Social Norms and Fertility

Appendix for Online Publication

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Appendix A Social Norms

According to Young (2018), social norms impose a uniformity of behavior within a given social group, and norm shifts may occur over time when there exist changes in objective circumstances or changes in subjective perceptions and expectations. In the paper, we mainly discuss two types of social norms: the unequal gender division of childcare and the social stigma attached to out-of-wedlock births. In this section, we first discuss the uniformity and strong time persistence of these two social norms. We then discuss other social norms that may affect fertility and marriage decisions.

A.1 Unequal Gender Division of Childcare

We discuss the robustness of our findings in Table 3 by investigating different types of households and childcare activities. We then conduct a regression analysis similar to De la Croix and Delavallade (2018) to examine how the proportion of housework/childcare provided by wives varies by birth cohorts and couple's education.

Table 3 in the main paper shows that for married couples with a wife aged 20-40, the proportion of childcare provided by the wife does not systematically change by the couple's education. Table A1 documents how the proportion of the wife's provision of childcare changes with the couple's education for different types of households with respect to the mother's age, the children's age, and whether the couple is dual-earner. We compute the proportion of the wife's provision of childcare for each household from the time-use diary of a wife and a husband in the Korean Time Use Survey (KTUS), then take the mean value of the proportions for married couples with the same level of education. Childcare in the survey includes the following activities: physical care for children (feeding, getting children ready for bed, bathing, etc.), reading to children, playing with children, providing medical care to children, providing home care to sick children, helping with homework or teaching children, picking up and dropping off children, and attending parent-teacher conferences. If the number of observations for couples with a particular level of education is less than 10, we do not report the proportion of the wife's provision of childcare and denote it as "N.A.". We use the pooled sample of 2004, 2009, and 2014 KTUS to construct samples for different types of households.

Panel A of Table A1 reports the proportion of childcare provided by wives for married couples with a wife aged 30–40. Panel B reports the proportion for those living with young children aged 6 or below. Panel

C reports the proportion for those living with young children aged 6 or below and a wife aged 20–40. Panel D reports the proportion for dual-earner households living with young children aged 6 or below. We don't find any systematic relationship between the proportion of childcare provided by wives and a couple's education level. This is consistent with what we document in Table 3. The proportion does not monotonically increase with husband's education conditional on wife's education. Likewise, the proportion does not monotonically decrease with wife's education conditional on husband's education. If the proportion of the wife's provision of childcare were decided based on the relative opportunity costs of a wife and a husband—which would likely depend on each spouse's relative educational attainment—we would see a monotone decrease in the proportion with a wife's relative education level.

Table A2 documents how the proportion of childcare provided by wives changes by different types of childcare activities. We classify childcare activities into three categories: (i) parental time for children's basic needs (Panel A); (ii) parental time for children's education (Panel B); and (iii) parental time for children's health (Panel C). Childcare time for children's basic need includes physical care for children (feeding, getting the child ready for bed, bathing, etc.), playing with children, and picking up and dropping off children. Childcare for children's education includes reading to children, helping with homework or teaching children, and attending parent-teacher conferences. Childcare for children's health includes providing medical care to children and providing home care to sick children. For each childcare activity, the proportion of childcare provided by wives does not systematically change with the education levels of a wife and a husband, thus confirming the strong uniformity across different groups.

To examine the statistical significance of the uniformity of the unequal gender division of childcare and its time persistence, we conduct a regression analysis following De la Croix and Delavallade (2018). We use the pooled sample of 2004, 2009, and 2014 KTUS. In this regression analysis, we test two hypotheses. First, we test whether the proportion of routine housework provided by wives changes with the education levels of a wife and a husband. Second, we test whether the proportion of routine housework provided by wives changes across different birth cohorts. We use time spent on routine housework rather than childcare in the regression, because old cohorts in the survey do not have young children living with them, and thus their time spent on childcare is zero. However, as a robustness check, we also do a regression on the time spent on childcare excluding the observations for old cohorts. The result is robust whether we use the time spent on housework or childcare in the regression. Routine housework includes the following activities: cleaning,

laundry, food preparation and clean-up, maintenance, and household management.

The regression specification is based on De la Croix and Delavallade (2018). We construct five birth cohorts: 1920s, 1930s, 1940s, 1950s, and 1960s based on the wife's birth year. We have five educational categories: primary school or below, middle school, high school, 2-year college, and 4-year college or above. The reference group is couples with the lowest education level (primary school or below) for both wife and husband.

We regress the proportion of routine housework provided by wives i (α_i) on a birth cohort indicator variable of the wife (B_i) and the interaction term of education levels of a wife and a husband $E_i^f \times E_i^m$. As control variables (Z_i), we include two dummy variables: one takes a value of 1 for dual-earner households and zero otherwise, and the other for households living with young children aged 6 or below.

$$\alpha_i = \beta_1 B_i + \beta_2 E_i^f \times E_i^m + \beta_3 Z_i + \varepsilon_i \tag{1}$$

Table A3 reports $\hat{\beta}_1$ and $\hat{\beta}_2$. We drop five educational matches from the analysis, because the number of observations for those educational matches is less than 25. The estimation results show that all coefficients of ($\hat{\beta}_1$ and $\hat{\beta}_2$) are statistically insignificant, supporting our hypothesis that the gender division of housework within a household does not change with a couple's education match or across different birth cohorts.

We do another regression using the time spent on childcare rather than on routine housework. We drop the cohort indicator variables and use only observations for the 1960 and 1970 birth cohorts to exclude those for old cohorts who don't spend any time on childcare. We regress the proportion of the wife's provision of childcare (α_i) on the interaction term of the education levels of a wife and a husband $E_i^f \times E_i^m$. Table A4 documents the results. Except for one case (in which the wife has the lowest education, and the husband gets middle school education), all coefficients are statistically insignificant, consistent with the previous findings.

A.2 Social Stigma Attached to Out-of-wedlock Births

The stigma attached to out-of-wedlock births had traditionally been the norm in both eastern and western societies (Akerlof et al., 1996; Dommaraju and Jones, 2011; Ochiai, 2011; Fernández-Villaverde et al., 2014; Raymo et al., 2015). The stigma has gradually faded in western societies, however, with the rise of

industrialization and economic development, and particularly with the advent of female contraception and the legalization of abortion (Akerlof et al., 1996; Fernández-Villaverde et al., 2014). In modern East Asian societies, in contrast, childbearing outside of marriage still incurs social stigma (Dommaraju and Jones, 2011; Ochiai, 2011; Raymo et al., 2015).

Figure A1 shows the proportion (%) of all live births for which the mother's legal marital status at the time of birth is other than married for South Korea, Hong Kong, Japan, US, UK, Finland, Spain, and Italy. Reference years for all countries other than Hong Kong are 1985, 2000, and 2015. Reference years for Hong Kong are 1995 and 2015. Data are from the OECD Family Database. We can make two observations from Figure A1. First, the proportion of births outside of marriage is substantially lower for South Korea, Hong Kong, Japan than for western countries across three survey years. For example, in 2015 the proportions of births outside marriage in South Korea, Hong Kong, Japan are 1.9%, 8.1%, and 2.3%, respectively; the average proportion for the western countries (U.S., UK, Finland, Spain, and Italy) is 41.4%.[1] Second, the proportions of births outside of marriage barely changed over time in South Korea, Hong Kong, and Japan, showing strong time persistence. In contrast, out-of-wedlock birth rates substantially increased between 1985 and 2015 in western countries. The average out-of-wedlock birth rate for western countries has increased from 14.1% in 1985 to 27.9% in 2000 to 41.5% in 2015.

A.3 Other Social Norms

Thus far, we have studied the social norm of unequal gender division in childcare and the social stigma attached to out-of-wedlock births. We now consider other potential norms. We first consider the norm of passing on the family name, which is regarded as a social responsibility in Confucian societies. Appendix A.3.1 shows evidence from World Value Surveys that the proportion of the population that believes having children is necessary is much higher in East Asian societies (66.4%) than western societies (23.8%). This norm differs from the social stigma attached to out-of-wedlock births in our model setting. Consider the following parental utility function of equation (2) in the main paper.

$$\begin{aligned} u(c_f^M, n) &= ln(c_f^M) + ln(\nu + \varepsilon^M n), \\ u(c_f^S, n) &= ln(c_f^S) + ln(\nu + \varepsilon^S n), \end{aligned} \tag{2}$$

[1] Among 36 OECD countries, the data for Iceland are not available. The average proportion for the remaining 33 OECD countries with available data other than South Korea and Japan is 41.5% in 2015.

The social stigma attached to out-of-wedlock births implies a smaller ε^S than ε^M. That is, the utility of having children is smaller for single mothers than married mothers. By contrast, the norm of passing on the family name implies a large difference in parental utility between having one child ($ln(\nu + \varepsilon^M)$) and no child ($ln(\nu)$) when married. Thus, the norm of passing on the family name translates into a small value of ν in our model. This is confirmed by the fact that our estimate of ν is much lower, at 6.5, than that in the U.S. (9.4) and developing countries (9.4) (Table 4 in the main paper). The counterfactual analysis in Appendix H.2 show that when ν increases, marriage rates and completed fertility for married mothers decrease, but childlessness rates for both single and married women increase (Rows (d) and (e) in Table H1).

We further modify the parental utility function of equation (2), allowing parents to derive different values from the first child and subsequent children to explicitly reflect the norm of passing on the family name. We then re-estimate the model with additional empirical moments of the percentage of couples with one child across education levels. Our estimation results show that South Korean parents indeed place more value on the first child than later children (Appendix F.4).

