:[12]

$$\left(\frac{c_{t+1}^M}{c_t^M}\right)^{\sigma} = \eta_c^{-1}\beta(1 + r_t) \quad (16)$$

The saving rate is derived as follows:

$$SR_t = 1 - \frac{1}{1 + \frac{\pi_A}{1+r_{t+1}}(\beta(1+r_{t+1}))^{1/\sigma}}\left[1 + \frac{\hat{z}_{t+1}}{(1+r_{t+1})}\right] \quad (17)$$

where $\hat{z}_{t+1}$ indicates the ratio of social security benefits to net disposable income, that is, $\hat{z}_{t+1} \equiv \frac{z_{t+1}}{(1-\tau_t - x_t)w_t^H}$.

[11] It is assumed that the government collects the savings of those who do not survive and uses them for unproductive purposes.

[12] Refer to Online Appendix B for the derivation of the first-order conditions and other equations discussed in this section.

The first-order condition for n_t, presented in Online Appendix B, implies that married households determine their fertility by weighing the utility gained from having a child against the utility forgone in current consumption due to the time required for childcare.

The utility function for unmarried individuals at time *t* is:[13]

$$V_S(t) = \frac{1}{1-\sigma}\eta_c({c_t^S}^{1-\sigma}) + \beta\pi_A(\frac{1}{1-\sigma}{c_{t+1}^S}^{1-\sigma})$$

It is assumed that for single individuals, a fraction h^u of total time is allocated to non-market home production activities (e.g., housework, food preparation, personal care), while the remaining $1-h^u$ is allocated to market work. The study assumes $h_u \equiv u \in [0,1]$ and considers it as exogenously given. This assumption is based on data from Statistics Korea (Economically Active Population Survey) and the International Labour Organization (2024), which show that unmarried men and women aged 25–54 had similar labor force participation rates of approximately 80% over the period 2000–2023. Therefore, for both single females and males:

$$h_t^{mw} = h_t^m = 1 - h^u = 1 - u, \;\; 0 < u < 1 \tag{18}$$

An unmarried individual's budget constraints at t and t+1 are:

$$c_t^S + s_t^S = (1 - \tau_t - x_t)w_t^s$$

$$\pi_A c_{t+1}^S = (1 + r_{t+1})s_t^S + z_{t+1}$$

where w_t^s denotes the total gross wage income of a single household, which can be either male or female. It is assumed that firms do not differentiate between married and unmarried individuals during production. Unmarried male or female adults receive the same wages as their married counterparts:

$$w_t^S = e_t^m w_t^m(1-u) \text{ or } e_t^f w_t^f(1-u)$$

If the first-order conditions of the unmarried individual are solved, the savings rate of the unmarried individual is similar to that of the married household, as shown in Equation (17).

[13] The utility function for unmarried individuals is written in a representative form for notational simplicity. However, c_t^S and c_{t+1}^S are determined by each individual's wage income, which differs by gender. As such, utility levels $V_S(t)$ may differ between men and women, even though the functional form is unified.

Korea's national pension system combines elements of both pay-as-you-go (PAYG) and funded models, requiring contributions from both employees and employers.[14] The benefits are calculated based on contributions and include a redistribution component. For simplicity, it is assumed that only children born to married individuals contribute to social security, and that parents expect to receive an average amount of benefits from the contributions of these children. Therefore, the ratio of social security benefits to net disposable income $\hat{z}_{t+1}$ equals ${\pi_A}^{-1} p_t n_t x_t$.

3.3 Human Capital Accumulation

Children's educational level, which determines their productivity as adults, is influenced by three factors: the average government spending on education per child, parents' human capital (e_t^f and e_t^m), and the time parents devote to each child.[15] It is assumed that the time spent by the mother and father is perfectly substitutable. However, their human capital stocks are combined in a Cobb–Douglas functional form, where χ and $1-\chi$ are the output elasticities of female and male human capital, respectively.

$$e_{t+1}^m = \bar{e}_t \left(\frac{\mu G_t}{\frac{\pi_C n_t N_t}{2}} \right)^{v_1} \left[\left(e_t^f\right)^{\chi} (e_t^m)^{1-\chi} \right]^{1-v_1} (2b\epsilon_t^e)^{v2} \tag{19}$$

$$e_{t+1}^f = \bar{e}_t \left(\frac{\mu G_t}{\frac{\pi_C n_t N_t}{2}} \right)^{v_1} \left[\left(e_t^f\right)^{\chi} (e_t^m)^{1-\chi} \right]^{1-v_1} (2(1-b)\epsilon_t^e)^{v2} \tag{20}$$

where G_t is total government educational spending, μ represents the efficiency of government spending, N_t is the number of individuals of generation *t*, and $\overline{n_t}$ is the average number of children per household. Under the representative household assumption, $\overline{n_t} = n_t$ holds in equilibrium. Parameter $\bar{e}_t$ captures the exogenous institutional and technological factors that affect the productivity of human capital formation. In this model, human capital and per capita output grow at the same rate along a balanced growth path.

[14] Korea's National Pension Service (NPS) was established in 1988. Salaried employees contribute 9% of their monthly income to the fund, split equally between the employee and employer. While the NPS has PAYG elements, it is partially funded. A portion of contributions is invested to build a reserve fund, which helps cover future payouts as the population ages and the ratio of retirees to workers rises. Pension benefits are determined based on earnings, years of contributions, and an income redistribution formula, with payouts typically starting at age 60.

[15] The formulae for children's human capital accumulation do not account for private education spending. However, parental time can be interpreted as including private educational investment.

During periods of rapid human capital accumulation and output growth, $\bar{e}_t$ may take on higher values, reflecting systemic improvements in the education system or broader development infrastructure.

3.4 Production

Market output is produced by identical firms, with the number of firms normalized to unity. Each firm's production function is expressed as:

$$Y_t^i = (E_t^m H_t^{mw} N_t^{m,i})^\alpha (E_t^f H_t^w N_t^{f,i})^\alpha (K_t^i)^{1-2\alpha} \quad (21)$$

where $\alpha \in (0,1)$ represents the elasticity of output with respect to male and female effective labor, which is assumed to be the same. The representative firm employs male and female workers whose average labor productivity (education level) is denoted as E_t^m and E_t^f, respectively. The variables H_t^{mw} and H_t^w represent the average time male and female adults allocate to market production, respectively, while $N_t^{m,i}$ and $N_t^{f,i}$ denote the number of male and female workers hired by firm *i*. K_t^i is the capital stock employed by firm *i*.

Taking input prices as given, firms maximize profits by selecting the optimal quantities of male and female workers and capital. Labor market discrimination against female workers is incorporated: while male workers are paid their marginal product, female workers receive only a fraction $d \in (0,1)$ of their marginal product. For simplicity, it is assumed that firms do not transfer profits arising from this discrimination to households. The firm's optimal choices for labor and capital are then determined by the following equations:

$$w_t^m = \frac{\alpha Y_t^i}{E_t^m H_t^{mw} N_t^{m,i}}, \; w_t^f = \frac{d\alpha Y_t^i}{E_t^f H_t^w N_t^{f,i}}, \; r_t = (1-2\alpha)\frac{Y_t^i}{K_t^i} \quad (22)$$

In equilibrium, $N_t^{m,i} = N_t^m$, $N_t^{f,i} = N_t^f$, and $K_t^i = K_t$ for all *i*, and the aggregate output is:

$$Y_t = \int_0^1 Y_t^i = (E_t^m H_t^{mw} N_t^m)^\alpha (E_t^f H_t^w N_t^f)^\alpha (K_t)^{1-2\alpha} \quad (23)$$

At equilibrium, the following equations hold: $e_t^m = E_t^m$, $e_t^f = E_t^f$, $h_t^{Male} = H_t^{mw}$, and $h_t^{Female} = H_t^w$. Note that $h_t^{Male} = p_t h_t^{mw} + (1-p_t)(1-u)$ and $h_t^{Female} = p_t h_t^w + (1-p_t)(1-u)$.

At labor market equilibrium, the gross wage incomes for married males and females are:

$$w_t^m e_t^m h_t^{mw} = d^{-1} w_t^f e_t^f h_t^w \quad (24)$$

Therefore, the total wage income for a married household is:

$$W_t^H = e_t^m h_t^{mw} w_t^m + e_t^f h_t^w w_t^f = (1+d^{-1}) e_t^f h_t^w w_t^f \quad (25)$$

For unmarried individuals, wage income is $(1-u)d^{-1}e_t^f w_t^f$ for males and $(1-u)e_t^f w_t^f$ for females because their work hours are equal to $(1-u)$. Therefore, their average income is:

$$W_t^S = \frac{1}{2}(1+d^{-1}) e_t^f w_t^f (1-u) \quad (26)$$

3.5 Government

The government finances its expenditure on education, G_t, and other purposes, U_t, by taxing wage income.[16] It is assumed that expenditure on other unproductive purposes is proportional to that on education: $U_t = \phi G_t$. Furthermore, the government budget is assumed to be balanced in each period.

$$G_t + U_t = \tau\left(E_t^m H_t^m N_t^m w_t^m + E_t^f H_t^w N_t^f w_t^f\right)$$

where τ is the tax rate of government expenditure.

Using the equilibrium condition in (22):

$$(1+\phi) g_t = \tau\left(E_t^m H_t^m w_t^m + E_t^f H_t^w w_t^f\right) = 2\tau(1+d)\,\alpha \frac{Y_t}{N_t} \quad (27)$$

where $g_t \equiv \frac{G_t}{N_t^f} = \frac{G_t}{N_t/2}$.

Therefore, $(1+\phi)G_t = \tau(1+d)\,\alpha Y_t$.

3.6 Market Clearing and Balanced Growth Path

The competitive equilibrium satisfies the following five conditions:

(i) A married household maximizes its utility with respect to c_t^m, c_{t+1}^m, n_t, h_t^w, h_t^R, and h_t^e.

(ii) The unmarried individual maximizes utility with respect to c_t^s and c_{t+1}^s.

[16] The model can be easily extended to include non-distortionary revenue used for public education expenditures or reallocating unproductive government spending to the education sector. This extension would result in a more positive contribution to economic growth through increased government spending on education.

(iii) The firm maximizes profits with respect to $N_t^{m,i}, N_t^{f,i}$, and K_t^i.

(iv) All markets clear. Specifically, the asset market-clearing condition requires capital stock at the beginning of period (t+1) to equal savings in period (t).

(v) The optimal probabilities of marriage p_t and p_{jt} are determined by first-order optimality conditions (6), (8), and (9).

Total saving S_t in equilibrium is derived as:

$$S_t N_t = SR_t \Phi N_t^f e_t^f [p_t(1-(2-\theta)v\pi_c n_t - \pi_c n_t \epsilon_t^e) + (1-p_t)(1-u)] w_t^f \tag{28}$$

where $\Phi = (1-\tau_t - x_t)(1+d^{-1})$.

From the asset-market-clearing condition:

$$K_{t+1} = S_t N_t = 2\Phi N_t^f SR_t e_t^f [p_t h_t^w + (1-p_t)(1-u)] w_t^f = 2\Phi d\alpha SR_t Y_t \tag{29}$$

In the balanced growth path, it can be verified that $\frac{Y_t}{N_t}$ and $\frac{K_t}{N_t}$ grow at the same rate as e_t^f and e_t^m. Therefore, human capital is key to perpetual growth.

The growth rate of per capita GDP in steady state is:

$$1+\gamma_{Y/N} = \Gamma_1[p^*(1-\theta v\pi_c n^* - \pi_c n^* \epsilon^{e*}) + (1-p^*)(1-u)]^\alpha [p^*(1-(2-\theta)v\pi_c n^* - \pi_c n^* \epsilon^{e*}) + (1-p^*)(1-u)]^\alpha (k_f^*)^{-2\alpha} d\alpha \Phi SR^* (p^* \pi_c n^*)^{-1} \tag{30}$$

where the variables with * denote steady-state values and $k^{f*} = (\frac{K}{e^f N^f})^*$.

4 Calibration and Baseline Steady-State Equilibrium

4.1 Calibration

This study calibrates the parameters of the model presented in Section 3 to reflect the Korean context discussed in Section 2. The parameters are calibrated to match the steady-state equilibrium of the baseline model in 2023, focusing on key variables such as the marriage rate, fertility rate, time allocation, and per capita output growth. The model is then recalibrated to match the corresponding target variables in 1990.

Comparing the calibrated parameters across these two steady-state equilibria enables an assessment of how socio-economic factors have influenced trends in marriage and fertility rates over the past 30 years.

Table 5 summarizes the values of the key target variables—fertility, marriage, labor market participation, savings rate, and per capita output growth—for Korea in 1990 and 2023 (2024 for fertility). Most of these values are sourced from the World Bank's World Development Indicators (2024), the Bank of Korea (2024), and Statistics Korea (2024). Where appropriate, averages from the early 2020s (2020–2023) and the early 1990s (1990–1995) are used to smooth short-term fluctuations.

The most recent fertility rate was 0.75 in 2024, whereas the marriage rate for women aged 25–49 was 0.689 in 2020. Among these women, 72% had a college degree or higher. The marriage rate for college-educated women was 0.636, compared with 0.825 for those without a college degree. Female and male labor force participation rates were 55.6% and 73.3%, respectively. The annual per capita income growth rate was 2.84%, and the household savings rate was 7%.

By contrast, in 1990, Korea exhibited markedly different demographic and economic conditions, as illustrated in Table 5. TFR was 1.570, and the marriage rate for women aged 25–49 was 0.921. The marriage rates for college- and non-college-educated women were 0.798 and 0.937, respectively, with only 11.9% of women in this age group holding a college degree or higher. Female labor force participation was lower (49.9%), whereas male participation was slightly higher (76.2%). Income growth was significantly stronger, with a per capita annual growth rate of 7.19%, and the household savings rate was 16.8%.

[Insert Table 5 here]

The calibration parameters are listed in Table 6. According to Statistics Korea (2024), in 2020, the ratio (Ψ) of college-educated women aged 20–44 to college-educated men aged 25–49 was 0.96. The ratio was significantly lower in 1990, at approximately 0.64.

The years of schooling for women and men are sourced from Barro and Lee's (2013) educational attainment dataset. On average, women aged 25–64 had 97% of the years of schooling of men in 2020, up from 81% in 1990. The value of parameter b in the model is derived from this relationship, defined as $(b/(1-b))^{\nu_2}$=(Average years of schooling for men/Average years of schooling for women). Given the value of ν_2, which is assumed to be 0.3, the value of parameter b is calculated as 0.53 in 2020 and 0.67 in

1990. Since parameter b captures gender bias in education, these two values indicate that with the expansion of women's education, gender bias in education rarely exists in 2020 compared with 1990.

The parameter for gender bias in child-rearing θ is derived as 0.37 in 2023. This value is based on the ratio of time spent by women to men on child-rearing (and home production activities), where $h_t^R / h_t^{mR} = (2-\theta)/\theta = 4.39$. Gender inequality in child-rearing was greater in 1990, with θ = 0.27. Data on the time spent on child-rearing and home production are from the OECD Time Use Database.

[Insert Table 6 here]

For marriage decisions, the bargaining power of the male in the household (Θ_t) is assumed to equal 1−θ, where θ represents the degree of gender bias in child-rearing within the household. The intensity of gender-unequal norms in society (γ) is calibrated using the relationship for 2023 derived from Equation (3), $\gamma = \theta^{-1}\, d(e_t^f / e_t^m)(1-\theta)$, which yields the value of 1.178. The parameter κ_j, which captures women's sensitivity to intra-household inequality, is calibrated to reflect differences by educational attainment. Specifically, it is set to 0.2 for college-educated women and 0 for non-college-educated women.[17]

The child survival rate under five and the survival probability from adulthood (age 25) to retirement (age 59) are calculated using age-specific mortality rates from Statistics Korea (2024).

For market output, elasticity with respect to both male and female labor inputs is assumed to be 0.3. The gender wage gap parameter (*d)* is defined as the ratio of female to male median wages, which was 0.71 in 2023 and 0.53 in 1990 (Table 2).