Women have traditionally been in a socially and economically disadvantaged position relative to men in East Asian patriarchal families, which we discuss in Appendix A.3.2 in detail. Lise and Yamada (2019) estimate the bargaining power of the wife in Japan, which is 0.11 lower than that for Canada in Browning et al. (2013). In our model, intrahousehold bargaining power depends on (i) the relative wages of the wife and husband and (ii) $\underline{\theta}$, which determines the low bound for the wife's bargaining power. Thus, the norm of low female intrahousehold bargaining power might be embodied by the low value $\underline{\theta}$. Table 4 in the main paper reports that the estimate of $\underline{\theta}$ is much lower than that in the U.S. Rows (f) and (g) in Table H1 show that when females enjoy higher bargaining power, marriage rates decrease, whereas changes in childlessness rates for both married and single women and completed fertility for married mothers are minimal.

The gender ideology of Confucianism may influence many aspects of life besides intrahousehold time allocation; for example, gender inequality and motherhood penalties in the workplace. We first consider female labor force participation (LFP), which is discussed in detail in Appendix A.3.3. Traditionally, mothers of young children are supposed to stay at home in Asian societies, which also used to be common in western societies (Doepke et al., 2015). The female LFP rate in South Korea has risen dramatically, from 0.28 in 1960 to 0.53 in 2016; this increase is larger than that in the U.S., where it rose from 0.38 in 1960 to 0.57 in 2016. Moreover, Appendix A.3.3 shows significant variations in female LFP rates across marriage type by

education, which contrasts with the little variation in childcare time (Table A3).

We then examine the gender wage gap in the labor market. Table 4 in the main paper shows that the gender wage gap is larger in South Korea than in both the U.S. and developing countries. Appendix A.3.4 shows that conditional on education, age, and age squared, the ratio of female to male wage rates has steadily increased from 0.634 for the 1920 cohort to 0.844 for the 1970 cohort. Thus, we conclude that women's labor market behaviors are much more responsive to economic incentives than their intrahousehold time allocation, although the former behaviors are still influenced by gender ideology. Rows (h) and (i) in Table H1 in Appendix H.2 show that when the gender wage gap decreases, marriage rates and completed fertility for married mothers decrease and childlessness rates for married women increase.

Our study focuses on fertility—i.e., the number of children—and ignores child quality. Another potential norm concerns the desire to have high-quality children, as East Asian societies—and South Korea in particular—are well known for high investment in private schooling and tutoring. Appendix A.3.5 discusses the heavy parental time devoted to educating children in East Asian societies. For example, total childcare time is 233 minutes per day in South Korea, compared with 201 minutes per day in the U.S. The difference in total childcare time between the two countries mostly comes from the difference in time spent on educational activities, such as reading and helping with homework: 35 minutes per day in South Korea and 17 minutes in the U.S. The emphasis on child quality and large amounts of time spent educating children may directly affect fertility through the child quantity-quality tradeoff, which is not considered in our model.[2] Rows (j) and (k) in Table H1 in Appendix H.2 show that when the variable time cost of raising a child decreases, completed fertility for married mothers increases substantially, and childlessness rates for both married and single women decrease.

A.3.1 Passing on the Family Name

The importance of family lineage has been characterized as a distinctive feature of the East Asian societies (Chu and Yu, 2010; Kim and Park, 2010; Chen and Li, 2014; Raymo et al., 2015). In the Confucian tradition, perpetuating familial lines is heavily emphasized, and it is a social and family obligation for a woman to give birth to children who can pass on their family name (Thompson, 1989; Thornton and Lin, 1994). The social norm of the value of passing on the family name can thus affect fertility and marriage decisions.

[2] De la Croix and Delavallade (2018) introduces a child quantity and quality tradeoff in an economic model on religion and fertility.

World Value Survey panel data 1992–2007 show cross-country differences in attitudes toward childless women. One question asks, "Do you think that a woman has to have children in order to be fulfilled, or is this not necessary?". Respondents answer yes or no. Figure A2 plots the proportion of individuals (male, female, and both) who answer "yes" across countries.[3]

We can make two observations from the data. First, the proportion of population who believe having children is fulfilling for a woman is much higher in Asian societies (average 66.4%) than western countries (23.8%). In particular, the proportion is 76% in South Korea, 66% in Singapore, 58% in Taiwan, 69% in Japan, 16% in the U.S., 17% in Canada, 15% in Finland, and 46% in Spain. Second, no significant gender difference exists regarding the proportion of population who believe that having children is fulfilling. For example, in South Korea, 77% of men state that having a child is fulfilling for a woman, and 78% of women say the same. Thus, the attitude toward being childless does not show any gender bias. This finding is consistent with our estimate for ν for South Korea (6.5), which is much lower than estimates for the U.S. (9.4) and the mean value of estimates for developing countries (9.4), as shown in Table 4 in the main paper.

A.3.2 Low Female Intrahousehold Bargaining Power

The sociology literature characterizes families in East Asian societies as patriarchal, which imposes severe social and economic disadvantages on women relative to men within a household (Greenhalgh, 1985; Thornton and Lin, 1994; Park and Cho, 1995; Whyte, 2005). For example, Greenhalgh (1985) states "Traditional Confucian China and its cultural offshoots, Japan and Korea, evolved some of the most patriarchal family systems that ever existed"(p. 265). A strongly patriarchal culture can affect intrahousehold bargaining power and resource allocation between the wife and husband.

A few papers in the economics literature directly estimate the sharing rule/bargaining power of a wife. Using Canadian data on household income and consumption, Browning et al. (2013) find that the estimate for the wife's consumption share of the household expenditure is 0.58. A comparable estimate for East Asian societies can be found in Lise and Yamada (2019) who use household consumption data from Japan; they find that an average wife's consumption share of household expenditure is about 0.47 in Japan. Hence, the wife's estimated bargaining power, as measured by a wife's consumption share of household expenditure

[3]Reference years for each country are as follows: South Korea (1982, 1990, 1995, 2001); Singapore (2002); Taiwan (1994); Japan (1981, 1990, 1995, 2000); U.S. (1981, 1995, 1999); Canada (2000); Finland (1981, 1996); and Spain (1990, 1995, 2000). Data for Hong Kong, UK, and Italy are not available.

in Canada, is higher by 0.11 (23%) than that in Japan.

The literature finds that intrahousehold bargaining power depends on a wife's labor supply, income, assets, and human capital, as well as social norms (Duflo and Udry, 2004; Heath and Tan, 2014). In our model, intrahousehold bargaining power depends on (i) the relative wages of the wife and the husband and (ii) $\underline{\theta}$, which determines the lower bound for the wife's bargaining power in consumption sharing within a household. In this setup, a low value of $\underline{\theta}$ may reflect the effects of the social norm associated with patriarchal culture on intrahousehold resource allocation. Our estimated value of $\underline{\theta}$ for South Korea is much lower, at 0.225, than that for the U.S. (0.864) in Baudin et al. (2015).

A.3.3 Female Labor Force Participation

Fogli and Veldkamp (2011) and Fernández-Villaverde et al. (2014) show that the social norm against working mothers can negatively affect female labor supply. The key mechanism they demonstrate is that women learn from others (e.g., women from previous generations or women in the same local labor market) how costly it is to be a working mother. The time trend in female labor force participation rates (LFPR) in the U.S. is consistent with their theory on information diffusion and the learning process regarding the social norm.

The social norm against working mothers can also play a role in explaining the time trend in female LFPR in East Asian societies. However, as Young (2018) suggests, a significant change in objective circumstances can shift norms. Because of the rapid economic growth in East Asian societies over the last decades, the social norm against working mothers can exhibit a weaker time persistence than the social norm on the gender division of childcare. To compare time persistence between the norms, we conduct a similar exercise as in Section A.1. We find that contrary to the social norm on unequal gender division of childcare, the female LFPR has significantly changed over time, and thus features little time persistence.

Table A5 tabulates the average female LFPR of married women by couple's education. The sample includes women born between 1945 and 1970, aged 30–60 (who completed schooling), and who are married living with a spouse. Data are from the 1960, 1966, 1970, 1975, 1985, 1990, 1995, 2000, 2005, 2010, and 2015 censuses of South Korea. An individual is classified as working if her employment status during the survey indicates (i) working, (ii) being employed but taking a temporary break, or (iii) working part-time

while attending school or doing housework.[4]

To check to what extent female LFPR is explained by the economic incentives of a household, we examine whether the wife's LFPR increases with her education conditional on the husband's education and decreases with his education conditional on the wife's education. We classify educational attainment into eight categories (no schooling, primary, middle school, high school, 2-year college, 4-year college, master's, and doctorate). We find that conditional on husband's education, wife's LFPR increases with her education, which is consistent with the substitution effect in the labor supply decision. Second, conditional on the wife's education, her LFPR decreases with the husband's education, which is consistent with the income effect in the labor supply decision. Therefore, contrary to the social norm on the unequal gender division of childcare, married women's LFPR varies systematically by her own and her husband's education, and the pattern is largely consistent with the economic incentives.

We regress a dummy variable that takes a value of 1 if a wife works (h_i) on the birth cohort indicator variable of the wife (B_i) and the interaction terms of educational levels of the wife and the husband ($E_i^f \times E_i^m$),

$$h_i = \beta_1 B_i + \beta_2 E_i^f \times E_i^m + \varepsilon_i. \tag{3}$$

Table A6 tabulates the estimates of β_1. Women's wage for each education level is higher for the recent cohorts than for the old cohorts because of the decrease in the gender wage gap and the increase in TFP over the last decades. Consistent with this trend, the LFPR of married women increases over the birth cohorts.

Table A7 tabulates the estimates of β_2. The benchmark group is married couples without schooling for either a wife or husband. The wife's LFPR increases with her education (substitution effect) and decreases with husband's education (income effect). The pattern is consistent with economic incentives of a household for labor supply.

In sum, we see that the female labor force participation has significantly changed over time, and this time trend is contrasted with that for the proportion of the wife's provision of childcare and housework.

[4] The Korean census collects data on the extensive margin of the labor supply (labor force participation), but does not include information on the intensive margin of the labor supply (working hours).

A.3.4 Gender Wage Gap

Although our model does not distinguish different sources for the gender wage gap, it is possible that an unequal gender social norm, such as a taste-based discrimination against female workers or occupational sorting based on gender, can also account for the gender wage gap (Barro and Becker, 1989; Gayle and Golan, 2012; Pan, 2015).[5] Thus, changes in the gender social norm in the workplace can partially explain changes in the gender wage gap over time.

We first discuss the time trend in the gender wage gap in South Korea. For the analysis, we use the annual Survey on Labor Conditions by Type of Employment (SLCTE) conducted with full-time workers in South Korea from 1980 to 2015.[6] We use the CPI to adjust for inflation.

Table A8 summarizes the sample construction used to estimate the Mincerian equation for different birth cohorts. The Mincerian equation is based on our model $w_e = \gamma z exp(\rho e)$. By taking a log transformation and adding a measurement error (ε_w), we have the following:

$$ln(w) = \beta_c + ln(\gamma) \cdot I_f + \rho \cdot e + \varepsilon_w,$$

where I_f is a dummy variable that takes a value of 1 if the individual is a woman and e is the schooling years. To get a cohort-specific Mincerian coefficients, we construct a cohort-specific sample and regress the log hourly wage on gender and years of schooling.[7] Figure A3 shows estimates for the gender wage gap γ for different birth cohorts. The estimated γ increases significantly from 0.634 for the 1920s cohorts to 0.844 for the 1970s cohorts. Unlike the proportion of the wife's provision of childcare and housework, the gender wage gap has substantially changed over time.

Changes in economic environments such as technology and industry in South Korea can be the main factor that accounts for the decreasing gender wage gap over time. Institutions also evolved over time, along with economic development, which could have further promoted gender equality in the workplace. For example, the South Korean government implemented the Equal Employment Act in 1987 to protect female workers from gender discrimination in the workplace. Many subsequent laws have been enacted in South

[5] For a further discussion on other sources of the gender wage gap, see Mincer and Polachek (1974);Goldin et al. (1992); Flabbi (2010); Adda et al. (2017); and Gayle and Golan (2012), among others.

[6] For details of the SLCTE, see Appendix D.

[7] Table A8 summarizes sample construction for each cohort. To adjust different age profiles for different birth cohorts, we include age and age squared as additional control variables in the regression.

Korea to protect women's rights in the workplace.

In sum, we find that the gender wage gap has significantly changed over time, and this time trend is contrasted with that for the proportion of the wife's provision of childcare and housework. This suggests that the social norm regarding the gender wage gap has little time persistence.

A.3.5 Child Quality

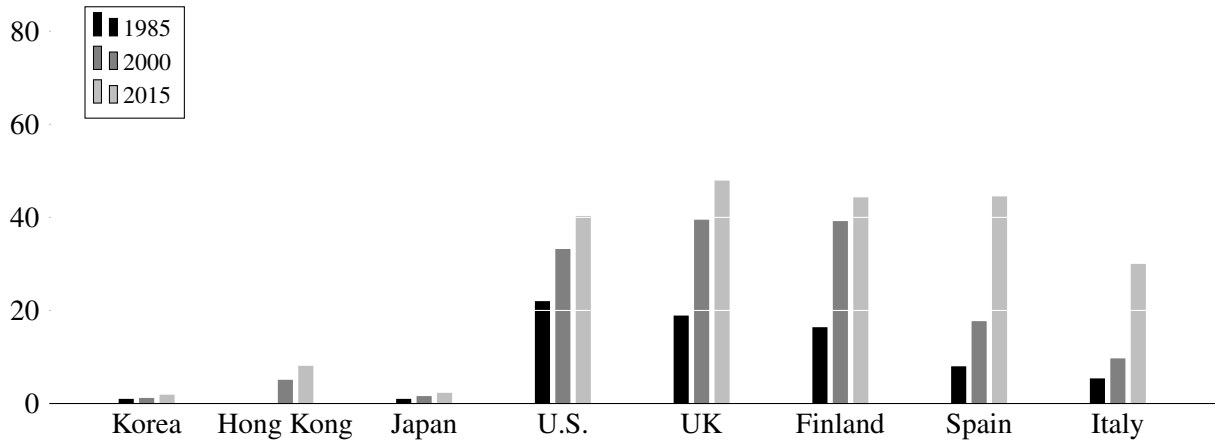
East Asian societies are known for a strong parental desire to have high-quality children in terms of academic achievements (Chua, 2011; Anderson and Kohler, 2013), which can be considered to be a social norm that can affect childcare and fertility decisions. Here, we compare parental time on childcare for different activities in South Korea using the 2009 KTUS, with that of the U.S. using the 2009 American Time Use Survey (ATUS).[8]

Table A10 shows the time spent on childcare in South Korea and the U.S. for different types of activities and by gender. We classify childcare activities into parental time for children's basic needs, children's education, and children's health. Childcare time for children's basic need includes physical care for children (feeding, getting the child ready for bed, bathing, etc.), playing with children, and picking up and dropping off children. The childcare for children's education includes reading to children, helping with homework or teaching children, and attending parent-teacher conferences. Childcare for children's health includes providing medical care to children and providing home care to sick children. The sample consists of married households with children aged 6 or below.

We find that total childcare time spent by married households in Korea is on average greater than that in the U.S. (233 min/day in Korea vs. 201 min/day in the U.S.). As for subcategories, South Korean parents on average spend 18 more minutes on children's education than their U.S. counterparts, which might reflect the social norm on the heavy parental time devoted to educating children in East Asian societies. Consistent with this conjecture, our estimate of the variable time cost of raising a child ϕ is 0.399, much higher than that in the U.S. (0.206) and developing countries (0.188) (Table 4 in the main paper).

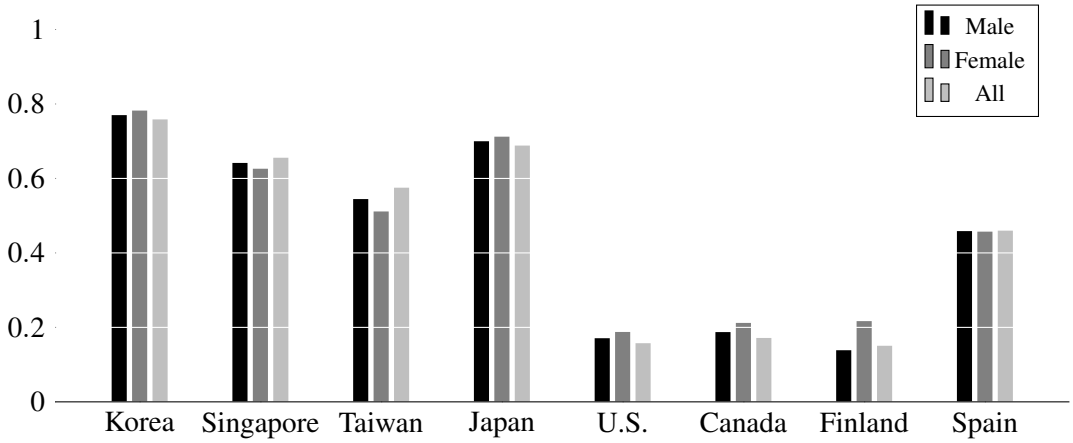
[8] Because the ATUS does not collect time-use diaries for household members, we report the average time spent on childcare by married men and married women for both countries.

Figure A1: Proportion (%) of Births Outside of Marriage



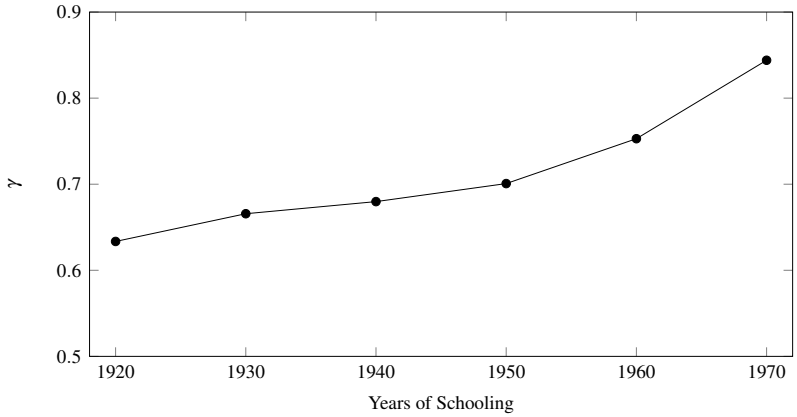
Note. The figure shows the proportion (%) of all live births for which the mother's legal marital status at the time of birth is other than married across countries over time. Reference years for countries other than Hong Kong are 1985, 2000, and 2015. Reference years for Hong Kong are 1995 and 2015. Data are from the OECD Family Database.

Figure A2: Proportion of Population who Believe Having Children is Necessary as a Woman



Note. The figure shows the proportion of population (male, female, and both) for each country who answered “yes" to the following question: “Do you think that a woman has to have children in order to be fulfilled or is this not necessary?" Data are from the World Value Survey panel data 1992–2007. The reference years for each country are South Korea (1982, 1990, 1995, 2001), Singapore (2002), Taiwan (1994), Japan (1981, 1990, 1995, 2000), U.S. (1981, 1995, 1999), Canada (2000), Finland (1981, 1996), and Spain (1990, 1995, 2000).