Regarding the government, the effective tax rate on output (τ) is calculated as the average ratio of tax revenues to GDP—15.7% in 2023 and 13.4% in 1990—sourced from the World Bank database. Based on OECD data, the ratio of social security contribution to GDP was 8.4% in 2023 and 1.9% in 1990 (OECD,

[17] While these values are partially judgmental, they are grounded in survey-based evidence showing that college-educated women—particularly those who are unmarried—exhibit consistently stronger rejection of traditional gender norms. According to the World Values Survey (Haerpfer et al., 2022), only 33.8% of unmarried, college-educated Korean women agreed with the statement that "Being a housewife is just as fulfilling as working for pay," compared to 40.0% of unmarried non-college-educated women and 46.4% of married women. This represents an at least 15–20% lower rate of acceptance of traditional domestic roles among the most progressive subgroup. This attitudinal gap can be interpreted as indicative of greater normative disutility from gender-unequal marriage arrangements among college-educated women. The calibration reflects a moderate but meaningful penalty relative to the baseline of no disutility for less-educated women. This setting provides a conservative approximation of heterogeneous responses to intra-household inequality across educational groups.

2024). The education spending efficiency parameter (μ) and the factor of unproductive, exogenous government expenditure relative to educational expenditure ($\emptyset$) are assumed to be 0.39 and 3, respectively.

Most of the other parameters have the same values for both 1990 and 2023. The preference parameters for consumption (η_c) and for children (η_e) are set to 3.4 and 1.3, respectively. The inverse of intertemporal elasticity of substitution (σ) is assumed to be 0.8. The elasticity of children's human capital with respect to public spending in education (v_1), parents' education time (v_2), and mother's human capital (χ) are assumed to be 0.4, 0.3, and 0.8, respectively. These parameter values are broadly consistent with those used in the macroeconomics and labor economics literature, including Agénor (2017), Kim et al. (2018), de la Croix and Doepke (2003), and Doepke and Tertilt (2019), which emphasize the role of parental investment, public education spending, and intergenerational human capital transmission in shaping fertility and economic growth outcomes. For the marriage decision, the elasticity of spousal search cost with respect to marriage probability (ε) is set to 1.52, following Ehrlich and Kim (2007), while the elasticity of marriage cost with respect to the ratio of college-educated women to men (ω) is set to 0.5.

Some parameters are derived by calibrating the model to match the steady-state values of the target variables. These calibrated parameter values are reported in Table 6 and include rearing time per child (v), education time per child (ϵ_t^e), elasticity of parental utility with respect to the number of children (δ),[18] marriage costs (ξ and ξ_j), productivity of human capital formation ($\overline{e_t}$), and time discount factor (β).[19] The values of these parameters are determined using the first-order conditions of the model and market equilibrium conditions. For example, ϵ_t^e and v are primarily determined from the first-order conditions of a married household's utility maximization, shown in Online Appendix B. In the final stage of the

[18] The parameter δ captures how strongly parents' utility from children responds to the number of children, holding other factors constant. A lower value of δ indicates a stronger preference for child quantity over quality. The calibration results show that δ increased from 0.64 in 1990 to 1.03 in 2023, suggesting a possible shift back toward valuing the number of children. During periods of high economic growth, δ may have been lower as parents prioritized investing in the education and quality of fewer children. Even with a rising δ, fertility may still decline due to changes in other factors, such as rising child-rearing and education costs or housing burdens that constrain marriage and childbearing decisions.

[19] Note that parameter β is the time discount factor over a generation. Interpreting a period of one generation as 30 years in this framework yields an annual discount factor of $\beta^{\frac{1}{30}}$. The parameter ρ, where $\beta^{\frac{1}{30}} = \frac{1}{1+\rho}$, is the annual time preference rate. When ρ is between 0.02 and 0.05, β ranges from approximately 0.23 to 0.55.

calibration, the parameters for marriage cost (ξ and ξ_j) are determined to satisfy Equations (8) and (9), where the marginal benefit of getting married is equal to its cost.

4.2 Baseline Steady-State Results: 2023 and 1990

This section presents the numerical results of the proposed model, beginning with the steady-state equilibrium of the baseline economy in 2023. Key target variables include the marriage rate, fertility rate, labor force participation, saving, and per capita output growth. The model also simulates a counterfactual steady state for 1990 by adjusting key parameters to reflect the economic and demographic conditions of that year. The simulated outcomes for 1990 and 2023 are then compared with the corresponding observed data.

Table 5 reports the observed and simulated values of target variables. Columns (1) and (2) present the observed data for 2023 (2024 for fertility) and 1990, respectively, including fertility, marriage, labor force participation, saving, and per capita output growth. Columns (3) and (4) show the corresponding steady-state values predicted by the model for 2023 and 1990, respectively. Overall, the model replicates key empirical moments well for both periods, supporting the credibility of the baseline model's calibration and structure.

Column (3) presents the baseline simulation results for 2023. The model closely replicates the key observed data. The marriage rate among women aged 25–49 is 0.689, and the fertility rate is 0.751. The marriage rate is 0.636 for college-educated women and 0.825 for non-college-educated women. The female labor force participation rate is 54.8%, close to the observed value of 55.6%, while the male rate is 78.9%, slightly higher than the observed 73.3%. The per capita output growth rate is 2.90%, marginally above the actual value of 2.84%. The saving rate is 7.0%, matching the data.

Column (4) presents the model's predictions for 1990. The simulated marriage rate among women aged 25–49 is 0.918, and the fertility rate is 1.570, closely matching the observed values of 0.921 and 1.570, respectively. Marriage rates are predicted at 0.798 and 0.935 for college-educated and non-college-educated women, respectively. The female labor force participation rate is 49.8%, matching the observed value exactly, while the male participation rate is 77.7%, slightly above the actual value of 76.2%. The simulated per capita output growth and saving rates also closely align with the 1990 data.

5 Counterfactual and Policy Simulations

Historical counterfactual simulations were performed for 1990 to examine how specific factors contributed to long-term trends in marriage and fertility over the past 30 years. In each simulation, one key factor—child-rearing time, marriage-related costs, or women's education—is set to the 2023 level, while all other parameters remain at their 1990 values. For example, in one scenario, it is assumed that women's education in 1990 had already reached the 2023 level. By comparing the resulting steady state with the actual 1990 equilibrium, the marginal effect of women's education on marriage and fertility rates as well as on labor market participation is estimated. Although this approach abstracts from interaction effects and relies on the specific structure of the model, it provides a valuable tool for isolating the long-term impacts of individual drivers within a coherent structural framework.

The study then focuses on policy simulations for 2023, reflecting the key initiatives introduced in recent years in response to Korea's low fertility. These policies include economic support for child-rearing, child education, and marriage, as well as measures to improve work–family balance. The simulated policy interventions include reductions in child-rearing costs (υ), educational time requirements (ϵ_t^e), and marriage costs (ξ and ξ_j). In addition, improvements in gender equality are modeled both within the household (θ and γ) and in the labor market (d). These simulations allow evaluation of the extent to which such government interventions can improve marriage and fertility outcomes in Korea.

5.1 Historical Counterfactual Simulations

This section examines how individual socio-economic changes since 1990 have shaped Korea's current marriage and fertility patterns. Specifically, a counterfactual approach is employed: starting from the 1990 steady state, the model simulates how outcomes change when one socio-economic parameter, such as child-rearing time, marriage-related costs, or gender equality, is set to its 2023 level, while all other parameters remain fixed at their 1990 values. This approach allows evaluation of the extent to which each factor alone shifts the model closer to the observed 2023 outcomes, particularly in terms of marriage and fertility rates.[20] The simulation results are reported in Columns (2)–(7) of Table 7.

[20] While this approach starts from the past and moves forward, its logic is broadly comparable to reversing individual variables from 2023 back to their 1990 levels.

[Insert Table 7 here]

A hypothetical scenario is constructed in which both parents' child-rearing and education time per child are increased to their 2023 levels, representing a 61% increase. Column (2) of Table 7 presents the simulation results compared with the 1990 baseline in Column (1). The effects on marriage rates are negligible. However, the number of children per married household drops sharply from 1.710 to 1.026, resulting in TFR declining significantly from 1.570 to 0.942. Fewer children provide parents with more opportunity to participate in the labor market. However, under this scenario, female labor force participation decreases marginally from 49.8% to 47.6%, mainly due to increased time demands from higher child-rearing and education time per child, combined with prevailing gender norms within the household. Meanwhile, male labor force participation rises significantly from 77.7% to 82.5%.

Column (3) reflects higher marriage costs in 2023 compared with 1990, corresponding to increases of 47% for men, 10% for college-educated women, and 19% for non-college-educated women. The increased costs significantly reduce marriage rates from 0.918 to 0.704 for males, from 0.798 to 0.654 for college-educated females, and from 0.935 to 0.711 for non-college-educated females. Although the number of children per married household increases slightly from 1.710 to 1.829, a larger reduction in the marriage rate leads to a decline in the fertility rate from the baseline of 1.570 to 1.288. Lower marriage rates also increase female labor force participation from 49.8% to 54.7%, whereas male labor force participation remains virtually unchanged at 77.6%.

Column (4) examines the effects of improved female education by simulating a scenario in which the share of college-educated women increases to its 2023 level ($\psi_c = 720$), average years of schooling for women and men rise to 13.5 and 13.9, respectively, and the female-to-male college ratio reaches 0.96. Under this scenario, the marriage rate declines from 0.918 to 0.833, while the number of children per married household rises slightly from 1.710 to 1.770. Consequently, the overall fertility rate falls modestly from 1.570 to 1.470, suggesting that improvements in female education have contributed only modestly to Korea's current low fertility rate, compared with the larger effects of rising child-rearing, education, and marriage costs.

In Column (5), greater gender equality within the household is assumed, where Θ is set to 0.631, θ to 0.639, and b to 0.525. Despite an increase in female bargaining power at home, the overall marriage rate remains unchanged. However, the number of children per married household rises slightly to 1.735, compared to the 1990 baseline of 1.710, leading to a modest increase in TFR. Greater female bargaining power also enables higher women's participation in the labor market, with female labor force participation rising to 51.2% and male participation declining to 75.6%. These results indicate that improvements in gender equality within households were not a driving factor behind the decline in marriage and fertility rates.

Column (6) assumes greater gender inequality in the labor market, where $d = 0.71$. This leads to a marginal increase in the overall marriage rate to 0.920, but results in a lower number of children per married household (1.543) compared to the baseline, which in turn reduces the fertility rate to 1.419. As gender inequality in the labor market improves and the number of children declines, female labor force participation increases significantly from 49.8% to 53.2%, whereas male participation increases slightly from 77.7% to 78.4%.

In Column (7), it is assumed that all scenarios from Columns (2) through (6) occur simultaneously. These combined socio-economic changes exert a strong negative effect on both marriage and fertility, reducing the rates to 0.703 and 0.715, respectively. As fewer women, especially college-educated women, choose to marry, and married households tend to have fewer children, both female and male labor force participation increase significantly to 57.4% and 80.2%, respectively.

These simulated outcomes closely align with Korea's observed 2023 values: a marriage rate of 0.689, fertility rate of 0.750, and female labor force participation of 55.6%. Overall, the results suggest that the observed demographic trends can be largely explained by the structural changes incorporated in the model.

The simulation results indicate that rising marriage and child-rearing costs have been the primary drivers of declining marriage and fertility rates since 1990, with increased female education also contributing modestly. The counterfactual analysis shows that applying today's costs and gender norms to the 1990 baseline can replicate much of Korea's current fertility decline, suggesting that economic and institutional conditions, rather than individual preferences, have largely shaped Korea's demographic trajectory.

5.2 Policy Simulations

Over the past two decades, the Korean government has implemented a wide range of policies to address persistently low fertility and delayed family formation. These measures include economic support for child-rearing (such as childcare subsidies and parental leave), efforts to promote work–life balance, and programs aimed at reducing the financial burden of marriage, particularly housing support for newlyweds. Despite expanded efforts and increased public spending, fertility rates continue to decline, raising concerns about the effectiveness of current interventions. Online Appendix C provides a detailed description of Korea's policy initiatives.

To assess the potential impact of Korea's policy initiatives on fertility and household behavior, five major interventions were incorporated into the model as policy shocks. These interventions are represented by three government program parameters: x_c, which captures measures that lower the time and opportunity costs of child-rearing; x_e, which captures policies that reduce the time and opportunity costs of child education; and x_m, which reflects support aimed at reducing the costs associated with marriage.[21]

First, the reduction in child-rearing costs, achieved through expanded childcare subsidies, public daycare provision, and home-care allowances, is modeled as a 25% decrease in the time required for child-rearing by both parents: $v' = (1 - x_c)$.

Second, government support for early childhood education—such as universal preschool access and education vouchers—is modeled as a 25% reduction in parental education time: $\epsilon_t^{e'} = \epsilon_t^e(1 - x_e)$. It is assumed that any time saved from reduced parental education input is offset by public support, such that the total effective time devoted to children's human capital formation remains unchanged.

Third, policies that promote marriage through financial transfers, tax incentives, and housing benefits are modeled as a 20% reduction in marriage-related search and setup costs, implemented as $\xi' = \xi\ (1 - x_m)$ and $\xi_j' = \xi_j\ (1 - x_m)$ for men and women, respectively.

In addition to these fiscal and in-kind support policies, the effects of structural reforms targeting gender inequality were evaluated. Specifically, the study simulates: (i) the promotion of gender equality within the household by setting θ=1 and $\gamma = 1$, which implies equal sharing of child-rearing responsibilities between men and women and the elimination of gender-unequal norms in marriage; and (ii) the elimination of labor market discrimination by setting the gender wage gap parameter d=1, indicating equal job opportunities and pay for both sexes.

These policy shocks represent a set of coordinated interventions aimed at alleviating economic and institutional barriers to marriage and fertility. The assumed magnitudes of reductions in time and monetary

[21] Online Appendix D shows that the effects of the three government policies are largely unchanged under alternative assumptions for key parameters.

costs of child-rearing, education, and marriage, and the full elimination of gender disparities, are intended to capture the upper bound of plausible and ambitious policy reforms. This approach allows the assessment of the model's response to both individual policies and a comprehensive, multi-dimensional policy package.

Table 8 presents the steady-state outcomes—including marriage and fertility rates, female and male labor force participation, and per capita economic growth—for each policy experiment as well as for the combined policy scenario in which all four initiatives are implemented simultaneously.

[Insert Table 8 here]

Column (2) presents the results of the first experiment, which assumes a 25% reduction in child-rearing time per child. While this policy does not affect marriage rates, it raises the fertility rate from 0.75 to 0.95, driven by the rise in the number of children per married household from the 2023 baseline of 1.09 to 1.38. However, the higher childcare demands slightly reduce female labor force participation, from 54.8% to 54.6%. Although this intervention boosts fertility, it lowers parental educational investment per child, weakening human capital formation and reducing per capita output growth from 2.90% to 2.44%.

Column (3) shows the effects of reducing parental education time by 25%. Similar to the previous scenario, this policy does not alter marriage rates but raises the fertility rate to 0.82, with the average number of children per married household increasing modestly to 1.18. The added childcare demands reduce female labor force participation to 53.7%, leading to a marginal decrease in per capita output growth to 2.72%.

Column (4) considers a reduction in marriage-related search and setup costs for both men and women, assuming a 20% decrease in the values of ξ and ξ_j, irrespective of educational attainment. As a result, the steady-state marriage rate increases from 0.689 to 0.80, with rates increasing to 0.744 for college-educated women and 0.964 for those with non-college education. The resulting expansion in family size slightly reduces female labor force participation, from 54.8% to 52.0%, while the per capita output growth rate decreases slightly to 2.85%.

The fourth experiment examines the elimination of gender inequality in child-rearing responsibilities and intra-household bargaining between men and women, with the results reported in Column (5). This policy produces only marginal changes in marriage rates, rising from 0.636 to 0.640 for college-educated women and declining slightly from 0.825 to 0.808 for non-college-educated women. The effect on fertility is minimal. However, equalizing child-rearing responsibilities results in the convergence of labor force participation rates for men and women, both of which reach 66.8%. This outcome is driven by a significant increase in female participation and a notable decrease in male participation.

Column (6) shows the effects of eliminating gender inequality in the labor market by closing the gender wage gap. In this scenario, the marriage rate for college-educated women decreases slightly, but the rate for non-college-educated women increases. The fertility rate declines from 0.751 to 0.672, driven by a reduction in the number of children per household. Labor force participation increases significantly for women due to higher returns to work, from 54.8% to 58.3%. Moreover, with higher output and more parental time allocated to education, the per capita output growth rate increases significantly from 2.89% to 3.51%.

Column (7) presents the results of the final experiment, in which all four policy interventions are implemented. This combined scenario increases the marriage rate to 0.807 and fertility rate to 1.189. Female labor force participation rises to 64.4%, but male participation declines to 64.4%. Despite gains in demographic outcomes, the per capita output growth rate declines to 2.48%, lower than the 2.90% baseline rate.

In summary, Table 8 illustrates that a package of policies aimed at lowering marriage costs, reducing child-rearing and education burdens, and promoting gender equality, both at home and in the labor market, can substantially increase marriage and fertility rates. However, these policy combinations may have unintended trade-offs. While they increase female labor force participation, the shift may reduce household-level investment in children's human capital, thereby slowing the accumulation of future labor productivity. Simultaneously, a decline in male labor force participation and total output can reduce government revenues and, consequently, public spending on education. The combined effects of weaker parental investment and reduced public education input result in slower human capital accumulation. As a result, per capita output growth declines. However, the impact on long-run total output growth may differ because higher population growth can partially offset the decline in per capita output.

The simulation results suggest that increasing marriage rates is essential for reversing Korea's fertility decline. While policies that support child-rearing enable married couples to have more children, they have a limited impact on marriage formation itself. In contrast, reducing marriage-related costs, particularly housing expenses, can directly encourage marriage, although designing effective policy interventions in this area remains a complex challenge.

In this context, Korean society may need to reconsider long-standing cultural norms that closely link marriage and childbirth. Although out-of-wedlock births remain rare by international standards, their proportion has gradually increased in recent years. Developing legal and social frameworks that support cohabitation and childbearing outside of marriage is essential for improving fertility outcomes in a shifting social landscape.

6 Conclusion

This study examined the drivers of Korea's sharp decline in marriage and fertility rates over the past three decades by developing a structural macroeconomic model grounded in micro-level findings. Using 25 years of panel data from KLIPS, survival model estimates indicate that rising female college attainment, higher marriage-related costs, increased female labor force participation, and growing child education burdens have contributed to steep declines in both marriage and fertility.

The structural model captures endogenous decisions regarding marriage, fertility, labor supply, and human capital formation, subject to gender-specific constraints in partner matching, caregiving, and intra-household bargaining. Simulation results indicate that rising marriage and child-rearing costs have been the primary drivers of declining marriage and fertility rates since 1990, whereas increased female education has had a more modest role. Counterfactual experiments further show that applying today's costs and gender norms to the 1990 baseline substantially reduces marriage and fertility rates, bringing them close to the levels observed in 2023.

Policy experiments suggest that interventions such as childcare and education support, marriage-cost subsidies, and gender-equalizing reforms can raise the fertility rate to approximately 1.2, which is still below replacement but comparable to the levels observed in Japan and Spain. These results underscore that opportunity costs play a central role in family decisions, particularly for college-educated women. Therefore, efforts to support fertility require not only reducing direct costs but also advancing structural reforms that promote gender equity within both households and labor markets.

In particular, policies that reshape social norms around marriage, sharply reduce marriage-related expenses, and enable highly educated women to balance childbearing with continued labor market participation merit serious consideration. In addition, the legal and institutional recognition of diverse family forms, including premarital cohabitation and non-marital childbearing, may help alleviate persistently low fertility by broadening the pathways to family formation.

The model also highlights important trade-offs. While cost-reduction and gender-equalizing policies can boost fertility, they may also reduce male labor supply and slow human capital accumulation. Improving the efficiency of the education system and sustaining technological progress are essential to offset these unintended negative effects and support long-term growth.

Finally, although the structural macroeconomic model demonstrates complex interactions among economic conditions, gender norms, and demographic behavior, several limitations remain. First, although the model incorporates matching frictions in the marriage market, it assumes equilibrium within each period and does not capture transitional dynamics or long-term mismatches. Second, while intra-household bargaining over time is modeled, fertility decisions are not jointly determined within couples, and the framework excludes divorce and repartnering. Third, labor supply decisions are simplified. Married women's work hours are modeled as the residual of their time endowment after childcare, and unmarried women are assumed to allocate their full time to market work. Fourth, alternative family structures such as cohabitation, single parenthood, or non-marital childbirth are not incorporated, despite their growing relevance. Fifth, the model treats gender inequality in the household (e.g., time allocation for childcare) and the labor market (e.g., wage gaps) as exogenous. It does not explicitly model how gender disparities arise or evolve over time in response to policies or social changes. Finally, the analysis focuses on steady-state outcomes and does not examine transitional dynamics or intergenerational welfare effects. Extending the model to a dynamic framework with heterogeneous agents, evolving family structures, and non-steady-state analyses is an important direction for future research.

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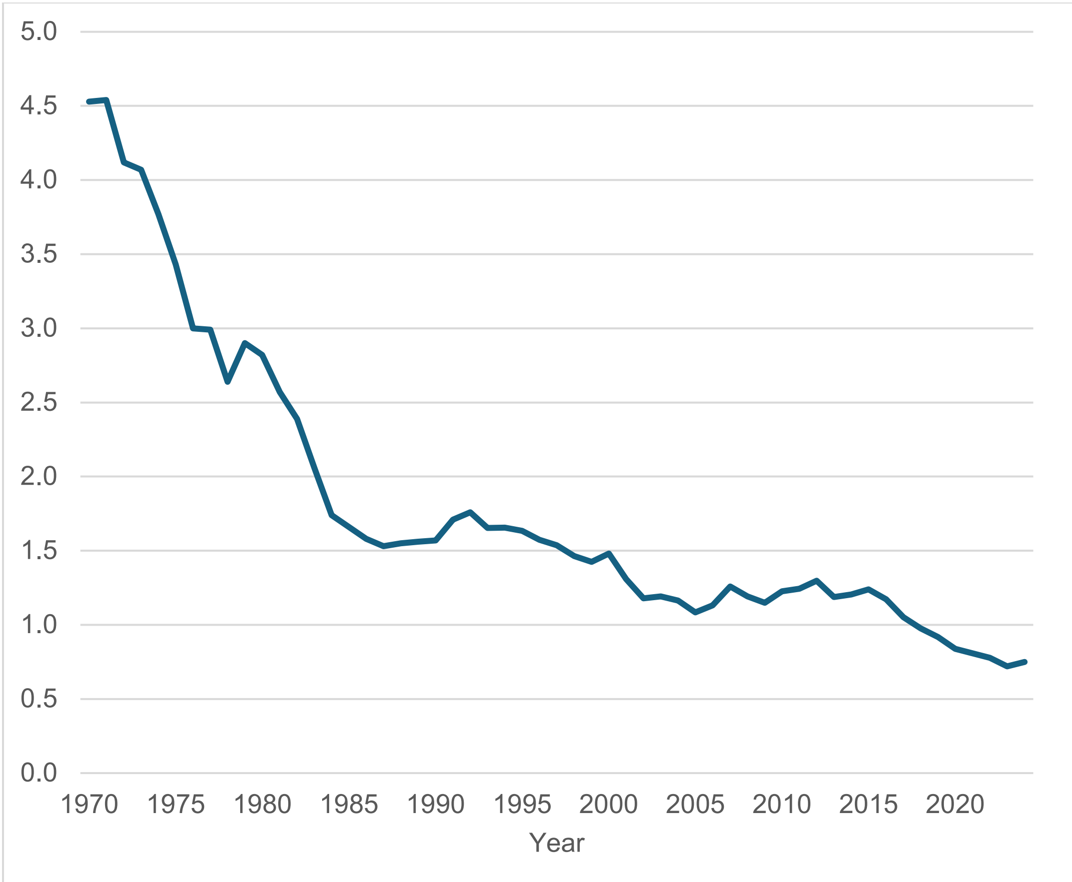


Fig. 1 Total Fertility Rate (TFR), 1970~2024

Source: Statistics Korea, Vital Statistics of Korea, KOSIS (accessed October 1, 2024).

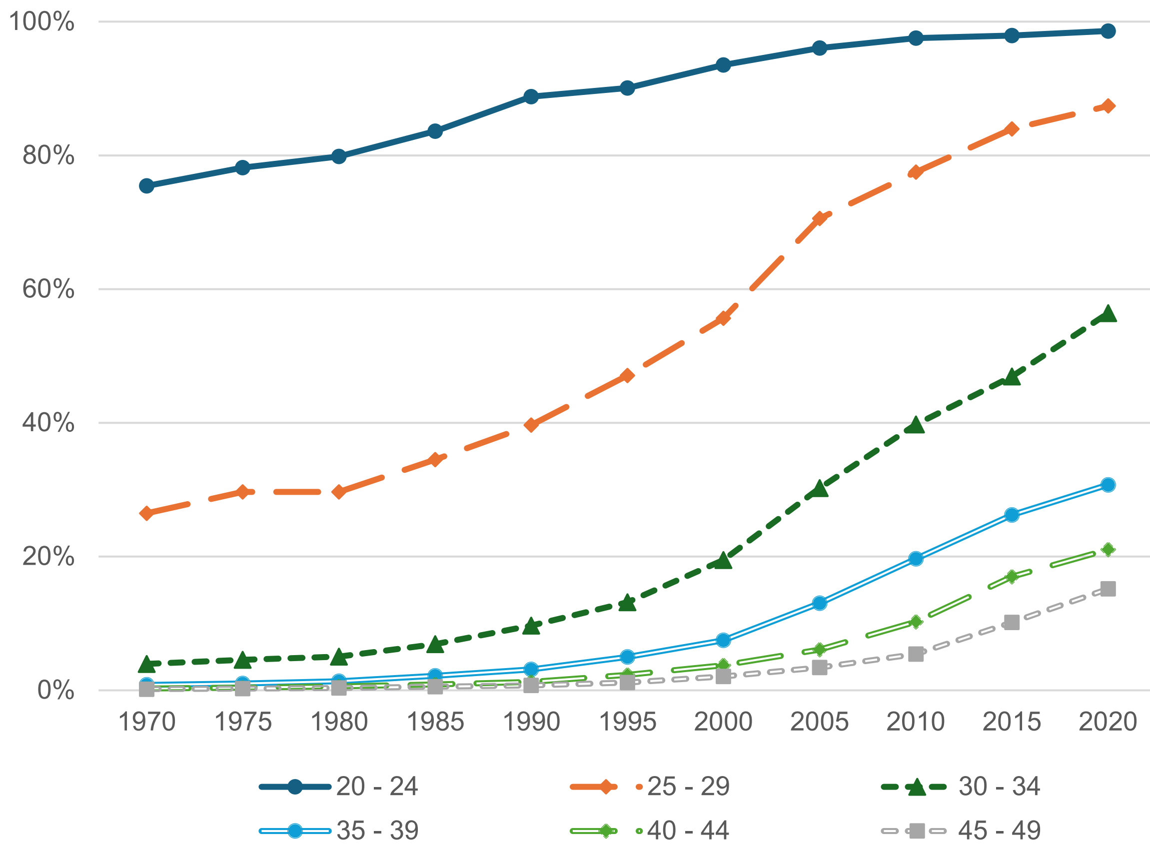


Fig. 2 Percentage of Never-Married by Age Groups, 1970~2020

Source: Statistics Korea, Korea Population Census, various years, KOSIS (accessed October 1, 2024).

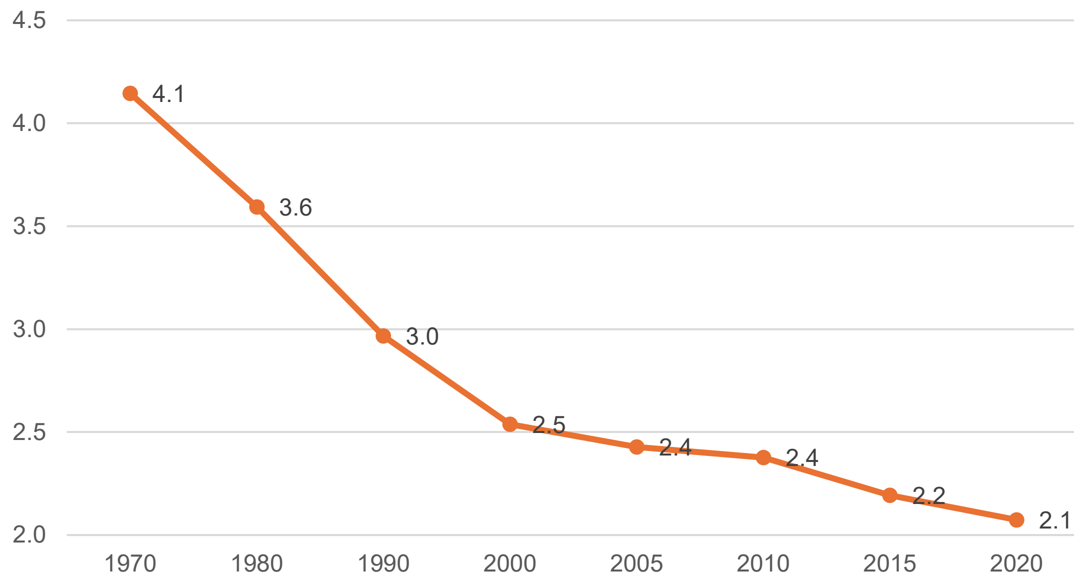


Fig. 3. Number of Children Among Married Women Aged Above 16, 1970~2020

Source: Statistics Korea, Population Census, various years, KOSIS (accessed October 1, 2024).

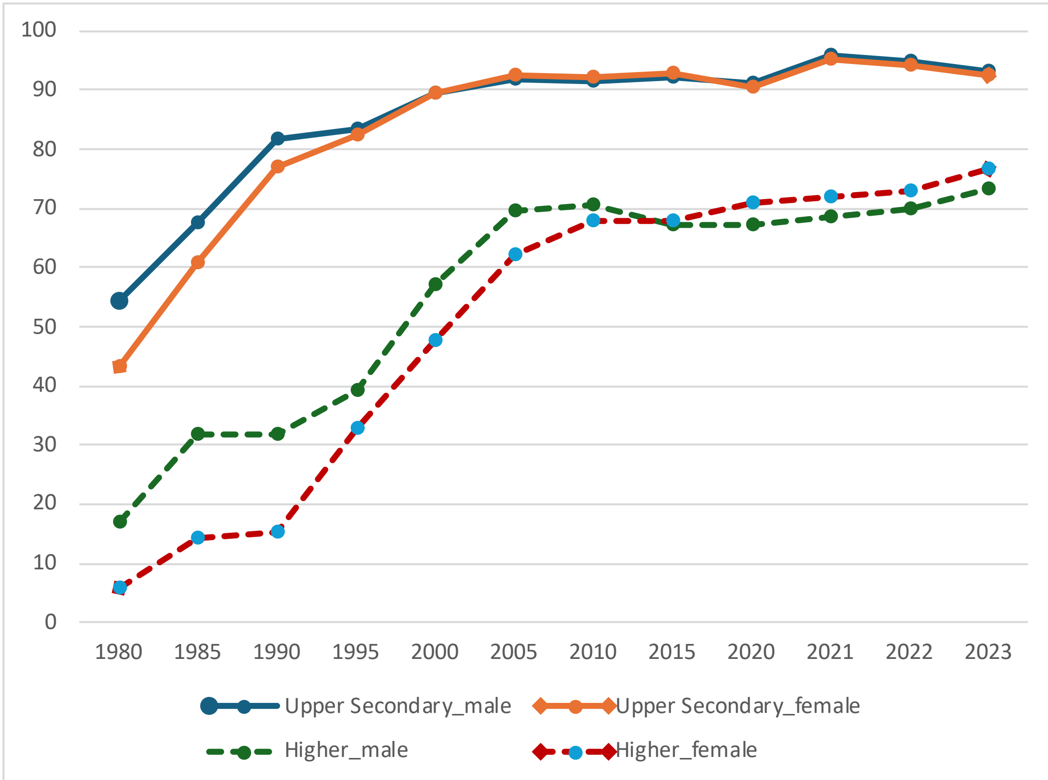


Fig. 4 School Enrollment Rates for Males and Females

Source: Korean Educational Development Institute, Basic Education Statistics (various years); Statistics Korea, Population Projections for Korea.