Figure A3: Gender Wage Gap (γ) by Birth Cohorts



Note. The figure shows the estimate for γ for each birth cohort in the Mincerian equation. γ captures the ratio of women's wage relative to men's wage. Table A8 documents the data sources and the sample construction for 1920–1970 birth cohorts.

Table A1: Proportion of Childcare Provided by Wives for Different Types of Households by Couple's Education

Panel A: Wife's Age 30-40					
			Husband		
Wife	6−	9	12	14	16+
6− (no/primary school)	0.802	0.876	0.794	N.A.	N.A.
9 (middle school)	0.880	0.870	0.840	N.A.	N.A.
12 (high school)	0.883	0.910	0.866	0.850	0.858
14 (2-year college)	N.A.	N.A.	0.849	0.802	0.830
16+ (4-year college or above)	N.A.	N.A.	0.826	0.815	0.804
Panel B: With Young Children					
			Husband		
Wife	6−	9	12	14	16+
6− (no/primary school)	0.786	0.878	0.753	N.A.	N.A.
9 (middle school)	0.774	0.743	0.794	N.A.	N.A.
12 (high school)	0.807	0.885	0.843	0.834	0.845
14 (2-year college)	N.A.	N.A.	0.825	0.785	0.813
16+ (4-year college or above)	N.A.	N.A.	0.797	0.797	0.779
Panel C: With Young Children, Wife's Age 20-40					
			Husband		
Wife	6−	9	12	14	16+
6− (no/primary school)	N.A.	N.A.	N.A.	N.A.	N.A.
9 (middle school)	N.A.	0.782	0.811	N.A.	N.A.
12 (high school)	N.A.	0.892	0.846	0.832	0.858
14 (2-year college)	N.A.	N.A.	0.828	0.784	0.812
16+ (4-year college or above)	N.A.	N.A.	0.805	0.794	0.781
Panel D: With Young Children, Dual earner					
			Husband		
Wife	6−	9	12	14	16+
6− (no/primary school)	N.A.	N.A.	N.A.	N.A.	N.A.
9 (middle school)	N.A.	0.761	0.731	N.A.	N.A.
12 (high school)	N.A.	0.904	0.806	0.803	0.792
14 (2-year college)	N.A.	N.A.	0.765	0.705	0.746
16+ (4-year college or above)	N.A.	N.A.	0.729	0.754	0.733

Note. The table shows the average proportion of childcare provided by wives by couple's education for different types of married households. Childcare includes the following activities: physical care for children (feeding, getting the child ready for bed, bathing, etc.), reading to children, playing with children, providing medical care to children, providing home care to sick children, helping with homework or teaching children, picking up and dropping off children, and attending parent-teacher conferences. Data are from the pooled sample of 2004, 2009, and 2014 KTUS. Panel A is for married households with a wife aged 30–40. Panel B is for married households with young children aged 6 or below. Panel C is for married households with young children aged 6 or below and a wife aged 20–40. Panel D is for dual-earner married households with young children aged 6 or below. If the number of observations is less than 10, we do not report the proportion and denote it as "N.A."

Table A2: Proportion of Childcare Provided by Wives for Different Types of Childcare Activities by Couple's Education

Panel A: Parental Time for Child's Basic Needs, Wife's Age 20-40					
			Husband		
Wife	6−	9	12	14	16+
6− (no/primary school)	0.722	0.934	0.778	N.A.	N.A.
9 (middle school)	0.897	0.928	0.918	N.A.	N.A.
12 (high school)	0.926	0.945	0.915	0.904	0.914
14 (2-year college)	N.A.	N.A.	0.885	0.846	0.876
16+ (4-year college or above)	N.A.	N.A.	0.877	0.839	0.853
Panel B: Parental Time for Child's Education, Wife's Age 20-40					
			Husband		
Wife	6−	9	12	14	16+
6− (no/primary school)	0.800	0.722	0.861	N.A.	N.A.
9 (middle school)	0.747	0.702	0.725	N.A.	N.A.
12 (high school)	0.877	0.805	0.794	0.782	0.782
14 (2-year college)	N.A.	N.A.	0.791	0.754	0.783
16+ (4-year college or above)	N.A.	N.A.	0.750	0.789	0.750
Panel C: Parental Time for Child's Health, Wife's Age 20-40					
			Husband		
Wife	6−	9	12	14	16+
6− (no/primary school)	0.733	N.A.	N.A.	N.A.	N.A.
9 (middle school)	1.000	0.500	0.715	N.A.	N.A.
12 (high school)	N.A.	0.958	0.883	0.880	0.872
14 (2-year college)	N.A.	N.A.	0.925	0.840	0.838
16+ (4-year college or above)	N.A.	N.A.	0.767	0.842	0.866

Note. The table shows the proportion of childcare provided by wives by couple's education for different types of childcare activities. Panel A shows the proportion of childcare provided by wives for children's basic needs, which includes physical care for children (feeding, getting the child ready for bed, bathing, etc.), playing with children, and picking up and dropping off children. Panel B shows the proportion of childcare provided by wives for children's education, which includes reading to children, helping with homework or teaching children, and attending parent-teacher conferences. Panel C shows the proportion of childcare provided by wives for children's health, which includes providing medical care to children and providing home care to sick children. The sample consists of married couples with a wife aged 20–40. Data are from the pooled sample of 2004, 2009, and 2014 KTUS. If the number of observations is less than 10, we do not report the proportion and denote it as "N.A.".

Table A3: Correlates of the Proportion of Routine Housework Provided by Wives with Birth Cohorts and Couple's Education

Panel A: estimates for birth cohorts ($\hat{\beta}_1$)					
Birth cohort	$\hat{\beta}_1$		SE		
1930	-0.014		0.0158		
1940	-0.005		0.0154		
1950	-0.015		0.0155		
1960	-0.003		0.0158		
Panel B: estimates for education matching ($\hat{\beta}_2$)					
	Husband				
Wife	6−	9	12	14	16+
6− (no/primary school)	-	-0.006	-0.003	N.A.	-0.006
	-	(0.340)	(0.651)	(-)	(0.795)
9 (middle school)	-0.006	0.009	-0.003	-0.021	-0.021
	(0.623)	(0.143)	(0.648)	(0.316)	(0.151)
12 (high school)	-0.005	-0.009	0.007	-0.000	0.005
	(0.762)	(0.401)	(0.158)	(0.960)	(0.402)
14 (2-year college)	N.A.	N.A.	0.001	0.008	-0.013
	(-)	(-)	(0.927)	(0.583)	(0.149)
16+ (4-year college or above)	N.A.	N.A.	-0.005	-0.008	0.000
	(-)	(-)	(0.729)	(0.675)	(0.984)

Note. The table shows the OLS estimation results of the proportion of routine housework provided by wives on birth cohort dummies ($\hat{\beta}_1$) and couple's education ($\hat{\beta}_2$). Additional control variables are dual-earner status and a dummy variable that takes a value of 1 for households living with young children aged 6 or below. The significance level is denoted as $^{*}(10\%)$,$^{**}(5\%)$, and $^{***}(1\%)$. In Panel B, standard errors are in parentheses. The reference is couples with primary education or below among 1920s birth cohort. Data are for married households from the pooled sample of 2004, 2009, and 2014 KTUS. If the number of observations is less than 25, we do not report the proportion and denote it as "N.A.". Routine housework includes the following activities: cleaning, laundry, food preparation and clean-up, maintenance, and household management.

Table A4: Correlates of the Proportion of Childcare Provided by Wives with Couple's Education

	Husband				
Wife	6−	9	12	14	16+
6− (no/primary school)	N.A.	0.107*	-0.032	N.A.	N.A.
	(-)	(0.085)	(0.582)	(-)	(-)
9 (middle school)	0.074	0.049	0.036	N.A.	N.A.
	(0.253)	(0.243)	(0.369)	(-)	(-)
12 (high school)	0.005	0.064	0.033	0.031	0.021
	(0.934)	(0.134)	(0.365)	(0.404)	(0.570)
14 (2-year college)	N.A.	N.A.	0.024	-0.012	-0.006
	(-)	(-)	(0.544)	(0.756)	(0.880)
16+ (4-year college or above)	N.A.	N.A.	-0.004	0.010	-0.011
	(-)	(-)	(0.920)	(0.797)	(0.765)

Note. The table shows the OLS estimation results of the proportion of childcare provided by wives on couple's education ($\hat{\beta}_2$). Additional control variables are dual-earner status and a dummy variable that takes a value of 1 for households living with young children aged 6 or below. The significance level is denoted as $^{*}(10\%)$,$^{**}(5\%)$, and $^{***}(1\%)$. Data are for married households from the pooled sample of 2004, 2009, and 2014 KTUS. The sample consists of the 1960 and 1970 birth cohorts only. If the number of observations is less than 25, we do not report the proportion and denote it as "N.A.". Childcare includes the following activities: physical care for children (feeding, getting the child ready for bed, bathing, etc.), reading to children, playing with children, providing medical care to children, providing home care to sick children, helping with homework or teaching children, picking up and dropping off children, and attending parent-teacher conferences.

Table A5: Wife's Labor Force Participation Rates with Couple's Education

	Husband							
Wife	0	6	9	12	14	16	18	20
0 (no schooling)	0.581	0.596	0.455	0.366	N.A.	0.286	N.A.	N.A.
6 (primary)	0.601	0.591	0.488	0.455	0.496	0.398	0.321	N.A.
9 (middle school)	0.523	0.575	0.460	0.377	0.414	0.323	0.348	N.A.
12 (high school)	0.557	0.598	0.541	0.459	0.476	0.336	0.302	0.394
14 (2-year college)	N.A.	0.754	0.694	0.623	0.590	0.487	0.467	0.380
16 (4-year college)	N.A.	0.565	0.626	0.549	0.619	0.410	0.377	0.376
18 (master's)	N.A.	N.A.	0.625	0.694	0.805	0.711	0.654	0.565
20 (doctorate)	N.A.	N.A.	N.A.	0.643	0.840	0.827	0.856	0.790

Note. The table tabulates the average female LFPR of married women by couple's education. Data are from the 1960, 1966, 1970, 1975, 1985, 1990, 1995, 2000, 2005, 2010, and 2015 censuses of South Korea. The sample includes women born between 1945 and 1970, aged 30-60, and who are married living with a spouse. If the number of observations is less than 20, we do not report the proportion and denote it as "N.A.".

Table A6: Correlates of Wife's Labor Force Participation Rates with Wife's Birth Cohort

birth cohort	$\hat{\beta}_1$	standard error
1950–1954	0.040^{***}	(0.0026)
1955–1959	0.113^{***}	(0.0025)
1960–1964	0.248^{***}	(0.0026)
1965–1970	0.283^{***}	(0.0027)

Note. The table tabulates the OLS estimates of β_1 in equation (3) in section A.3.3. The significance level is denoted as $^{*}(10\%)$,$^{**}(5\%)$, and $^{***}(1\%)$. Data are from the 1960, 1966, 1970, 1975, 1985, 1990, 1995, 2000, 2005, 2010, and 2015 censuses of South Korea. The sample includes women born between 1945 and 1970, aged 30-60, and who are married living with a spouse. The benchmark group is women born between 1945 and 1949.

Table A7: Correlates of Wife's Labor Force Participation Rates with Couple's Education

	Husband							
Wife	0	6	9	12	14	16	18	20
0	-	0.0232	-0.1300^{***}	-0.2331^{***}	N.A.	-0.3240^{***}	N.A.	N.A.
6	0.0143	-0.0064	-0.1101^{***}	-0.1471^{***}	-0.1528^{***}	-0.2058^{***}	-0.3165^{***}	N.A.
9	-0.1070^{***}	-0.0774^{***}	-0.1806^{***}	-0.2496^{***}	-0.2316^{***}	-0.2835^{***}	-0.2730^{***}	N.A.
12	-0.1150^{***}	-0.1010^{***}	-0.1695^{***}	-0.2503^{***}	-0.2509^{***}	-0.3497^{***}	-0.3810^{***}	-0.3183^{***}
14	N.A.	0.0269	-0.0411	-0.1338	-0.1652	-0.2461	-0.2659	-0.3464
16	N.A.	-0.1527	-0.0987	-0.2005^{***}	-0.1436^{***}	-0.3135^{***}	-0.3496^{***}	-0.3683^{***}
18	N.A.	N.A.	-0.0973	-0.0449	0.0446	-0.0402^{***}	-0.0839^{***}	-0.1865^{***}
20	N.A.	N.A.	N.A.	-0.1021	0.0996	0.0610^{*}	0.0937^{***}	0.0408^{*}

Note. The table tabulates the OLS estimates of β_2 of equation (3) in section A.3.3. The significance level is denoted as $^{*}(10\%)$,$^{**}(5\%)$, and $^{***}(1\%)$. Data are from the 1960, 1966, 1970, 1975, 1985, 1990, 1995, 2000, 2005, 2010, and 2015 censuses of South Korea. The sample includes women born between 1945 and 1970, aged 30–60, and who are married living with a spouse. The benchmark group is women born between 1945 and 1949. If the number of observations is less than 20, we do not report the proportion and denote it as "N.A.".

Table A8: Sample Construction for the Estimates for Historical Gender Wage Gap

Birth cohort	Birth year	Data	Age
1920	1920–1929	SLCTE 1980–2015	51–65
1930	1930–1939	SLCTE 1980–2015	51–65
1940	1940–1949	SLCTE 1980–2015	51–65
1950	1950–1959	SLCTE 1980–2015	45–65
1960	1960–1969	SLCTE 1980–2015	45–55
1970	1970–1979	SLCTE 1980–2015	35–45

Note. The table shows the sample construction used for estimation of the Mincerian equation for different birth cohorts born between 1920 and 1970. Data are from the pooled sample of the Survey of Labor Conditions by Type of Employment (SLCTE) 1980-2015.

Table A9: Mincer Earnings Regression by Birth Cohort

Cohort	Female	Years of Schooling
1920	0.634***	0.133***
	(4.14e-03)	(6.20e-04)
1930	0.666***	0.108***
	(1.69e-03)	(2.92e-04)
1940	0.680***	0.097***
	(9.45e-04)	(1.76e-04)
1950	0.701***	0.076***
	(3.94e-04)	(7.38e-05)
1960	0.753***	0.069***
	(3.10e-04)	(6.79e-05)
1970	0.844***	0.060***
	(3.85e-04)	(8.86e-05)

Note. The table reports estimates for the Mincerian earnings regression for each birth cohort. We run an OLS regression of the logged hourly wage on gender, years of schooling, age, and age squared for each birth cohort. Table A8 shows the sample construction for each birth cohort. We normalize the wage by using the CPI. Standard errors are in parentheses. The significance level is denoted as $^{*}(10\%)$,$^{**}(5\%)$, and $^{***}(1\%)$. The data source is the SLCTE from 1980 to 2015.

Table A10: Parental Time on Childcare and Children's Education

	Men	Women	Total	Women's Share
South Korea (unit: mins/day)				
Basic childcare	39.6	153.4	193.0	0.80
For children's education	5.3	29.7	35.0	0.85
For children's health	1.2	4.1	5.4	0.77
Total	46.1	187.2	233.3	0.80
Total except time spent educating children	40.8	157.5	198.3	0.79
U.S. (unit: mins/day)				
Basic childcare	72.6	107.6	180.2	0.60
For children's education	5.9	10.8	16.7	0.65
For children's health	1.3	2.6	3.9	0.66
Total	79.8	121.0	200.7	0.60
Total except time spent educating children	73.9	110.2	184.1	0.60

Note. The table shows time spent on childcare by gender in South Korea and the U.S. by different types of activities. The unit is minutes per day. The sample consists of married individuals with young children aged 6 or below. Childcare time for children's basic need includes physical care for children (feeding, getting the child ready for bed, bathing, etc.), playing with children, and picking up and dropping off children. The childcare for children's education includes reading to children, helping with homework or teaching children, and attending parent-teacher conferences. Childcare for children's health includes providing medical care to children and providing home care to sick children. Data are from 2009 KTUS for South Korea and 2009 ATUS for the U.S.

Appendix B Technical Details of Decomposition of Childlessness

B.1 Definition of Four Types of Childlessness

There are four types of childlessness in our model: natural, poverty-driven, social-stigma-driven, and opportunity-cost-driven childlessness. In this section, we show how a single woman's childlessness depends on her wage rate w_f.

Natural sterility is determined exogenously regardless of an individual's characteristics. The probability of being naturally sterile is uniformly distributed across education levels; for each w_f, a proportion χ_f of single women are childless because of natural sterility. A single woman who is not naturally sterile can remain childless for the following three reasons.

Poverty-driven childlessness is defined as follows:

$$c_f < \hat{c} \Rightarrow n = 0. \tag{4}$$

A single woman remains childless because of poverty if her consumption is lower than the minimum amount of consumption $\hat{c}$ required to procreate. From the budget constraint for a single woman, we have

$$c_f^S = (1-\delta_f)w_f + a_f - \mu^S - \frac{\phi}{A^S} w_f n.$$

Let $\overline{W}_f{}^P$ be the wage rate that satisfies $c_f^S = \hat{c}$ when $n = 1$. Then $\overline{W}_f{}^P$ is given by

$$\overline{W}_f{}^P = \frac{\hat{c} - a_f + \mu^S}{1 - \delta_f - \frac{\phi}{A^S}}.$$

A single woman with a_f is childless because of poverty iff her wage rate is lower than $\overline{W}_f{}^P$:

$$w_f < \overline{W}_f{}^P = \frac{\hat{c} - a_f + \mu^S}{1 - \delta_f - \frac{\phi}{A^S}}. \tag{5}$$

Social-stigma-driven childlessness for a single woman is defined as follows:

$$V_f^S(n \geq 1|\varepsilon^S = \varepsilon^M, w_f, a_f) > V_f^S(n = 0|\varepsilon^S = \varepsilon^M, w_f, a_f), \tag{6}$$

$$V_f^S(n = 0|\varepsilon^S < \varepsilon^M, w_f, a_f) \geq V_f^S(n \geq 1|\varepsilon^S < \varepsilon^M, w_f, a_f), \tag{7}$$

$$c_f^S \geq \hat{c}. \tag{8}$$

If a single woman who would have at least one child in the absence of the social stigma chooses not to have any children in the presence of the social stigma, we call this type of childlessness social-stigma-driven childlessness.