Note: Enrollment rate = (number of enrolled students/school-age population) × 100; school-age population: upper secondary school (ages 15–17) and higher education institutions (ages 18–21); the enrollment rate for higher education includes junior colleges, colleges of education, universities, and other tertiary-level institutions.

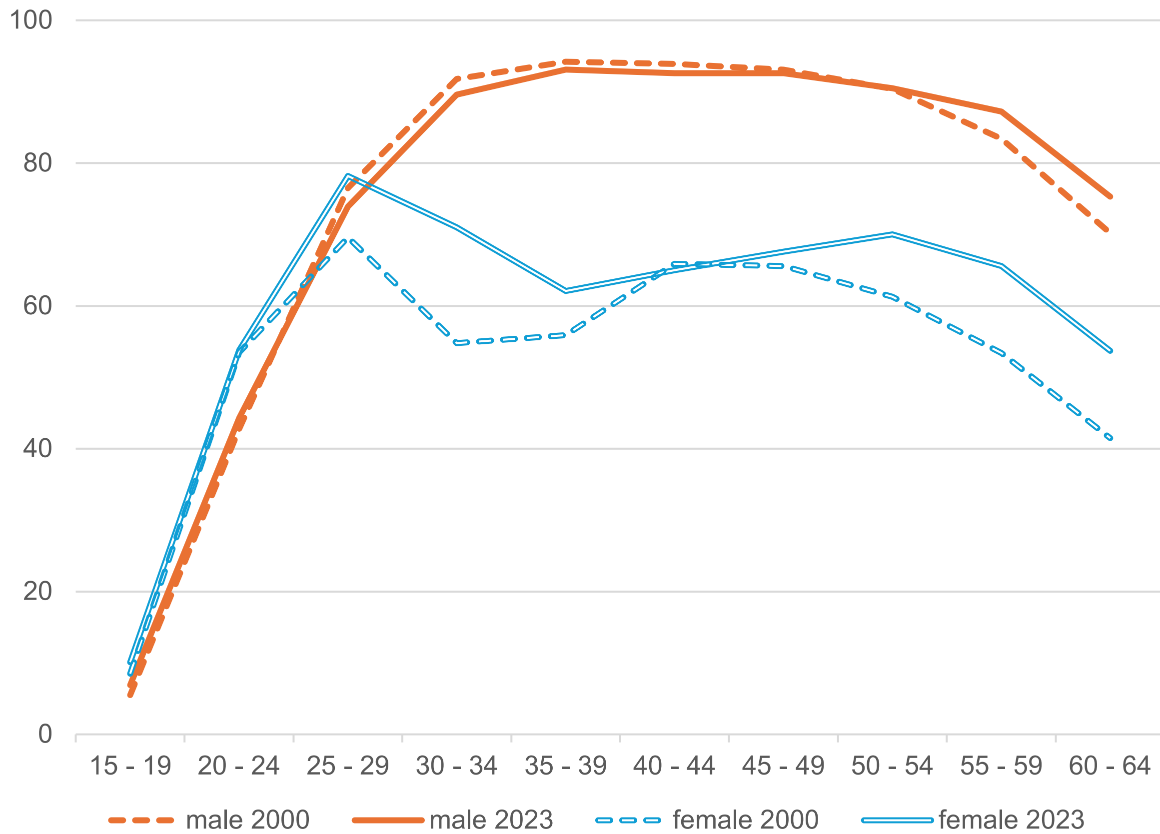
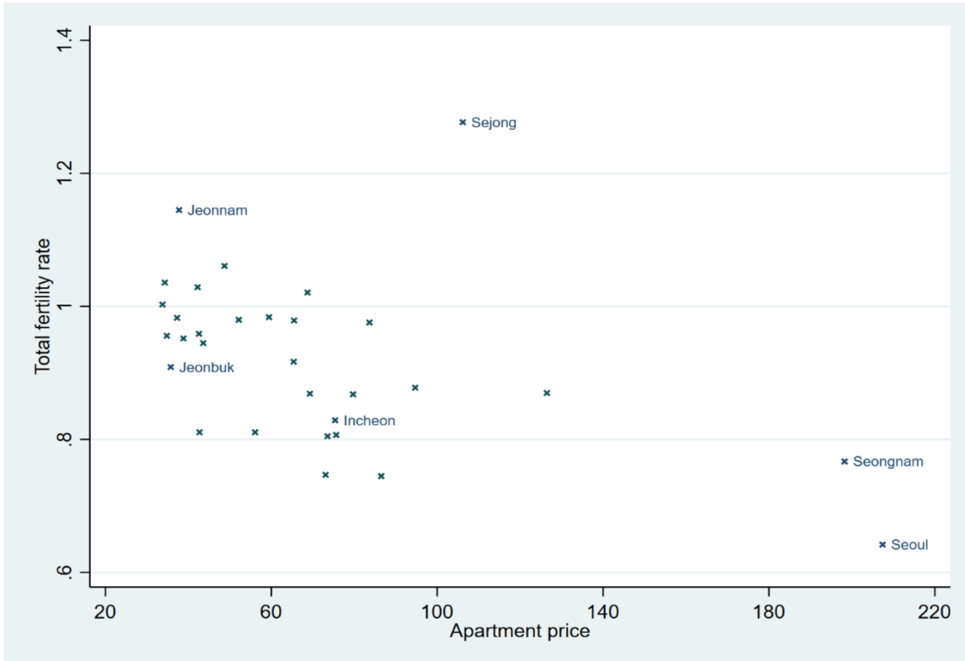
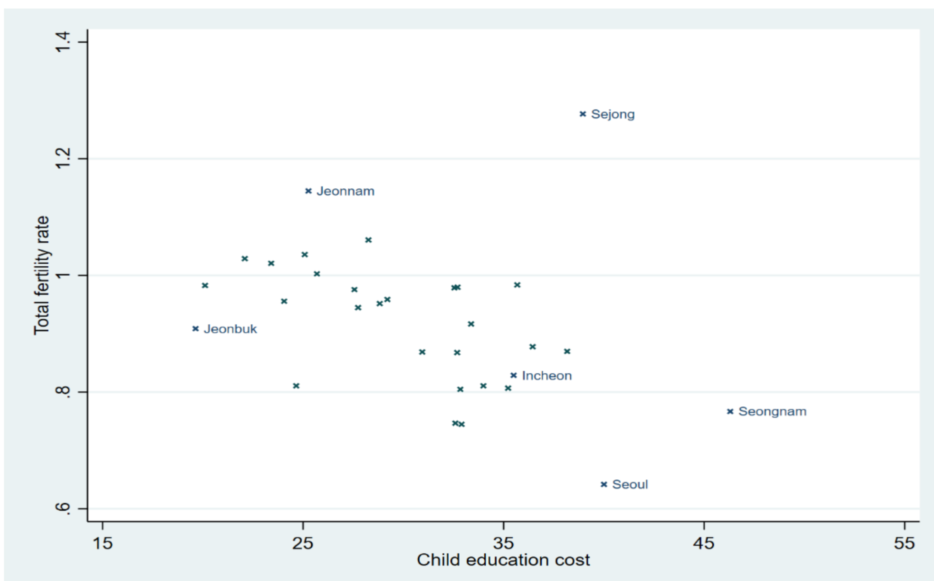


Fig. 5 Life-cycle Employment Rate of Working-age Population by Gender, 2000 and 2023

Source: Statistics Korea, Economically Active Population Survey (accessed October 5, 2024).



a. TFR vs. Housing price



b. TFR vs. Child private education cost

Fig. 6 TFR, Housing Costs, and Private Education Costs across Regions in 2020

Note: Data on TFR across regions are sourced from the Population Census. Housing prices are measured by the real apartment sales price by region, sourced from the Korea Real Estate Board (see Footnote 3). Child education cost is defined as the regional average of the real private education expenditure per child and is constructed using individual-level data from the KLIPS.

Table 1. Marriage and Fertility by Educational Level of Females, 1990 and 2023

	1990			2020		
	Share of women aged 25–49 (%)	Marriage rate (%)	Average no. of children per married woman (aged 15+)	Share of women aged 25–49 (%)	Marriage rate (%)	Average no. of children per married woman (aged 15+)
Total population	100	92.1	2.97	100	68.9	2.10
Primary or less	23.1	98.2	4.18	0.1	93.0	3.42
Lower secondary	25.8	96.5	2.43	1.1	91.5	2.20
Higher secondary	39.1	89.4	1.83	26.8	81.7	1.90
College or higher	11.9	79.8	1.66	72.0	63.6	1.68

Source: Statistics Korea, Population Census, 1990, 2023; KOSIS (accessed October 5, 2024).

Table 2. Gender Gap in Labor Market, 2023

	Women	Men
Labor force participation rate		
Total	55.6%	73.3%
High school	56.4%	71.6%
Bachelor's degree or higher	70.2%	86.3%
Distribution of workers by hours worked per week		
1~14 hours	8.1%	3.7%
15~35 hours	24.3%	13.6%
36 hours and above	65.6%	81.6%
Average hours worked	35.9	41.3
Gender wage gap		
Average wage	66.4%	100%
Bachelor's degree or higher	68.3%	100%
Median earnings	70.7%	100%

Source: Statistics Korea, Annual Report on the Economically Active Population Survey, 2023; Ministry of Employment and Labor, Survey on Labor Conditions by Type of Employment, 2023; OECD

Table 3. Survival Analysis: Incidence of Marriage by Sex

	(1) Male	(2) Female
Age	0.979***	1.526***
	(0.0780)	(0.0840)
Age squared	-0.014***	-0.023***
	(0.0012)	(0.0013)
Only child	0.056	0.004
	(0.0793)	(0.1638)
Metropolitan residence	-0.020	0.073
	(0.0802)	(0.0752)
School enrolled	-0.220	-0.480***
	(0.1606)	(0.1614)
Employed (lagged)	-0.157*	-0.101
	(0.0878)	(0.0825)
Income (lagged)	0.464***	0.138***
	(0.0357)	(0.0216)
Junior college	0.215**	-0.158*
	(0.0895)	(0.0834)
University	0.393***	-0.194**
	(0.0815)	(0.0788)
Parent homeowner	0.272***	-0.003
	(0.0808)	(0.0741)
Region-specific apartment price (lagged)	0.093	-0.116*
	(0.0683)	(0.0670)
Ratio of college-educated women to men	-3.061***	-2.543***
	(0.6891)	(0.6230)
Constant	-20.264***	-25.356***
	(1.3778)	(1.3585)
Observations	28,673	22,703

Note: Standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1. See Online Appendix Table A3 for the results, variable definitions, and cohort-specific analyses.

Table 4. Survival Analysis: Incidence of Childbirth Among Female Adults

VARIABLES	(1) Female	(2) Female
Age	0.669***	0.668***
	(0.0857)	(0.0857)
Age squared	-0.012***	-0.012***
	(0.0013)	(0.0013)
Only child	-0.374**	-0.377**
	(0.1703)	(0.1703)
School enrolled	-0.310	-0.309
	(0.2011)	(0.2011)
Employed (lagged)	-0.586***	-0.591***
	(0.0702)	(0.0706)
Income (lagged)	0.016	0.020
	(0.0144)	(0.0155)
Junior college	0.277***	0.280***
	(0.0798)	(0.0799)
University	0.296***	0.301***
	(0.0740)	(0.0744)
Homeowner	0.243***	0.241***
	(0.0574)	(0.0575)
Household income (lagged)	0.126***	0.124***
	(0.0465)	(0.0466)
Household financial assets (lagged)	-0.001	-0.000
	(0.0212)	(0.0212)
Region-specific education cost (lagged)	-0.026***	-0.026***
	(0.0035)	(0.0035)
Metropolitan residence	0.136**	0.138**
	(0.0588)	(0.0589)
Dummy for the marriage year (t) and (t-1)		-0.041
		(0.0634)
Constant	-10.831***	-10.790***
	(1.3915)	(1.3929)
Observations	5,137	5,137

Note: The dummy for marriage years (t) and (t-1) equals 1 for the marriage year (t) and the prior year (t-1), and 0 otherwise. Standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1. See Online Appendix Table A4 for the results, variable definitions, and cohort-specific analyses.

Table 5. Value of Target Variables

Parameters	Description	Data		Model	
		2023	1990	2023	1990
p	Marriage rate for women aged 25–49	0.689	0.921	0.689	0.918
p_c	Marriage rate for college-educated women aged 25–49	0.636	0.798	0.636	0.798
p_{nc}	Marriage rate for non-college-educated women aged 25–49	0.825	0.937	0.825	0.935
$p \times n$	Fertility	0.750	1.570	0.751	1.570
h_t^W	Female labor force participation rate	55.6	49.9	54.8	49.8
h_t^M	Male labor force participation rate	73.3	76.2	78.9	77.7
$\gamma_{Y/N}$	Annual per capita income growth rate (%)	2.84	7.19	2.90	7.20
SR	Net domestic saving rate (%)	7.0	16.8	7.0	16.6

Note: The parameter values for 2023 are either from 2023, 2024, or the average from 2020 to 2023, whereas those for 1990 are either from 1990 or the average from 1990 to 1995.

Table 6. Calibration Parameters

Parameter	Description	Value	
		2023	1990
Marriage			
Θ	The bargaining power of the male in the household	0.631	0.733
γ	Intensity of gender-unequal norms in marriage	1.178	–
κ_{nc}	Sensitivity to gender norms (non-college women)	0	–
κ_c	Sensitivity to gender norms (college women)	0.2	–
ξ	Marriage cost parameter for men	1.62*	1.09*
$\xi_{F,C}$	Marriage cost parameter for women with college education	1.84*	1.68*
$\xi_{F,NC}$	Marriage cost parameter for women with non-college education	1.26*	1.06*
ψ_c^f	Share of women aged 25–49 with college education	0.720	0.119
e_t^f/e_t^m	Female-to-male ratio of average years of schooling (ages 25–64)	0.97	0.81
Ψ	Ratio of college-educated women (ages 20–44) to men (ages 25–49)	0.96	0.64
ω	Elasticity of marriage cost w.r.t. Ψ for college-educated women	0.5	–
ε	Elasticity of spousal search cost w.r.t. marriage probability	1.52	–
Households			
β	Time discount factor	0.36*	0.60*
π_c	Child survival probability, under five	0.999	0.993
π_A	Survival probability from adulthood (age 25) to retirement (age 60)	0.936	0.834
σ	Inverse of intertemporal elasticity of substitution	0.8	–
x	Social security contribution rate	0.084	0.019
u	Proportion of unmarried person's non-market activity	0.2	–
Married household:			
η_c	Preference parameter for consumption	3.4	–
η_e	Preference parameter for children	1.3	–
δ	Elasticity of parental utility w.r.t. the number of children	1.03*	0.64*
θ	Bargaining power of a female in child-rearing time	0.369	0.267
υ	Rearing time per child	0.254*	0.122*
ϵ_t^e	Education time per child	0.102*	0.099*
b	Education time allocated for boys (gender bias in education)	0.525	0.670
$\bar{e}$	Productivity of human capital formation	3.61*	22.0*
υ_1	Elasticity w.r.t. public spending in education	0.4	–
υ_2	Elasticity w.r.t. parent's education time	0.3	–
χ	Elasticity w.r.t. mother's human capital	0.8	–
Market Output			
α	Elasticity of output w.r.t. male and female labor input	0.3	–
d	Gender gap in wage	0.71	0.53
Government			
τ	Tax rate on output	0.157	0.134
μ	Education spending efficiency parameter	0.39	–
$\emptyset$	Ratio of unproductive government spending to education spending	3.0	–

Note: Parameter values marked with * indicate calibrations to match the observed target variables. “–” indicates that the parameter value is unchanged from the 2023 baseline. “w.r.t.” stands for “with respect to.”

Table 7. Historical Simulation: Effects of Female Education, Child-Rearing and Marriage Costs, and Gender Inequality

		1990 Baseline	Child-rearing and education time = 2023	Marriage-related costs = 2023	Female college share = 2023	Female bargaining power at home = 2023	Labor market gender inequality = 2023	All changes combined
		(1)	(2)	(3)	(4)	(5)	(6)	(7)
p	Marriage rate	0.918	0.919	0.704	0.833	0.918	0.920	0.703
p_c	Marriage rate for women with college education	0.798	0.797	0.654	0.798	0.797	0.798	0.652
$p_{nc,C}$	Marriage rate for women with non-college education	0.935	0.935	0.711	0.925	0.934	0.936	0.835
n	Number of children per married household	1.710	1.026	1.829	1.768	1.735	1.543	1.017
$p \times n$	Fertility	1.570	0.942	1.288	1.474	1.593	1.419	0.715
h_t^W	Female labor participation rate (%)	49.8	47.6	54.7	51.8	51.2	53.2	57.4
h_t^M	Male labor participation rate (%)	77.7	82.5	77.6	77.7	75.5	78.4	80.2

Note: Column (2) assumes both child-rearing time and parental education time per child increased to 2023 levels. Column (3) shows the increase in marriage costs until 2023. Column (4) assumes the share of college-educated women, the average educational attainment of both women and men, and the ratio of college-educated women to men are set at 2023 levels. Column (5) assumes improved gender equality in child-rearing responsibilities and intra-household bargaining to 2023 levels. Column (6) reflects greater gender equality in the labor market, represented by a decrease in the gender wage gap. Column (7) incorporates all changes from Columns (2)–(6).

Table 8. Policy Simulation: Effects of Child-Rearing Costs, Marriage Costs, and Gender Equality

		2023 Baseline (1)	Child-rearing costs (↓25%) (2)	Child-education costs (↓25%) (3)	Marriage-related costs (↓20%) (4)	Gender equality at home (↑$\gamma = 1$, $\theta = 1$) (5)	Labor market gender equality (↑d = 1) (6)	All policies combined (7)
p	Marriage rate	0.689	0.690	0.690	0.805	0.687	0.692	0.807
$p_{F,C}$	Marriage rate for college-educated women	0.636	0.637	0.636	0.744	0.640	0.634	0.747
$p_{F,NC}$	Marriage rate for non-college educated women	0.825	0.825	0.827	0.964	0.808	0.841	0.962
n	Number of children per married household	1.090	1.378	1.184	1.051	1.097	0.971	1.472
$p \times n$	Fertility	0.751	0.950	0.817	0.846	0.754	0.672	1.189
h^W	Female labor participation rate	54.8	54.60	53.74	52.0	66.8	58.3	64.43
h^M	Male labor participation rate	78.9	77.42	79.89	79.1	66.8	79.9	64.43
$\gamma_{Y/N}$	Per capita output growth rate (annual, %)	2.899	2.440	2.719	2.854	2.900	3.506	2.477

Note: Column (1) assumes a 25% reduction in child-rearing time. Column (2) shows a 25% reduction in parental education time per child. Column (3) shows a 20% reduction in marital costs. Column (4) assumes the complete elimination of gender inequality in child-rearing and intra-household bargaining, whereas Column (5) eliminates gender inequality in the labor market. Column (6) combines all five policy changes.

Online Appendix

A. Determinants of Marriage and Childbirth

B Steady-State Equations and Balanced Growth Rate

C. Korea's Policy Responses to Low Fertility

D. Sensitivity Test

A. Determinants of Marriage and Childbirth

A.1. Data

The data for this analysis are mainly from the Korean Labor and Income Panel Study (KLIPS) (Korea Labor Institute, 2024), a longitudinal survey conducted annually since 1998. This survey covers 5,000 urban households with 13,317 members aged 15 and older. To address sample attrition, additional samples were added for 2009 and 2018, incorporating 1,415 and 5,044 households, respectively. The analysis is based on data from 25 waves, starting from the initial wave in 1998 to the latest in 2022, using the original sample combined with the 2009 and 2018 additions.

The KLIPS household data include detailed information on each household member's personal characteristics such as sex, birth year and educational level, as well as household-level attributes such as income and assets. The relationship code with the household head allows us to verify each member's status within the household, while changes in household composition due to birth or marriage are also identifiable.

Regional-level information that could influence marriage and childbirth decisions was also collected, including child education expenditure and housing prices. Child education expenditure is defined as the regional average of monthly private education expenditure per child and is constructed using individual KLIPS data. Housing prices are measured by the average apartment sales price for individual regions.[22] The regions were classified into 31 groups, including the capital city, six metropolitan cities, 14 large cities with populations exceeding 500,000, nine provinces and Sejong.[23] To ensure comparability, these variables were deflated using the regional

[22] The regional apartment sales price index (June 2021 = 100), provided by the Korea Real Estate Agency, was converted and used to measure housing prices by region. Specifically, all regional indices were first converted to actual prices using the average apartment price in each region in June 2021 and then re-scaled into an index where the national average price in June 2021 equals 100. This approach allows us to reflect regional differences in actual price levels during the sample period.

[23] The six metropolitan cities are Busan, Daegu, Daejeon, Incheon, Gwangju and Ulsan. The 14 large cities with a population of over 500,000 consist of Namyangju, Bucheon, Seongnam, Siheung, Ansan, Anyang, Pyeongtaek, Gimpo, Paju, Cheonan, Jeonju, Pohang and Gimhae.

Consumer Price Index. Educational expenditure was compiled annually across these 31 regions, and a (lagged) three-year moving average was applied for the analysis.

The ratio of college-educated women aged 20–44 to college-educated men aged 25–49 was constructed by region, using data from the Population Census. This variable represents an educational imbalance in the marriage market, after considering the age difference between men and women in marriage, and serves as a proxy for spousal search costs, given that college-educated women tend to have higher spousal search costs owing to their preference for educational homogamy or hypergamy. The data are available at five-year intervals and are annualized by interpolation.

For marriage analysis, the sample was limited to never-married respondents aged 18–53 at the time of the survey, identifying 18 as the starting age for marriage. To include parental attributes, the sample was further limited to respondents who lived with their parents for at least one wave during the survey periods. Reflecting Korea's common practice of adult children living with their parents until marriage, co-residency rates were high in the sample, with 87.7% of all respondents residing with their parents for at least one year during the observation period.

The primary focus of the study was on the transition to first marriage, measured in the dataset by a dummy variable indicating 0 for the year a participant remains unmarried until that year and 1 for the year of marriage. The participants were tracked until they got married, at which point they were excluded from the analysis. Therefore, those who remained unmarried in 2022 or the latest year of observation were right-censored.

Figure A1 shows the trends in the rate of unmarried adults by age and birth cohort. Overall, the proportion of individuals who never get married declined in the late 20s and early 30s across cohorts. However, this distribution shifted rightward for later cohorts born in the 1980s and 1990s, reflecting a substantial increase in the age-specific unmarried rate among people in their 20s and early 30s. The 1954–1958, 1959–1963 and 1964–1968 cohorts each account for only 0.2%, 0.5% and 2.3% of the sample over the 25-year period, respectively. This was likely due to the higher marriage rates of these cohorts, attributed to their older age (30–44) in the first survey in 1998, making them potentially unrepresentative of their cohorts. Therefore, these cohorts were excluded.

[Insert Figure A1 here]

Marriage information was integrated with individual characteristics that may influence marriage decisions, including age, education, income and employment, as well as regional-level housing prices and the sex ratio of college-educated adults. After eliminating respondents with missing data on these variables, the final sample included 81,337 person-year observations of 7,616 unmarried individuals across 25 survey waves. Table A1 provides summary statistics: the average age was 29.4, with females accounting for 45% of the sample and 52% residing in metropolitan areas, including Seoul and six other metropolitan cities. In terms of education, 22% of the participants had a high school diploma or lower, 26% were junior college graduates and 51% held university degrees. The average annual income in real terms (at the 2020 constant price) in the year before measuring the dependent variable was KRW 20.3 million. During the survey period, 17% enrolled in school and 65% engaged in paid work (including self-employment). Parental information, if available, such as home ownership, was also considered. The sex ratio of college-educated adults indicating a sex imbalance in the marriage market was 0.95.[24] Table 3 also reports separate summary statistics for female and male subsamples. Compared with males, females were more likely to be married, relatively less educated, employed at lower rates and had lower incomes.

[Insert Table A1 here]

For childbirth analysis, the sample was restricted to female respondents aged 18–53 who had been married at least once. The sample included 22,803 person-year observations of 2,114 married women across 25 survey waves. The sample included those who were married but had no children in the initial 1998 survey.

[Insert Table A2 here]

Table A2 presents the summary statistics for this female sample. Among them, 1,547 (73%) had their first child during the survey period, at an average age of 29.1. Furthermore, 28% had a high school diploma or lower, 44% held university degrees, with 53% engaging in paid work during the survey period. The average annual household income in the year before measuring the dependent

[24] Similar to private education costs and apartment prices, regional disparities persist in the sex ratio of college-educated adults. In the sample, the five regions with the highest ratios of college-educated women to men in 2020 are Busan (1.23), Seoul (1.01), Daegu (0.98), Jeonju (0.98) and Gwangju (0.98). Conversely, the five regions with the lowest ratios are Paju (0.84), Chungnam (0.84), Pyeongtaek (0.85), Jeonnam (0.85) and Siheung (0.85).

variable for this group was KRW 46.9 million in real terms, while the mother's average annual income was KRW 17.8 million.

Among women who did not have their first child during the survey period, 34% had a high school education or lower and 43% held university degrees. Of these, 62% were engaged in paid work, with an average annual household income of KRW 51.5 million and an average annual income of KRW 22.2 million for women without children.

Table A2 also shows that an average household's financial assets amounted to KRW 29.4 million, with a wide distribution. On average, women who have yet to have their first child possessed greater financial assets than those who had a child. Meanwhile, 46% of women's households owned a home. Among married women who had their first child, the homeownership rate was 45%, marginally lower than that of women without children (49%). Table B2 also shows that the average educational expense per child was KRW 274,800 per month. Education expenses per child tend to be higher in regions where the households of women without children are located, compared to regions where women who have had their first child reside.

A.2. Analysis of marriage and childbirth

A discrete-time hazard model was employed based on Fukuda (2013) and Chang et al. (2024) to assess the determinants of first marriage and childbirth. For this analysis, person–year panel data was constructed, and a complementary log-log (CLL) model was applied to determine the risk of first marriage. The CLL model assumes an asymmetric distribution and is particularly used when an event of interest is rare (Hernandez-Quevedo et al., 2008).

The model estimates the hazard of first marriage (or childbirth) for an individual i at time t using the following specification:

$$\log(-\log(1-h_{it})) = \alpha + \beta_1 age_{it} + \beta_2 age_{it}^2 + \gamma X_{it} + e_i$$

where h_{it} denotes the hazard probability of the event, that is, first marriage in this context occurring at time t. Following Fukuda (2013) and Chang et al. (2024), age serves as the duration variable. The baseline hazard is modelled as a function of age and its quadratic term to capture the nonlinear relationship between age and the risk of marriage. X_{it} represents a set of covariates, comprising both time-varying factors—such as school enrolment, employment status, income and residence in metropolitan cities—and time-invariant characteristics, including being an only child and educational attainment. The set of covariates also includes regional-level information, such as child education costs and the ratio of college-educated women to men. In the marriage analysis, apartment prices and sex ratio were included to capture setup and search costs. In contrast, the childbirth analysis includes child education costs to reflect fertility-related expenditure burdens. To mitigate potential endogeneity in the model, time-varying individual variables are incorporated as lagged values or replaced with their regional averages.

For the analysis of first marriage, the observation units of interest are individuals i =1,…, N who change to the state of marriage at times t = 1, 2, …, T. The duration of interest is the time between t_1, the age at which an individual is first at risk of getting married, and t_m, the age at which an individual enters marriage. The study identifies t_1 to be 18. Once the individual is married at t_m, he/she no longer appears in the data. Those who remain unmarried in the latest year of observation are right-censored. During each period, the outcome is recorded as either remaining single or transitioning to marriage. The sample was divided by sex.

For the analysis of first childbirth, the sample is limited to married women. The observation units of interest are individuals j =t_m,…, N who experience their first childbirth at times t =t_b, 2, …, T. The duration of interest is the time between t_m, the age at which a married female is first at risk of giving birth and t_b, the age at which she actually gives birth. Once the female delivers a baby at t_b, she no longer appears in the data. This approach allows for evaluating the timing and determinants of first childbirth within the married population.

The sample includes 378 women who got married and gave birth to their first child in the same year. The survival model excludes these women, because they have only one observation. To address this issue, information from the year before marriage was incorporated for married women for whom data were available. Additionally, a dummy variable is generated that takes the value of 1 for the marriage year and the prior year. This dummy variable was included in the specification to control for pre-marriage conditions that may influence childbirth decisions differently compared to post-marriage.

Table A3 reports estimation results of the survival analysis, assessing the determinants of first marriage. Columns (1) and (2) present the results for male and female samples, respectively, controlling individual background characteristics and parental financial information and homeownership. To investigate generational shifts, an additional survival analysis was conducted using two distinct cohorts: an 'old' cohort (born 1969–1983) and 'young' cohort (born 1984–1998). Members of the younger cohorts are currently in their 20s, 30s or 40s. Columns (3) and (5) focus on the older cohort for men and women, respectively, while Columns (4) and (6) focus on the younger cohort for men and women, respectively.

[Insert Table A3 here]

Table A3 highlights the importance of age and education in determining the likelihood of first marriage. Across all specifications, age is positively associated with marriage probability, but its effect diminishes over time, as evidenced by the positive coefficients for age and negative coefficients for age squared. The hazard of first marriage begins to decline after age 36 for men (Column 1) and after 33 for women (Column 2).

As discussed in previous studies, education plays a significant role in determining the incidence of first marriage. As illustrated in Column (2), school enrolment is significantly and negatively associated with the likelihood of marriage for women, suggesting that academic commitment delays marital decisions. Interestingly, the relationship between educational attainment and the likelihood of marriage differs by sex. For men, higher educational attainment (e.g. junior college or university) increases the likelihood of marriage, as indicated by the positive coefficients in Column (1). By contrast, higher education reduces the probability of marriage for women, as shown by the significant negative coefficients in Column (2). This aligns with prior studies suggesting that women with advanced education prioritize career aspirations over marriage. This may also indicate that Korean women tend to spend more time finding suitable partners for marriage.

Income emerges as a consistent and significant determinant. As indicated by the positive coefficient for income, higher income raises the likelihood of marriage for both sexes. This reflects the importance of financial stability in marital decision-making. However, the role of employment status varies. For men, employment status has a negative relationship with the probability of marriage in Column (1); however, for women, employment status is not significantly associated with the likelihood of marriage.

Columns (1) also highlight the role of family support in facilitating marriage given the positive coefficients for parental homeownership, especially among men. This is likely because it is common for couples to live with the man's parents after marriage, reflecting traditional family arrangements.

The association between apartment prices in residential regions and marital likelihood varies according to sex. For women, the coefficient of apartment prices is negative and statistically significant, suggesting that higher apartment prices reduce the likelihood of marriage. This indicates that the financial burden of higher living and household setup costs, often considered part of marriage costs, may contribute to delays in marriage. Residing in a metropolitan city is not a statistically significant determinant of marriage.