Opportunity-cost-driven childlessness is defined as follows:

$$V_f^S(n \geq 1|\varepsilon^S = \varepsilon^M, w_f, a_f) \leq V_f^S(n = 0|\varepsilon^S = \varepsilon^M, w_f, a_f), \tag{9}$$

$$c_f^S \geq \hat{c}. \tag{10}$$

If a single woman chooses not to have children because of the high opportunity cost of raising children even without the social stigma, we call this type of childlessness opportunity-cost-driven childlessness. Let $\overline{W}_f(n = k, \varepsilon^S)$ be the wage rate that satisfies the following condition:

$$V_f^S(n = k, \varepsilon^S) = V_f^S(n = 0, \varepsilon^S). \tag{11}$$

Then $\overline{W}_f(n = k, \varepsilon^S)$ is given by

$$\overline{W}_f(n = k, \varepsilon^S) = \frac{a_f - \mu^S}{\frac{\phi}{A^S}\left(\frac{\nu}{\varepsilon^S} + k\right) - (1 - \delta_f)}.$$

It can be shown that $V_f^S(n = k, \varepsilon^S) < V_f^S(n = 0, \varepsilon^S)$ iff $w_f > \overline{W}_f(n = k, \varepsilon^S)$. Also, because $\overline{W}_f(n = k, \varepsilon^S)$ decreases by k, the following holds:

$$V_f^S(n \geq 1, \varepsilon^S) < V_f^S(n = 0, \varepsilon^S) \iff w_f > \overline{W}_f(n = 1, \varepsilon^S) \tag{12}$$

From equations (9) and (12), for a given a_f, a single woman is childless due to the high opportunity cost of

raising children iff

$$w_f > \overline{W}_f(n=1, \varepsilon^S = \varepsilon^M).$$

From equations (6)–(7), and (12), a single woman is childless because of the social stigma iff

$$w_f \leq \overline{W}_f(n=1, \varepsilon^S = \varepsilon^M) \quad \text{and}$$

$$w_f > \overline{W}_f(n=1, \varepsilon^S < \varepsilon^M).$$

Because $\overline{W}_f(n=1, \varepsilon^S < \varepsilon^M)$ is smaller than $\overline{W}_f(n=1, \varepsilon^S = \varepsilon^M)$, we have a non-degenerate range of w_f for which stigma-driven childlessness exists.

Figure B1 graphically illustrates how a single woman's childlessness depends on her wage (w_f), given that her non-labor income is high enough so that $c \geq \hat{c}$ (i.e., no poverty-driven childlessness).

B.2 Counterfactual Analysis without the Social Stigma

Table B1 compares model predictions for the childlessness rates of single women and completed fertility of single mothers with and without the social stigma across education levels. The social stigma has negative effects on the childlessness rate of single women. In the absence of the social stigma, completed fertility of single mothers increases, except for those with middle school education. In sum, the total fertility of single women increases by 0.03.

B.3 Decomposition of Sources of Childlessness

Table B2 shows the decomposition of sources of childlessness for single women for South Korea and the U.S. Column (1) is the decomposition result based on our benchmark simulation. Column (2) is the decomposition result for the U.S. from Baudin et al. (2015). The table shows that the two main sources of childlessness for single women are poverty-driven and opportunity-cost-driven for both countries, and the two countries are similar in terms of their shares.

Why is the share of social-stigma-driven childlessness so low in South Korea? The reason is related to South Korea's hump-shaped marriage pattern between marriage rates and women's education. Given a very high value of having children (a very low value of ν), if lowly educated women are single, that

is mainly because their marriage offers are rejected due to the possibility of poverty-driven-childlessness. Those poor women have to remain childless even when they become single. On the other hand, if highly educated women are single in Korea, that is mainly because having children is too costly for them. Those highly educated women would remain childless when they become single due to the high opportunity cost. Since most single women's fertility decisions are either poverty-driven or opportunity-cost-driven, little space remains for the social stigma to play a role. The small effect of the social stigma on fertility may be also related to the low cohabitation rate in South Korea, where cohabitation is not a popular alternative to marriage. In contrast, cohabitating couples account for a large proportion of births in many western societies.

Figure B1: Social-Stigma-Driven Childlessness

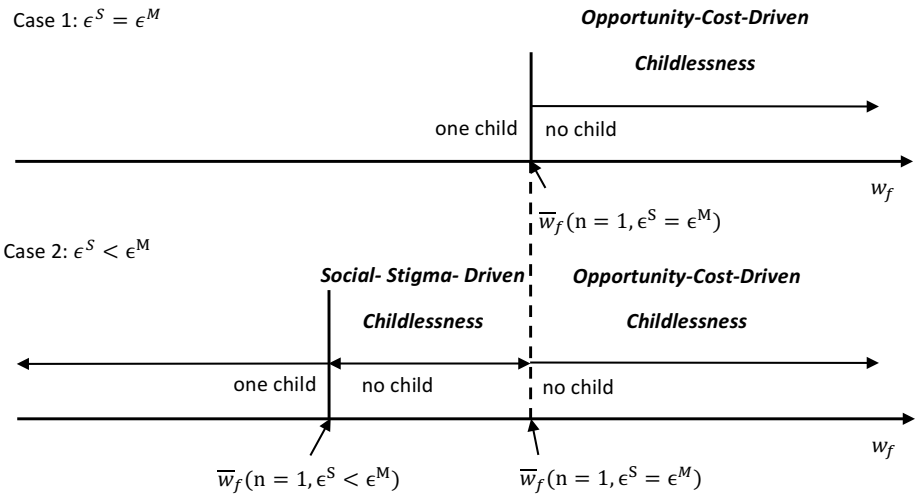


Table B1: Counterfactual Analysis: Childlessness Rates for Single Women and Completed Fertility of Single Mothers without the Social Stigma Attached to Out-of-Wedlock Births ($\varepsilon^S = \varepsilon^M = 1$)

Childlessness Rate of Single Women			Completed Fertility of Single Mothers	
Women's Education	Benchmark	$\varepsilon^S = \varepsilon^M = 1$	Benchmark	$\varepsilon^S = \varepsilon^M = 1$
	(1)	(2)	(3)	(4)
0	0.973	0.966	1.784	1.920
6	0.947	0.889	1.292	1.314
9	0.961	0.921	1.222	1.151
12	0.985	0.954	1.056	1.109
14	0.993	0.975	1.000	1.047
16	0.997	0.989	1.000	1.000
18	0.999	0.996	1.000	1.000
Average	0.982	0.957	1.213	1.203

Table B2: Decomposition of Sources of Childlessness for Single Women

	South Korea (1)	U.S. (2)
Poverty-driven (%)	32.70	29.71
Stigma-driven (%)	2.19	N.A.
Opportunity-cost-driven (%)	62.82	46.69
Natural Sterility (%)	0.49	2.30
Total (%)	98.20	78.70

Note. The table shows the decomposition of sources of childlessness for single women. Column (1) is the decomposition result based on the benchmark simulation. Column (2) is the decomposition result from Baudin et al. (2015).

Appendix C Details of Quantitative Analysis for Taiwan

We estimate our model using data from censuses and household surveys of Taiwan to confirm that our main quantitative results hold for other East Asian societies. In this section, we present the data, estimation results, and model fit.

Table C1 summarizes the data used to estimate our model for Taiwan. We use the full sample of the 2010 population and housing census of Taiwan to obtain marriage rates for men and women by education levels and the distribution of educational attainment of men and women. Following the sample construction for South Korea, educational attainment is categorized into seven levels: no schooling, primary school, middle school, high school, 2-year college, 4-year college, and master's or doctoral degree, which, respectively, corresponds to 0, 6, 9, 12, 14, 16, and 18 years of schooling.[9] Also, we drop individuals who are divorced or widowed from the sample, and focus on individuals aged 45–69.[10] Unlike the South Korean census, the Taiwanese census does not include fertility information. We use the Women's Marriage, Fertility, and Employment Survey (WMFE) 2010 and 2013 to get empirical moments on (i) completed fertility of married mothers, (ii) childlessness rates of married women by education, and (iii) the aggregate childlessness rate of single women. Data on the completed fertility of single mothers are not available for Taiwan.

To obtain an estimate for the proportion of childcare provided by wives (α'), we use the 2006 Taiwan Time Use Survey (TTUS). We construct the proportion of the wife's provision of childcare for each household from the time-use diary of a wife and a husband and use the average value of the proportions as α'. We have 0.80 for α' for Taiwan, the average proportion for dual-earner married couples living with unmarried children and a wife aged 20–60.[11]

To obtain the estimates for the wage equation, we use the 2010 Manpower Utilization Survey. We focus on individuals aged between 20 and 59 with wage earnings, and regress log hourly wage on schooling years and gender. The Mincerian equation is based on our model $w_e = \gamma z exp(\rho e)$. Taking a log transformation

[9] The Taiwanese census has 10 categories of educational attainment. We classify "illiterate" or "self-taught" as no schooling; "preschool" and "primary school or below" as primary school; "junior high school" as middle school; "senior high school" as high school; "vocational and technical college" and "junior college" as 2-year college; "university" as 4-year college; and "master's or doctor of philosophy" as master's or doctoral degree.

[10] The Taiwanese census contains age data in 5-year bins.

[11] We find that α' ranges from 0.80 to 0.87 for different groups of households.

and adding a measurement error (ε_w), we have the following:

$$ln(w) = \beta_c + ln(\gamma) \cdot I_f + \rho \cdot e + \varepsilon_w,$$

where I_f is a dummy variable that takes a value of 1 if the individual is a woman, and e is schooling years. The estimate for γ is 0.792 and the estimate for ρ is 0.060 (Table C3).

To obtain the estimate for goods cost for maintaining single households relative to that for married households (μ^S/μ^M), we use the 2010 Family Income and Expenditure Survey.

We estimate 10 parameters using Simulated Methods of Moment (SMM) by minimizing the distance between empirical and simulated moments as in the main paper. We have a total of 28 empirical moments. Table C2 shows 27 of them: completed fertility of married mothers, childlessness rates for married women, and marriage rates for men and women by education. The remaining moment is the aggregate childlessness rate of single women.[12]

From Table C2, we can see that marriage and fertility in Taiwan and South Korea have similar patterns. Completed fertility of married mothers decreases from 3.287 to 1.959 as women's education increases from no schooling to master's or doctoral degree in Taiwan. The corresponding numbers for South Korea are 3.204 and 1.928. The childlessness rate of married women in Taiwan is 0.024, very close to that of South Korea (0.029). Childlessness rates for married women show a U-shaped pattern in South Korea and Taiwan. Finally, marriage rates for men (0.912) and women (0.942) in Taiwan are as high as in South Korea.