The ratio of college-educated women to men is a significant determinant for both men and women, as shown in Columns (1) and (2). The negative coefficient for the ratio of college-educated women to men indicates that a higher number of college-educated women aged 20–44 available compared to the number of college-educated men aged 25–49 in each region reduces the likelihood of first marriage for both men and women. This may be attributed to the challenges of finding a 'suitable' partner within a limited pool, making it more difficult for individuals to match their preferences in the marriage market.

Generational shifts are explored across Columns (3)–(6), revealing significant differences. First, the positive association between attaining university education and marriage remains significant for men in the older cohort but disappears for those in the younger cohort, as shown in Columns (3) and (4). By contrast, for women, the negative association between attaining university education and marriage is more pronounced in the younger cohort, as reported in Columns (5) and (6).

In addition, the negative impact of apartment prices is statistically significant among younger cohorts for both men and women, but not among older cohorts, as shown in Columns (4) and (6). This indicates that the adverse effect of rising housing costs on marriage has become more pronounced in recent years.

Finally, the negative relationship between the ratio of college-educated women to college-educated men and marriage likelihood remains significant for older cohorts but disappears for younger cohorts, as indicated in Columns (3) and (5). This may indicate that the traditional tendency toward homogamy and hypergamy has weakened among younger cohorts.

Table B4 presents the survival analysis results for the determinants of first childbirth among married women. Column (1) reports the estimates for married women, focusing on individual characteristics and household financial and homeownership variables. Columns (2) and (3) divide the sample into two groups: the older cohort in Column (2) and the younger cohort in Column (3). The specification includes a dummy variable, which takes the value of 1 for the marriage year (t) and the prior year (t-1).[25]

[Insert Table A4 here]

Column (1) highlights age as a significant determinant of first childbirth. The coefficients for age and its squared term indicate that as women grow older, the likelihood of having a first child increases but at a diminishing rate. This suggests that the likelihood of childbirth peaks at the age of 26 before declining. Being an only child is significantly negatively associated with a woman's likelihood of first childbirth compared to those with siblings. This strong negative relationship may reflect unique family dynamics or societal expectations for an only child.

Employment status is negatively associated with the likelihood of first childbirth. Employed women are less likely to transition to motherhood compared to unemployed women. This may reflect the opportunity cost of child-rearing for employed women and the challenges in balancing work and family life in Korea. Interestingly, a married woman's individual income is not a significant determinant of first childbirth. Unlike marriage decisions, where individual income plays a critical role, fertility decisions are less influenced by a woman's earnings. This suggests that other factors, such as household income or broader support systems, may play a more significant role in determining the likelihood of childbirth. This interpretation is supported by the

[25] The study also allowed the impact of each factor on childbirth to differ between the pre- and post-marriage periods by interacting each factor with the dummy variable. For most variables, there were no significant differences between the two periods. The estimation results are available from the authors upon request.

finding that higher household income is significantly associated with an increased probability of childbirth.

Additionally, homeownership is a statistically significant factor, as illustrated in Column (1). The positive coefficient for homeownership indicates that households that own a home are more likely to have a child than those that do not. However, household financial assets do not have a significant impact on the likelihood of childbirth. This finding suggests that stable housing and income may play a more crucial role in fertility decisions than liquid financial resources.

Region-specific child education expenses are significantly and negatively associated with the likelihood of having a first child. Higher private education costs in a region may discourage or delay childbearing among married women amid concerns of the financial burden of raising and educating children.

Residing in metropolitan cities is positively associated with the probability of first childbirth, as indicated by the significantly positive coefficient. This indicates that better infrastructure and access to childbirth and child-rearing services in metropolitan areas may positively influence childbirth decisions among married women.

Educational attainment plays a significant role in childbirth. Women with junior college or university education are more likely to give birth compared to those with higher secondary education or less, as shown in Column (1). At first glance, this finding appears inconsistent with theoretical predictions. However, once the sample is restricted to married women, the effect of women's educational attainment on the likelihood of first childbirth becomes less clear. It is possible that women who delayed childbirth for educational reasons tend to have children sooner after marriage.

An additional survival analysis was conducted using separate samples for the younger and older cohorts. The estimation results in Columns (2) and (3) highlight the significant differences between the two groups. As Column (2) demonstrates, the positive association between higher educational attainment and the likelihood of having a child is pronounced in the older cohort. Specifically, women in the older cohort with a university education are more likely to give birth than those with higher secondary education or lower within the same age group. By contrast, educational attainment no longer serves as a significant determinant of childbirth for women in the younger cohort, as shown in Column (3). This finding is consistent with observations from the census data presented in Table 1, where the average number of children among married women did not differ significantly between those with college and higher secondary education.

Women's employment status and homeownership remain significant determinants for childbirth across generations. Region-specific child education expenses are also significantly and negatively associated with the likelihood of first childbirth. both in both older and younger cohorts. By contrast, household income is a significant factor only for the younger cohort, suggesting that the probability of giving birth increases with household income in this group.

Table A1. Summary Statistics for the Analysis of Marriage: Sample of Adults Aged 18−53

	Total			Female			Male		
	N	Mean	SD	N	Mean	SD	N	Mean	SD
Female (=1)	7,616	0.45	0.50	3,428	1.00	0.00	4,188	0.00	0.00
Age	7,616	29.43	6.53	3,428	28.08	5.86	4,188	30.53	6.84
Age of first marriage	2,398	30.95	4.41	1,236	29.86	4.03	1,162	32.12	4.50
Ever married	7,616	0.32	0.46	3,428	0.36	0.48	4,188	0.28	0.45
Only child (=1)	7,616	0.13	0.34	3,428	0.04	0.20	4,188	0.21	0.41
Metropolitan residence	7,616	0.52	0.50	3428	0.27	0.44	4,188	0.20	0.40
Employed (=1)	7,616	0.65	0.48	3,428	0.65	0.48	4,188	0.64	0.48
Annual average income (KRW 10,000)	7,616	2,026	1,759	3,428	1,819	1,378	4,188	2,196	2,003
School enrolled (=1)	7,616	0.17	0.37	3,428	0.15	0.35	4,188	0.18	0.39
Secondary education or lower (=1)	7,616	0.22	0.42	3,428	0.21	0.41	4,188	0.23	0.42
Junior college (=1)	7,616	0.26	0.44	3,428	0.28	0.45	4,188	0.25	0.43
University or higher (=1)	7,616	0.51	0.50	3,428	0.50	0.50	4,188	0.52	0.50
If parents have their own house (=1)	7,612	0.76	0.43	3,425	0.76	0.43	4,187	0.76	0.43
Region-specific apartment price (index)	7,616	0.98	0.59	3428	0.95	0.07	4,188	0.95	0.07
Ratio of college-educated women to men	7,616	0.95	0.07	3428	0.54	0.50	4,188	0.50	0.50
If the first child's birth was observed	7,616	0.23	0.42	3,428	0.27	0.44	4,188	0.20	0.40

Table A2. Summary Statistics for the Analysis of Childbirth: Sample of Female Adults Aged 18–53

	Total			First childbirth			Childless		
	N	Mean	SD	N	Mean	SD	N	Mean	SD
Female (=1)	2,114	1.00	0.00	1,547	1.00	0.00	567	1.00	0.00
Age	2,114	31.48	6.40	1,547	29.09	3.86	567	38.02	7.31
Age of first marriage	2,099	30.29	5.16	1,542	29.05	3.71	557	33.72	6.80
Household income (KRW 10,000)	1,962	4,819	3,341	1,424	4,692	2,911	538	5,154	4,261
Household financial assets (KRW 10,000)	1,745	2,940	5,150	1,260	2,410	3,203	485	4,318	8,139
Homeowner (=1)	2,114	0.46	0.50	1,547	0.45	0.50	567	0.49	0.50
Only child (=1)	2,114	0.04	0.18	1,547	0.03	0.16	567	0.06	0.23
Metropolitan residence (=1)	2,114	0.49	0.50	1,547	0.50	0.50	567	0.48	0.50
Employed (=1)	2,114	0.55	0.50	1,547	0.53	0.50	567	0.62	0.49
Annual average income (KRW 10,000)	2,114	1,899	1,578	1,547	1,781	1,510	567	2,220	1,712
School enrolled (=1)	2,114	0.04	0.19	1,547	0.05	0.21	567	0.01	0.10
Secondary education or lower (=1)	2,113	0.29	0.46	1,546	0.28	0.45	567	0.34	0.48
Junior college (=1)	2,113	0.27	0.44	1,546	0.28	0.45	567	0.23	0.42
University or higher (=1)	2,113	0.44	0.50	1,546	0.44	0.50	567	0.43	0.50
Region-specific education expenses per child (KRW 10,000)	2,114	27.48	10.37	1,547	24.85	9.47	567	34.66	9.25
The marriage year (t) and the prior year (t-1)	2,114	0.56	0.50	1,547	0.61	0.49	567	0.44	0.50

Table A3. Survival Analysis: Incidence of Marriage by Sex and Cohort

	(1) Male	(2) Female	(3) Male: Old	(4) Male: Young	(5) Female: Old	(6) Female: Young
Age	0.979***	1.526***	0.859***	1.244***	1.448***	1.768***
	(0.0780)	(0.0840)	(0.0867)	(0.3185)	(0.0943)	(0.2365)
Age squared	-0.014***	-0.023***	-0.013***	-0.018***	-0.022***	-0.027***
	(0.0012)	(0.0013)	(0.0013)	(0.0052)	(0.0015)	(0.0040)
Only child	0.056	0.004	0.082	0.320**	-0.184	0.353
	(0.0793)	(0.1638)	(0.0979)	(0.1421)	(0.2551)	(0.2176)
Metropolitan residence	-0.020	0.073	-0.258***	-0.067	-0.054	-0.187
	(0.0802)	(0.0752)	(0.0952)	(0.1780)	(0.0952)	(0.1446)
School enrolled	-0.220	-0.480***	-0.337*	-0.063	-0.657***	-0.156
	(0.1606)	(0.1614)	(0.1884)	(0.3067)	(0.1929)	(0.2956)
Employed (lagged)	-0.157*	-0.101	0.024	-0.727***	-0.187**	0.131
	(0.0878)	(0.0825)	(0.1040)	(0.1643)	(0.0945)	(0.1683)
Income (lagged)	0.464***	0.138***	0.431***	0.598***	0.136***	0.144***
	(0.0357)	(0.0216)	(0.0427)	(0.0772)	(0.0259)	(0.0419)
Junior college	0.215**	-0.158*	0.248**	0.407*	-0.022	-0.226
	(0.0895)	(0.0834)	(0.0988)	(0.2293)	(0.0966)	(0.1740)
University	0.393***	-0.194**	0.526***	0.320	-0.005	-0.290*
	(0.0815)	(0.0788)	(0.0884)	(0.2212)	(0.0910)	(0.1672)
Parent homeowner	0.272***	-0.003	0.328***	0.025	0.016	-0.182
	(0.0808)	(0.0741)	(0.0938)	(0.1618)	(0.0926)	(0.1267)
Apartment price (lagged)	0.093	-0.116*	0.119	-0.453***	-0.115	-0.315**
	(0.0683)	(0.0670)	(0.0744)	(0.1709)	(0.0754)	(0.1417)
Ratio of college-educated women to men	-3.061***	-2.543***	-1.808**	2.558	-1.316*	0.029
	(0.6891)	(0.6230)	(0.7604)	(1.8642)	(0.7035)	(1.4962)
Constant	-20.264***	-25.356***	-18.787***	-30.428***	-24.704***	-31.662***
	(1.3778)	(1.3585)	(1.4943)	(5.0848)	(1.5128)	(3.6291)
Observations	28,673	22,703	15,985	12,688	10,998	11,705

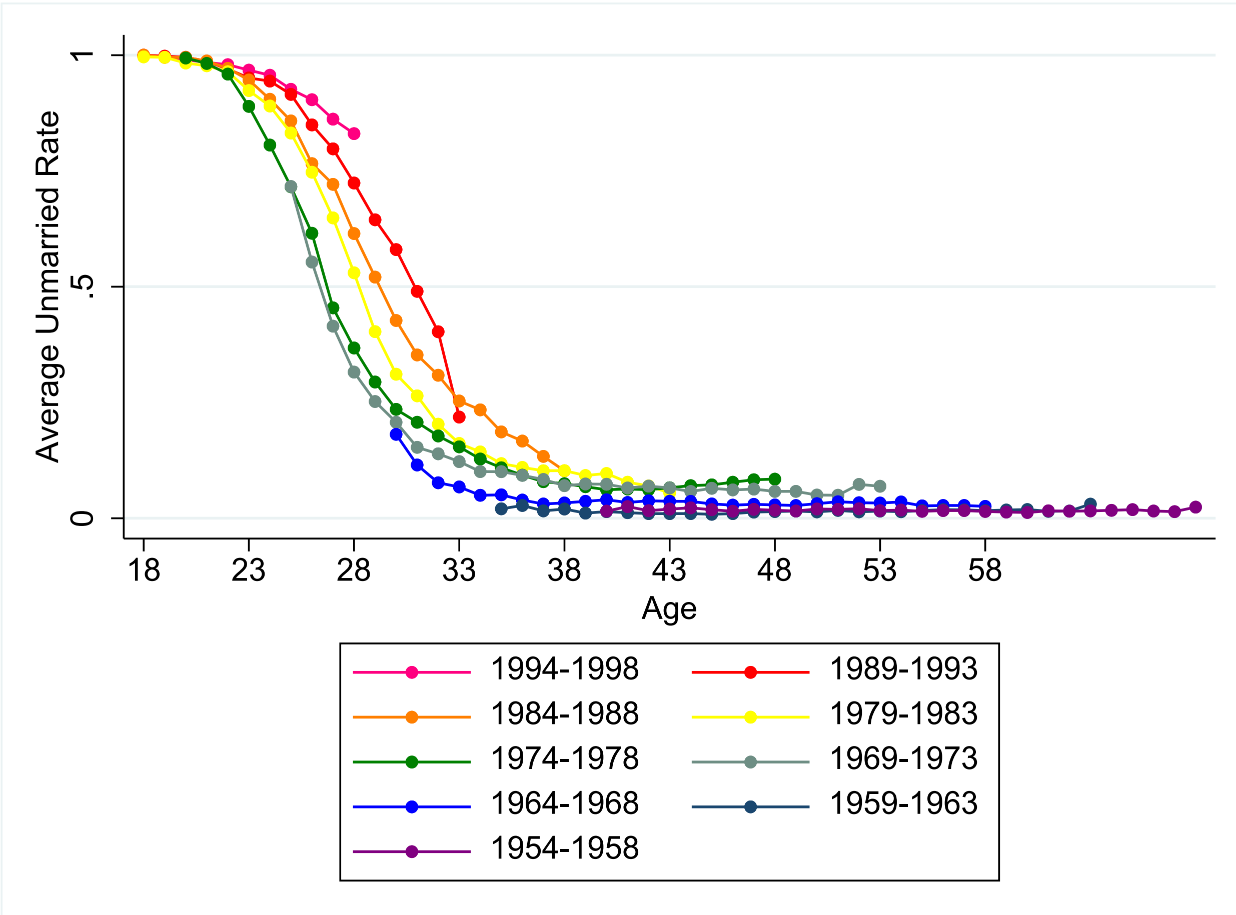
Note: ‘Old’ indicates cohorts born from 1969 to 1983, while ‘Young’ indicates cohorts born between 1984 and 1998. Standard errors are indicated in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A4. Survival Analysis: Incidence of Childbirth Among Female Adults by Cohort

	(1) All	(2) Old	(3) Young
Age	0.668***	0.734***	-0.042
	(0.0857)	(0.0993)	(0.2386)
Age squared	-0.012***	-0.013***	0.000
	(0.0013)	(0.0015)	(0.0039)
Only child	-0.377**	-0.373	-0.327
	(0.1703)	(0.2284)	(0.2619)
Metropolitan residence	0.138**	0.165**	-0.047
	(0.0589)	(0.0688)	(0.1221)
School enrolled	-0.309	-0.362*	-0.060
	(0.2011)	(0.2190)	(0.5128)
Employed (lagged)	-0.591***	-0.555***	-0.700***
	(0.0706)	(0.0803)	(0.1501)
Income (lagged)	0.020	0.012	0.042
	(0.0155)	(0.0181)	(0.0315)
Junior College	0.280***	0.393***	-0.101
	(0.0799)	(0.0893)	(0.1861)
University	0.301***	0.355***	0.083
	(0.0744)	(0.0828)	(0.1760)
Homeowner	0.241***	0.254***	0.269**
	(0.0575)	(0.0669)	(0.1145)
Household income (lagged)	0.124***	0.058	0.338***
	(0.0466)	(0.0527)	(0.0994)
Household financial assets (lagged)	-0.000	0.006	-0.038
	(0.0212)	(0.0241)	(0.0447)
Region-specific education cost (lagged)	-0.026***	-0.020***	-0.025***
	(0.0035)	(0.0044)	(0.0081)
Dummy for the marriage year (t) and (t-1)	-0.041	-0.088	0.115
	(0.0634)	(0.0748)	(0.1243)
Constant	-10.790***	-11.315***	-1.948
	(1.3929)	(1.6182)	(3.6589)
Observations	5,137	3,897	1,240

Note: The dummy for the marriage years (t) and (t-1) is 1 for the marriage year (t) and the prior year (t-1) and 0 otherwise. 'Old' indicates cohorts born from 1969 to 1983, while 'Young' indicates cohorts born from 1984 to 1998. Standard errors are indicated in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Fig. A1. Cumulative Unmarried Rate by Age for Birth Cohorts



Note: Constructed using the sample of Korean Labor and Income Panel Study (KLIPS) from 1998 to 2022.