Table C3 shows estimates for the model parameters. Panel A tabulates estimates for the parameters directly estimated from the data, and Panel B tabulates estimates from the SMM. We also document the corresponding parameter estimates for South Korea in our main estimation, for the U.S. (Baudin et al. (2015)), and for 36 developing countries studied in Baudin et al. (2020). Overall, the estimates for Taiwan and South Korea are quite similar.

Finally, Figure C1 shows model fit for the estimation for Taiwan. Our estimated model well matches the fertility and marriage patterns in Taiwan (Figure C1).

[12] A total of 30 empirical moments are used in our main estimation for South Korea, whereas 28 empirical moments are used in the estimation for Taiwan. Two additional empirical moments for the main estimation for South Korea are (i) the marriage rate of men with no schooling and (ii) completed fertility of single mothers. In the estimation for Taiwan, we do not use the marriage rate of Taiwanese men with no schooling because of a very small number of observations (only 0.28% of the total number of the male sample compared to 1.64% for South Korea), and do not use completed fertility of single mothers in Taiwan because it is unavailable.

Table C1: Data Used for the Estimation

Data Source	Year	Moment
Population and Housing Census	2010	Marriage rate, education share
Women's Marriage, Fertility and Employment Survey	2010, 2013	Completed fertility of married mothers
		Childlessness rates of married/single women
Taiwan Time Use Survey	2006	Proportion of childcare provided by wives
Manpower Utilization Survey	2010	Gender wage gap (γ), returns to schooling (ρ)
Family Income and Expenditure Survey	2010	Goods cost for maintaining single households relative to that for married households (μ^S/μ^M)

Table C2: Marriage Rates and Fertility for Taiwan

			Childlessness rate	Completed fertility of mothers	Marriage rate	
Education level	e	Observations	Married	Married	Women	Men
1. No schooling	0	12,280	0.0252	3.287	0.940	N.A.
2. Primary school	6	231,579	0.0134	3.007	0.977	0.909
3. Middle school	9	185,758	0.0142	2.646	0.960	0.888
4. High school	12	58,499	0.0241	2.347	0.913	0.903
5. 2-year college	14	217,842	0.0287	2.136	0.914	0.933
6. 4-year college	16	60,156	0.0475	2.021	0.854	0.944
7. Graduate	18	14,947	0.0761	1.959	0.791	0.959
All		781,061	0.0238	2.515	0.942	0.912

Note. Completed fertility is the number of children of mothers aged 45–64, and the childlessness rate is the proportion of married women aged 45–64 who don't have any children. The years of schooling that correspond to each education level are denoted as e. Data for marriage rates and sample distribution by educational attainment are from the full sample of the 2010 population and housing census. Data for the completed fertility of married mothers and childlessness rates for married women are from the 2010 and 2013 Women's Marriage, Fertility and Employment Survey.

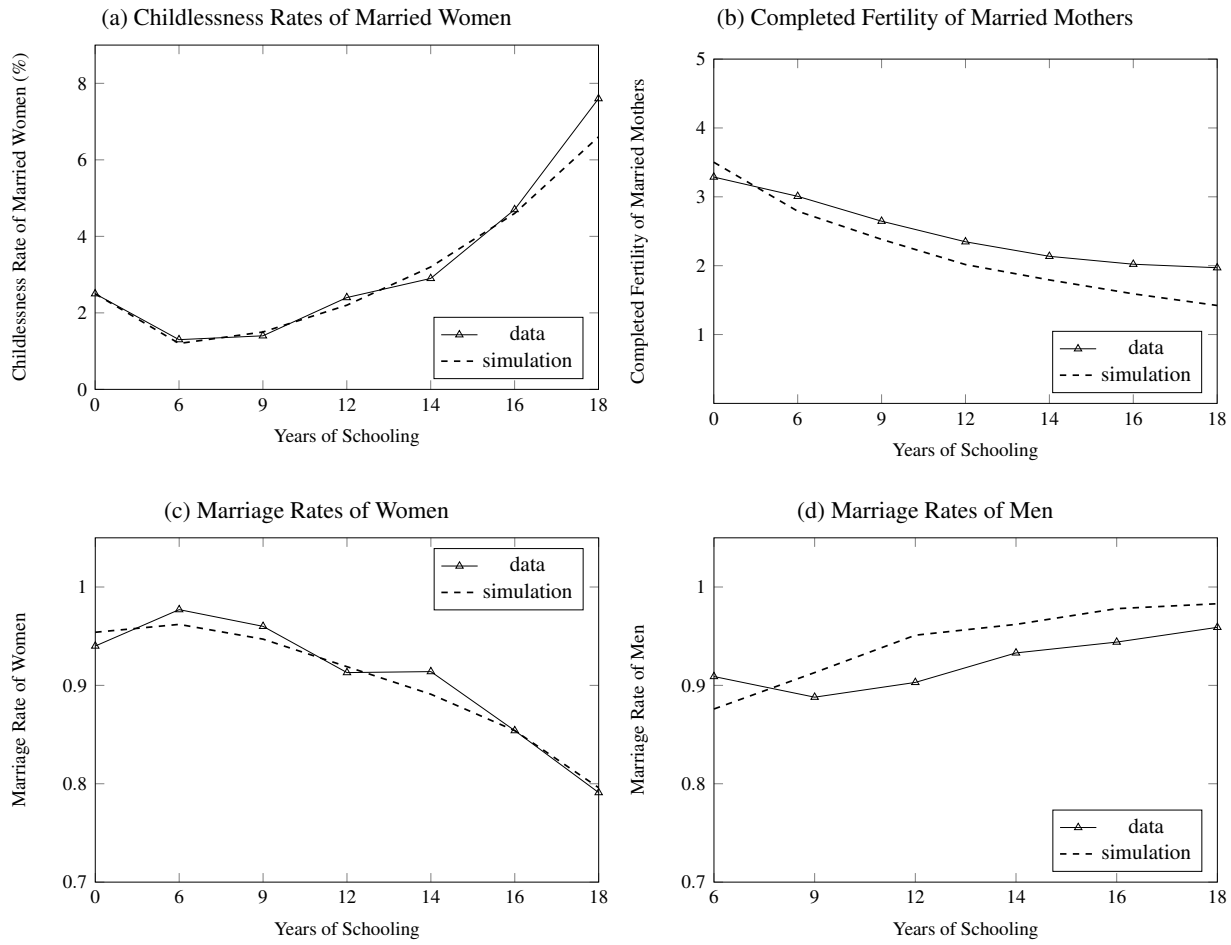
Table C3: Model Parameters

Panel A: a priori information							
Description	Parameter	Taiwan	Korea	Comparison with Literature			
				Baudin *et al.* (2015)	Baudin *et al.* (2020) Mean	Min	Max
Return to schooling[a]	ρ	0.060	0.069	0.092	0.05	0.05	0.05
Gender wage gap	γ	0.792	0.704	0.869	0.786	0.67	0.88
Proportion childcare provided by women	α'	0.800	0.801	0.524	0.754	0.506	0.974
Elasticity parameter	ψ	0.471	0.465	1.0	1.0	1.0	1.0
Home production productivity (single)	A^S	2.023	2.035	1.0	1.0	1.0	1.0
Ratio of goods costs: singles vs. married	μ^S/μ^M	0.675	0.662	1.0	1.0	1.0	1.0
Natural sterility parameter	$\chi_f = \chi_m$	0.005	0.005	0.012	0.01	0.01	0.01
Panel B: Parameters estimated by SMM							
Description	Parameter	Taiwan	Korea	Comparison with Literature			
				Baudin *et al.* (2015)	Baudin *et al.* (2020) Mean	Min	Max
Mean of non-labor income[b]	m_a	0.319	0.296	0.435	0.406	0.194	0.870
Standard deviation of non-labor income	σ_a	0.342	0.273	0.497	0.648	0.581	0.893
Goods cost for married households	μ^M	0.525	0.680	0.272	0.281	0.012	0.546
Minimum consumption to procreate	$\hat{c}$	0.302	0.190	0.399	0.354	0.097	0.529
Preference parameter	ν	7.366	6.505	9.362	9.367	8.097	11.099
Time cost of being single (men)	δ_m	0.094	0.003	0.256	0.197	-0.023	0.367
Time cost of being single (women)	δ_f	-0.031	-0.080	0.077	0.077	-0.057	0.278
Bargaining parameter	$\underline{\theta}$	0.311	0.225	0.864	0.442	0.035	0.972
Variable cost of raising a child[c]	ϕ	0.407	0.399	0.206	0.188	0.154	0.206
Social norm of stigma	ε^S	0.879	0.892	1.0	1.0	1.0	1.0

Note. Panel A presents parameters estimated directly from the data. Panel B presents parameters estimated from SMM. For parameters estimated from SMM, we compare our estimates with the estimates for South Korea discussed in our main analysis and those from the literature. Parameters estimated in Baudin et al. (2015) are for the 1990 U.S. sample, whereas parameters estimated from Baudin et al. (2020) are for 36 developing countries.

[a]: Baudin et al. (2020) uses $\rho = 0.05$ for the 36 developing countries.
[b]: Since $m_a = 1.001$ in Baudin et al. (2015) is the average ratio of non-labor income to women's wage, not the mean non-labor income as in our paper, we compute the mean non-labor income for Baudin et al. (2015) by multiplying women's wage by 1.001 .