B. Steady-State Equations and Balanced Growth Rate

This appendix derives the equations required to solve for the steady-state values and to calculate the balanced growth rate.

Households

The economy consists of two types of households: married and unmarried. Each seeks to maximize its utility function subject to specific constraints.

The married family's collective utility takes the composite form: $\Theta_t V_M^m(t) + (1-\Theta_t)\, V_M^f(t)$. The problem for a married household is to maximize its utility function:

$$V_M(t) = \Theta_t V_M^m(t) + (1-\Theta_t)\, V_M^f(t) = \eta_c \frac{1}{1-\sigma} {c_t^M}^{1-\sigma} + \eta_e \left[\frac{1}{1-\sigma} \left(\left(\frac{\pi_c n_t}{2} \right)^{\delta} e_{t+1}^m \right)^{1-\sigma} + \frac{1}{1-\sigma} \left(\left(\frac{\pi_c n_t}{2} \right)^{\delta} e_{t+1}^f \right)^{1-\sigma} \right] + \beta \pi_A \frac{1}{1-\sigma} {c_{t+1}^M}^{1-\sigma} - (1-\Theta_t)\gamma \kappa_j V_s^f(t)\,, \text{ j=c, nc (for females)}$$

(A1)

subject to

$$(1-\tau_t - x_t) e_t^m (1 - \theta v \pi_c n_t - \pi_c n_t \epsilon_t^e) w_t^m + (1-\tau_t - x_t) e_t^f (1-(2-\theta) v \pi_c n_t - \pi_c n_t \epsilon_t^e) w_t^f - \mathrm{c_t^M} - \frac{\pi_A c_{t+1}^M}{1+r_{t+1}} + \mathrm{z_{t+1}} = 0$$

(A2)

$$e_{t+1}^m = \bar{e} \left(\frac{\mu G_t}{\frac{n_t N_t}{2}} \right)^{\nu_1} \left[(e_t^f)^{\chi} (e_t^m)^{1-\chi} \right]^{1-\nu_1} (2b\epsilon_t^e)^{\nu_2} \qquad \text{(A3)}$$

$$e_{t+1}^f = \bar{e} \left(\frac{\mu G_t}{\frac{n_t N_t}{2}} \right)^{\nu_1} \left[(e_t^f)^{\chi} (e_t^m)^{1-\chi} \right]^{1-\nu_1} (2(1-b)\epsilon_t^e)^{\nu_2} \qquad \text{(A4)}$$

The bargaining power of the male Θ_t is determined as

$$\Theta_t = \frac{e_t^m w_t^m}{e_t^m w_t^m + \frac{1}{\gamma} e_t^f w_t^f} = \left(1 + \gamma^{-1} (e_t^f / e_t^m)(w_t^f / w_t^m)\right)^{-1} = \left(1 + \gamma^{-1} d (e_t^f / e_t^m)\right)^{-1} \qquad \text{(A5)}$$

The first-order optimality conditions derived from the married household problem are

$(c_t)\qquad \eta_c c_t^{M^{-\sigma}} = \lambda$

$(c_{t+1})\quad \beta\pi_A c_{t+1}^{M}{}^{-\sigma} = \lambda \frac{\pi_A}{1+r_{t+1}}$

Combining two equations yields

$$\left(\frac{c_{t+1}^M}{c_t^M}\right)^\sigma = \beta\eta_c^{-1}(1+r_{t+1}) \tag{A6}$$

$$(\epsilon_t^e)\quad \eta_e\left(\left(\frac{\pi_c \mathrm{n_t}}{2}\right)^{\delta} \mathrm{e_{t+1}^m}\right)^{-\sigma}\left(\frac{\pi_c \mathrm{n_t}}{2}\right)^{\delta}\bar{e}\left(\frac{\mu G_t}{\frac{\pi_c n_t N_t}{2}}\right)^{\nu_1}\left[(e_t^f)^\chi (e_t^m)^{1-\chi}\right]^{1-\nu_1}(2b)^{\nu_2}\nu_2(\epsilon_t^e)^{\nu_2-1}$$

$$+\eta_e\left(\left(\frac{\pi_c \mathrm{n_t}}{2}\right)^{\delta} \mathrm{e_{t+1}^f}\right)^{-\sigma}\left(\frac{\pi_c \mathrm{n_t}}{2}\right)^{\delta}\bar{e}\left(\frac{\mu G_t}{\frac{\pi_c n_t N_t}{2}}\right)^{\nu_1}\left[(e_t^f)^\chi (e_t^m)^{1-\chi}\right]^{1-\nu_1}(2(1-b))^{\nu_2}\nu_2(\epsilon_t^e)^{\nu_2-1}$$

$$= \eta_c \mathrm{c_t^{M^{-\sigma}}}(1-\tau_t - x_t)(e_t^m n_t w_t^m + e_t^f n_t w_t^f] \tag{A7}$$

$$(n_t)\quad \eta_e(\mathrm{e_{t+1}^m})^{1-\sigma}\left(\frac{1}{2}\right)^{\delta(1-\sigma)}\delta\pi_c(\pi_c \mathrm{n_t})^{\delta(1-\sigma)-1} + \eta_e\left(\mathrm{e_{t+1}^f}\right)^{1-\sigma}\left(\frac{1}{2}\right)^{\delta(1-\sigma)}\delta\pi_c(\pi_c \mathrm{n_t})^{\delta(1-\sigma)-1}$$

$$= \eta_c \mathrm{c_t^{M^{-\sigma}}}(1-\tau_t - x_t)\pi_c[\mathrm{e_t^f w_t^f}(\epsilon_t^e + (2-\theta)\mathrm{v}) + e_t^m \mathrm{w_t^m}(\epsilon_t^e + \theta\mathrm{v})]\,. \tag{A8}$$

An unmarried individual maximizes their utility function.

$$V_S(t) = \eta_c \frac{1}{1-\sigma} c_t^{S^{1-\sigma}} + \beta\pi_A \frac{1}{1-\sigma} c_{t+1}^{S}{}^{1-\sigma}$$

subject to

$$(1-\tau_t - x_t)e_t^f w_t^S - c_t^S - \frac{\pi_A\, c_{t+1}^S}{1+r_{t+1}} - \mathrm{z_{t+1}} = 0$$

The first-order optimality conditions derived from the unmarried individual problem suggest

$$\left(\frac{c_{t+1}^S}{c_t^S}\right)^\sigma = \beta\eta_c^{-1}(1+r_{t+1})$$

Dynamics for population size N_t

The number of adults in the next period N_{t+1} is the number of surviving children born at time t. Because the number of married households at time t is $\frac{p_t N_t}{2}$ and each household contributes n_t children, the dynamics of N_t can be expressed as

$$N_{t+1} = \pi_c n_t \frac{p_t N_t}{2} \tag{A9}$$

Savings

To derive the savings rate of married households, we use the following intertemporal budget constraint:

$$c_t^M + \frac{\pi_A c_{t+1}^M}{1+r_{t+1}} = (1 - \tau_t - x_t) w_t^H + \frac{z_{t+1}}{(1+r_{t+1})} \tag{A10}$$

Substituting (A6) into (A10) yields,

$$c_t^M + \frac{\pi_A}{1+r_{t+1}} (\beta \eta_c^{-1}(1 + r_{t+1}))^{1/\sigma} c_t^M = (1 - \tau_t - x_t) w_t^H + \frac{z_{t+1}}{(1+r_{t+1})}$$

$$c_t^M = \frac{1}{1+\frac{\pi_A}{1+r_{t+1}}(\beta \eta_c^{-1}(1+r_{t+1}))^{1/\sigma}} \left[(1 - \tau_t - x_t) w_t^H + \frac{z_{t+1}}{(1+r_{t+1})}\right] \tag{A11}$$

The savings rate, SR_t, defined as the ratio of savings to net disposable income, is derived as follows:

$$SR_t = 1 - \frac{1}{1+\frac{\pi_A}{1+r_{t+1}}\left(\beta \eta_c^{-1}(1+r_{t+1})\right)^{\frac{1}{\sigma}}} \left(1 + \frac{\hat{z}_{t+1}}{(1+r_{t+1})}\right) \tag{A12}$$

where $\hat{z}_{t+1}$ indicates the ratio of social security benefit to net disposable income, which is derived as $\hat{z}_{t+1} \equiv \frac{z_{t+1}}{(1-\tau_t-x_t) w_t^H} = {\pi_A}^{-1} p_t \pi_c n_t x_t$.

The savings rate for an unmarried household follows the same formula as in Equation (A12).

Labor market equilibrium

At labor market equilibrium, the gross wage incomes of married males and females are related as follows:

$$w_t^m e_t^m h_t^{mw} = d^{-1} w_t^f e_t^f h_t^w \tag{A13}$$

Therefore, the total wage income for a married household is:

$$W_t^H = e_t^m h_t^{mw} w_t^m + e_t^f h_t^w w_t^f = (1+d^{-1}) e_t^f h_t^w w_t^f \quad \text{(A14)}$$

For married households h_t^w represents the wife's remaining time after child-rearing and education. By contrast, for unmarried individuals, the wage income is $d^{-1} e_t^f w_t^f (1-u)$ for males and $e_t^f w_t^f (1-u)$ for females, with h_t^w equal to $(1-u)$. Thus, their average wage income becomes

$$W_t^S = \frac{1}{2}(1+d^{-1})(1-u) e_t^f w_t^f \quad \text{(A15)}$$

Total wage income for married and unmarried workers is

$$W_t N_t = \frac{p_t}{2} N_t W_t^H + (1-p_t) N_t W_t^S = \frac{p_t}{2} N_t (1+d^{-1}) e_t^f h_t^w w_t^f + \frac{1-p_t}{2} N_t (1+d^{-1})(1-u) e_t^f w_t^f \quad \text{(A16)}$$

Firms

Production function is given by:

$$Y_t^i = (E_t^m H_t^{mw} N_t^{m,i})^\alpha (E_t^f H_t^w N_t^{f,i})^\alpha (K_t^i)^{1-2\alpha}$$

Firms do not differentiate between married and unmarried individuals in production.

At equilibrium, $e_t^m = E_t^m$, $e_t^f = E_t^f$, $Y_t^i = Y_t$, $N_t^{m,i} = N_t^{f,i} = \frac{1}{2} N_t$, $H_t^m = h_t^{Male} = [p_t h_t^{mw} + (1-p_t)]$, $H_t^f = h_t^{Female} = [p_t h_t^w + (1-p_t)(1-u)]$.

From the Cobb-Douglas production function, the total wage is equal to αY_t for males in an equilibrium, while it is $d\alpha Y_t$ for females We can drive the average wage rates for males and females:

$$w_t^f = \frac{2d\alpha}{e_t^f h_t^F} \frac{Y_t}{N_t} = \frac{2d\alpha}{e_t^f [p_t h_t^w + (1-p_t)(1-u)]} \frac{Y_t}{N_t} = \frac{2d\alpha}{e_t^f [p_t(1-(2-\theta) v \pi_c n_t - \pi_c n_t \epsilon_t^e) + (1-p_t)(1-u)]} \frac{Y_t}{N_t} \quad \text{(A17)}$$

$$w_t^m = \frac{2\alpha Y_t}{e_t^m h_t^M N_t} = \frac{2\alpha}{\left(\frac{b}{1-b}\right)^{v_2} e_t^f [p_t(1-\theta v \pi_c n_t - \pi_c n_t \epsilon_t^e) + (1-p_t)(1-u)]} \frac{Y_t}{N_t} \quad \text{(A18)}$$

Total savings

Total saving S_t in equilibrium is derived by:

$$S_tN_t = \frac{p_t}{2}N_tS_t^M + (1-p_t)N_tS_t^S$$

$$= \frac{p_t}{2}N_t[SR_t(1-\tau_t-x_t)w_t^H] + (1-p_t)N_t[SR_t(1-\tau_t-x_t)w_t^S]$$

$$= SR_t(1-\tau_t-x_t)N_t[\frac{p_t}{2}(1+d^{-1})e_t^f h_t^w w_t^f + \frac{1}{2}(1-p_t)(1-u)(1+d^{-1})e_t^f w_t^f]$$

$$= \frac{1}{2}SR_tN_t(1-\tau_t-x_t)(1+d^{-1})e_t^f w_t^f[p_th_t^w + (1-p_t)(1-u)]$$

$$= SR_t\Phi N_t^f e_t^f[p_t(1-(2-\theta)v\pi_cn_t - \pi_cn_t\epsilon_t^e) + (1-p_t)(1-u)]w_t^f \quad \text{(A19)}$$

where $\Phi = (1-\tau_t-x_t)(1+d^{-1})$.

We can also derive the interest rate as:

$$r_{t+1} = \frac{(1-2\alpha)Y_{t+1}}{K_{t+1}} \quad \text{(A20)}$$

Dynamics for capital stock and output

From the condition for the equilibrium in section 4.6, we have

$$K_{t+1} = S_tN_t = \Phi N_t^f SR_te_t^f[p_th_t^w + (1-p_t)(1-u)]w_t^f = \Phi d\alpha SR_tY_t \quad \text{(A21)}$$

Dividing both sides by K_t,

$$\frac{K_{t+1}}{K_t} = \Phi d\alpha SR_t\frac{Y_t}{K_t} \quad \text{(A22)}$$

Total output can be rewritten as:

$$Y_t = \left(\frac{E_t^mN_t^m}{K_t}\right)^\alpha \bar{Y}\left(\frac{E_t^fN_t^f}{K_t}\right)^\alpha [H_t^{mw}]^\alpha[H_t^w]^\alpha K_t$$

$$= \left(\frac{E_t^mN_t^m}{K_t}\right)^\alpha \bar{Y}\left(\frac{E_t^fN_t^f}{K_t}\right)^\alpha [p_th_t^{mw} + (1-p_t)(1-u)]^\alpha[p_th_t^w + (1-p_t)(1-u)]^\alpha K_t$$

$$= \left(\frac{1}{k_t^m}\right)^{\alpha} \left(\frac{1}{k_t^m}\right)^{\alpha} [p_t(1 - \theta v \pi_c n_t - \pi_c n_t \epsilon_t^e) + (1 - p_t)(1 - u)]^{\alpha} [p_t(1 - (2 - \theta) v \pi_c n_t - \pi_c n_t \epsilon_t^e) + (1 - p_t)(1 - u)]^{\alpha} K_t \quad \text{(A23)}$$

where $k_t^m = \frac{K_t}{E_t^m N_t^m}$ and $k_t^f = \frac{K_t}{E_t^f N_t^f}$.

We can derive physical capital to output ratio as:

$$\frac{Y_t}{K_t} = \left(\frac{1}{k_t^m}\right)^{\alpha} \left(\frac{1}{k_t^f}\right)^{\alpha} [p_t(1 - \theta v \pi_c n_t - n_t \pi_c \epsilon_t^e) + (1 - p_t)(1 - u)]^{\alpha} [p_t(1 - (2 - \theta) v \pi_c n_t - \pi_c n_t \epsilon_t^e) + (1 - p_t)(1 - u)]^{\alpha} \quad \text{(A24)}$$

Since $\frac{e_{t+1}^m}{e_{t+1}^f} = (\frac{b}{1-b})^{\nu_2}$ and $k_t^m = k_t^f (\frac{1-b}{b})^{\nu_2}$,

$$\frac{Y_t}{K_t} = \Gamma_1 [p_t(1 - \theta v \pi_c n_t - \pi_c n_t \epsilon_t^e) + (1 - p_t)(1 - u)]^{\alpha} [p_t(1 - (2 - \theta) v \pi_c n_t - \pi_c n_t \epsilon_t^e) + (1 - p_t)(1 - u)]^{\alpha} \left(\frac{1}{k_t^f}\right)^{2\alpha} \quad \text{(A25)}$$

where $\Gamma_1 = (\frac{b}{1-b})^{\alpha \nu_2}$

Dynamics for human capital

From (17) and (25) in the main text,

$$e_{t+1}^f = \bar{e}_t \left(\frac{\mu G_t}{\frac{\pi_c n_t N_t}{2}}\right)^{\nu_1} \left[(e_t^f)^{\chi} (e_t^m)^{1-\chi} \right]^{1-\nu_1} (2(1-b)\epsilon_t^e)^{\nu 2}$$

$$= \bar{e}_t \left(\frac{\mu \tau (1+d) \alpha}{\pi_c n_t / 2}\right)^{\nu_1} \left(\frac{(1+\emptyset)^{-1} Y_t}{N_t}\right)^{\nu_1} \left[(e_t^f)^{\chi} (e_t^m)^{1-\chi} \right]^{1-\nu_1} (2(1-b)\epsilon_t^e)^{\nu 2}$$

$$= \bar{e}_t \left(\frac{\mu \tau (1+d) \alpha}{\pi_c n_t / 2}\right)^{\nu_1} \left(\frac{(1+\emptyset)^{-1} Y_t}{N_t}\right)^{\nu_1} \left[e_t^f \, (\frac{b}{1-b})^{\nu_2 (1-\chi)} \right]^{1-\nu_1} (2(1-b)\epsilon_t^e)^{\nu 2} \quad \text{(A26)}$$

$$\frac{Y_t}{0.5e_t^f N_t} = \frac{Y_t}{K_t}\frac{K_t}{e_t^f N_t^f} = \frac{Y_t}{K_t}k_t^f =$$

$$= \Gamma_1\,[p_t h_t^{mw} + (1-p_t)(1-u)]^{\alpha}\,[p_t h_t^{w} + (1-p_t)(1-u)]^{\alpha}(k_t^f)^{1-2\alpha}$$

$$= \Gamma_1\,[p_t(1-\theta v\pi_c n_t - \pi_c n_t\epsilon_t^e) + (1-p_t)(1$$

$$- u)]^{\alpha}[p_t(1-(2-\theta)v\pi_c n_t - \pi_c n_t\epsilon_t^e) + (1-p_t)(1-u)]^{\alpha}(k_t^f)^{1-2\alpha}$$

Dynamics for k_t^f

$$k_{t+1}^f = \frac{K_{t+1}}{E_{t+1}^f N_{t+1}^f} = \frac{K_{t+1}}{E_{t+1}^f 0.5p_t\pi_c n_t N_t/2} = \frac{d\alpha\Phi SR_t Y_t}{0.25p_t E_{t+1}^f \pi_c n_t N_t}$$

$$= \frac{d\alpha\Phi SR_t(Y_t/N_t)}{0.25p_t\pi_c n_t\bar{e}_t\left(\frac{\mu\tau(1+d)\alpha}{\pi_c n_t/2}\right)^{\nu_1}\left(\frac{(1+\emptyset)^{-1}Y_t}{N_t}\right)^{\nu_1}(e_t^f)^{1-\nu_1}[2(1-b)\epsilon_t^e]^{\nu_2}\left[\left(\frac{b}{1-b}\right)^{\nu_2(1-\chi)}\right]^{1-\nu_1}}$$

$$= \frac{2p_t^{-1}d\alpha\Phi SR_t}{[2(1-b)]^{\nu_2}\left[\left(\frac{b}{1-b}\right)^{\nu_2(1-\chi)}\right]^{1-\nu_1}\bar{e}_t(\pi_c n_t)^{1-\nu_1}}(\mu\tau(1+d)\alpha)^{-\nu_1}(1+\emptyset)^{\nu_1}\left(\frac{Y_t}{0.5e_t^f N_t}\right)^{1-\nu_1}(\epsilon_t^e)^{-\nu_2}$$

$$= \Gamma_2 p_t^{-1}SR_t\left(\frac{Y_t}{0.5e_t^f N_t}\right)^{1-\nu_1}(\epsilon_t^e)^{-\nu_2} \qquad \text{(A27)}$$

where $\Gamma_2 = \frac{2d\alpha\Phi}{[2(1-b)]^{\nu_2}\left[\left(\frac{b}{1-b}\right)^{\nu_2(1-\chi)}\right]^{1-\nu_1}\bar{e}_t(\pi_c n_t)^{1-\nu_1}}(\mu\tau(1+d)\alpha)^{-\nu_1}(1+\emptyset)^{\nu_1}$.

By definition,

$$\frac{Y_t}{0.5e_t^f N_t} = \frac{Y_t}{K_t}\frac{K_t}{e_t^f N_t^f} = \frac{Y_t}{K_t}k_t^f$$

$$= \Gamma_1\,[p_t h_t^{mw} + (1-p_t)(1-u)]^{\alpha}\,[p_t h_t^{w} + (1-p_t)(1-u)]^{\alpha}(k_t^f)^{1-2\alpha}$$

$$= \Gamma_1\,[p_t(1-\theta v\pi_c n_t - \pi_c n_t\epsilon_t^e) + (1-p_t)(1-u)]^{\alpha}\,[p_t(1-(2-\theta)v\pi_c n_t - \pi_c n_t\epsilon_t^e) + (1-p_t)(1-u)]^{\alpha}(k_t^f)^{1-2\alpha} \qquad \text{(A28)}$$

Combine (A28) with (A27)

$$k_{t+1}^f = \Gamma_2 \mathrm{p}^{-1}SR_t\,(\bar{A}\Gamma_1)^{1-\nu_1}\,[p_t(1-\theta v n_t - n_t\epsilon_t^e) + (1-p_t)(1-u)]^{\alpha(1-\nu_1)}\,[p_t(1-(2-\theta)v\pi_c n_t - \pi_c n_t\epsilon_t^e) + (1-p_t)(1-u)]^{\alpha(1-\nu_1)}(k_t^f)^{(1-2\alpha)(1-\nu_1)} \qquad \text{(A29)}$$

Steady-state growth rate

From (A9), (A21) and (A25)

$$\frac{Y_{t+1}}{N_{t+1}} = \frac{Y_{t+1}}{K_{t+1}}\frac{K_{t+1}}{N_{t+1}} = \frac{Y_{t+1}}{K_{t+1}}K_{t+1}\frac{1}{N_{t+1}}$$

$$= 2\Gamma_1 \left[\left[p_t(1-\theta v\pi_c n_t - \pi_c n_t \epsilon_t^e) + (1-p_t)(1-u)\right]\right]^{\alpha} \left[p_t(1-(2-\theta)v\pi_c n_t - \pi_c n_t \epsilon_t^e)\right.$$
$$\left. + (1-p_t)(1-u)\right]^{\alpha} \left(\frac{1}{k_{t+t}^f}\right)^{2\alpha} d\alpha\Phi SR_t \frac{1}{p_t n_t}\frac{Y_t}{N_t}$$

In the steady state, we have

$$1+\gamma_{Y/N} = 2\bar{A}\,\Gamma_1[p^*(1-\theta v\pi_c n^* - \pi_c n^* \epsilon^{e*}) + (1-p^*)(1-u)]^{\alpha}[p^*(1-(2-\theta)v\pi_c n^* - \pi_c n^* \epsilon^{e*}) + (1-p^*)(1-u)]^{\alpha}(k_f^*)^{-2\alpha} d\alpha\Phi SR^*(p^*\pi_c n^*)^{-1} \quad \text{(A30)}$$

where the variables with * are steady-state values and $k^{f*} = (\frac{K}{e^f N^f})^*$.

C. Korea's Policy Responses to Low Fertility

In response to the socio-economic challenges posed by rapidly declining fertility and accelerating population aging, the Korean government launched the Basic Plan for a Low Fertility and Aging Society in 2006. This comprehensive policy framework, updated every five years, serves as the cornerstone of Korea's family and population policies. Since its inception, the plan has steadily expanded to include a wide array of measures aimed at encouraging marriage, childbirth, and child-rearing, while promoting work–life balance.

C.1. Economic support for childbirth and child-rearing

The central pillar of the government's response has been the provision of financial incentives and subsidies to reduce the direct and indirect costs of raising children. These include:

- Childbirth grants and allowances: Local and central governments have introduced lump-sum cash transfers to families upon childbirth, with amounts varying by region and birth order.
- Child allowances and childcare subsidies: Since 2018, the government has provided monthly cash benefits to households with children aged below seven. The childcare allowance program specifically targets children below age five who are cared for at home, whereas daycare subsidies cover the cost of institutional childcare. The state has also expanded the supply of national and public daycare centers to reduce reliance on costly private services.
- Phased expansion of free childcare and early education: The government has pledged to provide free childcare and pre-school education for children up to age five by 2027, reflecting a long-term commitment to reducing early childhood education costs.

C.2. Parental leave and work–family balance

Korea's statutory parental leave, first introduced in the early 2000s, allows up to one year of leave with benefits funded by employment insurance. Since the mid-2010s, the government has:

- Increased wage replacement rates for those availing leave, especially during the initial months.
- Introduced policies encouraging couples to take leave simultaneously or sequentially.
- Strengthened legal protections to prevent discrimination against those taking leave.

Despite these improvements, substantial gender disparities persist. In 2023, 73.2% of eligible mothers took parental leave compared to only 7.4% of eligible fathers, underscoring the enduring cultural and workplace barriers to paternal involvement in childcare.

To complement leave policies, the government has promoted work–life balance initiatives, such as reduced working hours for parents with young children, flexible work schedules, staggered commuting times, and telecommuting arrangements. However, the uptake remains uneven across sectors, with small and medium-sized enterprises often lagging behind large corporations in implementation.

C.3. Marriage and housing support

Recognizing that delayed and forgone marriages are closely linked to fertility decline, the government has introduced various programs to reduce the financial burden of marriage and family formation. Key measures include:

- Public housing programs: Priority allocation of rental units and subsidized mortgages for newly-weds, with additional benefits for couples with children.
- Housing finance support: Lower interest loans and tax incentives for first-time home-buyers, particularly newly-weds.
- Tax relief for intergenerational transfers: Expanded exemptions on gifts and inheritance taxes for financial support from parents used for weddings or housing purchases.

These policies reflect the recognition that high housing costs, especially in metropolitan areas, pose a significant obstacle to family formation among young adults.

C.4. Fiscal commitment and international comparison

As a result of these policy initiatives, public awareness regarding Korea's low-fertility problem has risen significantly, and government expenditure on family support has expanded. Nevertheless, Korea's overall spending remains modest compared with international standards. In 2019, total family policy expenditures amounted to 1.56% of GDP, well below the OECD average of 2.29%. In particular, cash-based benefits such as family allowances, parental leave, and related transfers accounted for only 0.32% of GDP, compared with the OECD average of 1.12% (OECD, 2025).

These figures highlight both the progress made and the limitations of Korea's approach. While the scale of financial support has grown over time, the relative size of the commitment lags behind other OECD countries.

D. Sensitivity Test

This section evaluates the robustness of the three policy experiments—namely, a 25% reduction in child-rearing costs, a 25% reduction in child-education costs, and a 20% reduction in marriage costs—to alternative assumptions for key parameters listed in Table 6. For instance, we re-simulate the effects of the child rearing cost reduction under alternative values of college women's sensitivity to gender norms, κ_C, changing it from the baseline value of 0.2 to 0 (low) and 0.4 (high). The results are shown in Appendix Table D1, along with the baseline simulation outcomes from Table 8 for reference.

Across a sufficiently wide range of values for key parameters, the simulated fertility and marriage rates remain close to the baseline in Table 8 across Columns (1) to (6). In most cases, especially for marriage rates, deviations from the baseline are within 10%, suggesting that the policy effects are robust qualitatively. However, fertility rates demonstrate greater sensitivity to preference and elasticity parameters. For the child-rearing cost reduction (Column (1)), the child-education cost reduction (Column (3)), and the marriage cost reduction (Column (5)), fertility rates deviate by more than 10% from the baseline when varying the values of preference parameter for children (η_e) and elasticity of parental utility with respect to the number of children (δ). Moreover, fertility responses to the child-education cost reduction are additionally sensitive to the elasticity with respect to public education spending (υ_1) and parental education time (υ_2), while fertility responses to marriage cost reduction are more sensitive to the elasticity of spousal search costs with respect to marriage probability (ε).

Table D1. Sensitivity Test: Effects of Three Government Policy under Alternative Assumptions for Key Parameters

Parameter		Baseline: Values in 2023	Alternatives	**Child-Rearing costs (↓25%)** Fertility Rate	**Child-Rearing costs (↓25%)** Marriage Rate	**Child-education costs (↓25%)** Fertility Rate	**Child-education costs (↓25%)** Marriage Rate	**Marriage costs (↓20%)** Fertility Rate	**Marriage costs (↓20%)** Marriage Rate
				(1)	(2)	(3)	(4)	(5)	(6)
Simulation Results in Table 8				**0.950**	**0.690**	**0.817**	**0.690**	**0.846**	**0.805**
κ_C	Sensitivity to gender norms (college women)	0.2	0 (low)	0.954	0.694	0.820	0.693	0.849	0.809
			0.4 (high)	0.945	0.685	0.812	0.685	0.843	0.801
ε	Elasticity of spousal search cost w.r.t. marriage probability	1.52	1.3 (low)	0.909	0.653	0.782	0.653	0.828	0.783
			1.8 (high)	0.989	0.725	0.850	0.725	0.863	0.827
σ	Inverse of intertemporal elasticity of substitution	0.8	0.67 (low)	0.863	0.689	0.734	0.689	0.766	0.805
			0.91 (high)	1.028	0.703	0.889	0.703	0.914	0.819
η_e	Preference parameter for children	1.3	1 (low)	0.761	0.677	0.657	0.676	0.695	0.792
			1.6 (high)	1.108	0.698	0.948	0.698	0.967	0.814
δ	Elasticity of parental utility w.r.t. the number of children	1.03	0.8 (low)	0.798	0.691	0.692	0.691	0.656	0.807
			1.2 (high)	1.051	0.689	0.898	0.689	0.964	0.804
θ	Bargaining power of a female in child-rearing time	0.369	0.1 (low)	0.912	0.690	0.912	0.690	0.789	0.806
			0.5 (high)	0.962	0.689	0.962	0.689	0.868	0.805
υ_1	Elasticity w.r.t public spending in education	0.4	0.1 (low)	1.145	0.697	0.968	0.696	0.981	0.812
			0.6 (high)	0.864	0.686	0.749	0.686	0.784	0.802
υ_2	Elasticity w.r.t parent's education time	0.3	0.1 (low)	0.882	0.685	0.759	0.685	0.987	0.801
			0.5 (high)	1.020	0.694	0.875	0.694	0.694	0.811