Figure C1: Model Fit: Childlessness Rates of Married Women, Completed Fertility of Married Mothers, and Marriage Rates of Women and Men, by Years of Schooling (Taiwan)



Appendix D Data Sources and Sample Construction

D.1 Data for Stylized Facts

Table D1 documents variable definitions, data sources, and lists of developing countries for Tables 1 and 2 in the main paper. The TFR is the average number of children who would be born per woman if all women were to live to the end of their childbearing years and give birth to children according to a given fertility rate at each age. The marriage rate is defined as the share of those who are married (not including consensual union if it is separately identified in the data) in the total population aged 45–49.[13] The childlessness rate is the proportion of married/single women aged 45 and above who do not have any children. For Japan, Hong Kong, and Singapore, we report one minus the out-of-wedlock birth rate as the childlessness rate of single women due to data limitations. The developing countries in this paper are categorized as low-income, lower-middle-income, and upper-middle-income countries according to the World Bank's criteria in 2010. The developing countries included in Table 1 are the 36 countries studied in Baudin et al. (2020). Table 2 includes five out of the 36 developing countries in Table 1 because time use data are not available for the other 31 countries.

D.2 Data for Main Analysis

Table D2 lists the datasets used in our main estimation. The main dataset for SMM estimation is the 20% sample of the 2015 population and housing census (census) of South Korea, which contains 9,538,188 individuals. To calculate completed fertility, we further restrict the sample to either "married, spouse present" or "never-married" individuals aged 45–70, similar to Baudin et al. (2015); our final sample contains 2,750,992 individuals. The census provides information on sex, marital status, the number of children of married women, and the educational attainment of household members. Educational attainment is the highest grade attended, which is categorized into seven levels: no schooling, primary school, middle school, high school, 2-year college, 4-year college, and master's or doctoral degree, which correspond to 0, 6, 9, 12, 14, 16, and 18 years of schooling, respectively.[14] Table 5 in the main paper summarizes the marriage rates of men and women, completed fertility of married mothers, and childlessness rates of married women by education

[13] The marriage rate for developing countries is defined as the share of those who are in the monogamous union out of the total population aged 40–54 (Baudin et al., 2020).

[14] The 20% sample of the 2015 census does not provide separate data for master's and doctorate degrees.

levels in our sample. Because the 2015 census survey collects fertility information only for individuals ever married (married, widowed, or divorced), fertility information for singles is not available in the 20% sample of the 2015 census. To obtain the childlessness rate of single women, we use the summary statistics for a population sample (administrative data) of the 2015 census.

We use the 2015 Single Parent Family Status Survey (SPFS) to get an empirical moment for the completed fertility of single mothers. The SPFS 2015 collects information on 2,552 single-headed households on the family structure of a household, the number of children, childcare arrangements, and employment status. We use all never-married single mothers in the sample to get the completed fertility of single mothers.[15] The mean and standard deviation of the completed fertility of single mothers is 1.15 and 0.46, respectively.

To document the intrahousehold division of childcare between a husband and a wife, we use the 2009 KTUS. The 2009 KTUS collects time-use diaries from 21,000 individuals in 8,090 households. The list of activities classified in the KTUS is comparable to that in the American Time Use Survey (ATUS). Different from the ATUS that collects time-use diaries only for one household member, the KTUS collects time-use diaries for all household members, which allows us to precisely measure the proportion of the wife's provision of childcare for each household in South Korea. The KTUS also includes information on the age of a wife and a husband, whether they have young children aged 6 or below (before the formal schooling age) living in the household, and whether they are dual earners or not.[16]

Table D3 presents the proportion of routine housework/childcare provided by wives for different types of households. We construct the proportion of childcare provided by wives for each household and take the average value of the proportions for married couples in the sample. Routine housework includes the following activities: cleaning, laundry, food preparation and clean-up, maintenance, and household management. Childcare includes the following activities: physical care for children (feeding, getting the child ready for bed, bathing, etc.), reading to children, playing with children, providing medical care to children, providing home care to sick children, helping with homework or teaching children, picking up and dropping off children, and attending parent-teacher conferences. Panel A tabulates the proportion of routine housework/childcare provided by wives for married couples living with children aged 6 or below. Panel B is that for dual-earner households. Panel C is that for dual-earner households living children aged 6 or below.

[15] In the sample, 96% of single mothers are either divorced, separated, or widowed, and only 6% have never married. Due to the small sample size, we do not restrict the sample to those aged 45–70.

[16] The KTUS does not collect data on the number of children or the age of each child.

Panel D is that for married couples living with unmarried children. The sample restriction on wife's age is 20–60 in column (1) and 20–40 in column (2). A proportion of childcare provided by wives varies between 0.74 (Panel C) and 0.86 (Panel D). The benchmark estimate for α' in the main paper is the proportion of childcare provided by wives for married couples with children aged 6 or below (column (1) of Panel A). The proportion does not change much with an additional restriction on wife's age (columns (1) and (2)).

To estimate the productivity of home production for single households relative to that for married households $\frac{A^S}{A^M}$, we use the model implications for (i) labor input in home production for single mothers (equation (5) in the main paper): $A^S l_f^S = \phi n$; and (ii) that for married mothers when the social norm governs the intrahousehold division of childcare (equation (14) in the main paper): $A^M l_f^M(\alpha') = \zeta_2 \phi n$, where l_f^S and l_f^M are labor inputs in home production for single and married mothers, respectively. To get an estimate for $\frac{A^S}{A^M} = \frac{l_f^M(\alpha')}{l_f^S}\frac{1}{\zeta_2}$, we use the mean values of time spent on childcare for single mothers (l_f^S) and married mothers (l_f^M) who are working and living with children aged 6 or below from the KTUS 2009.

To estimate the gender wage gap γ and returns to schooling ρ, we use the annual Surveys on Labor Conditions by Type of Employment (SLCTE) conducted with full-time workers in South Korea from 1980 to 2015. The surveys contain information on the employee's demographic characteristics (gender, age, education, and work type), working hours, and monthly income for workers in 32,000 establishments for the sample period. Based on the pooled sample of 1980–2015 SLCTE, we delete observations from the top and bottom 3% of the wage distribution and adjust the price level by the Consumer Price Index (CPI) and focus on individuals between 20 and 50 years of old. The Mincerian equation is based on our model $w_e = \gamma z exp(\rho e)$. By taking a log transformation and adding a measurement error (ε_w), we have the following:

$$ln(w) = \beta_c + ln(\gamma) \cdot I_f + \rho \cdot e + \varepsilon_w,$$

where I_f is a dummy variable that takes a value of 1 if the individual is a woman and e is schooling years. The estimate for γ is 0.704 and the estimate for ρ is 0.069 (Table 4).

We use the 2015 Household Income and Expenditure (HIE) survey in South Korea to estimate the ratio of the goods cost for maintaining single households to that for married households (μ^S/μ^M). The 2000 HIE contains information on marital status, age, education, employment status, monthly income, and monthly expenditures of 8,700 households. The expenditure is divided into 464 categories following the

Classification of Individual Consumption by Purpose. To compute μ^S/μ^M, we use the median value of the sum of household expenditures on food, clothing, and housing. Table D4 summarizes the goods cost of households by marital status.

D.3 Data for Historical Simulation

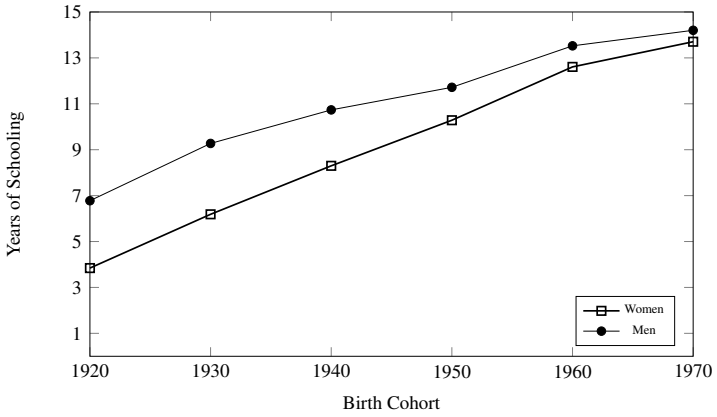
The five waves of censuses (1985, 1990, 2000, 2010, and 2015) of South Korea are used for the historical simulation of demographic transition in Section 5.6.[17] Table D5 summarizes how we construct cohort-specific data for fertility, marriage rates, and the share of population by education levels. Following our sample construction for the benchmark estimation, the sample for each birth cohort includes individuals who are “married, spouse present" or "never married". The earliest cohort in our historical simulation is the 1920 birth cohort. We do not include previous birth cohorts in the analysis, because the Korean War could have had nontrivial impacts on marital status and completed fertility for those who were born before 1920. Table D6 tabulates marriage rates and fertility in South Korea for each birth cohort. Table D7 presents the distribution of educational attainment and marriage rates by education levels across the different cohorts used in the historical simulation. Figure D1 plots the average educational attainment of men and women by birth cohort (top panel) and the difference in educational attainment between men and women by birth cohort (bottom panel). Appendix A.3.4 discusses the estimation for the cohort-specific wage equation. The data source for the TFP in South Korea is the World Development Indicators from the World Bank. For each cohort, we use the 30-year average of TFPs to proxy for the mean life-cycle wage rate, as in Baudin et al. (2015).[18] Finally, the TFP for the 1920 cohort is normalized to one so that the average completed fertility of married mothers for the 1920 cohort in the simulation matches that in the data.

[17] We do not use the 1975, 1980, and 1995 census data in the historical simulation, because they do not contain fertility information for both married and single women.

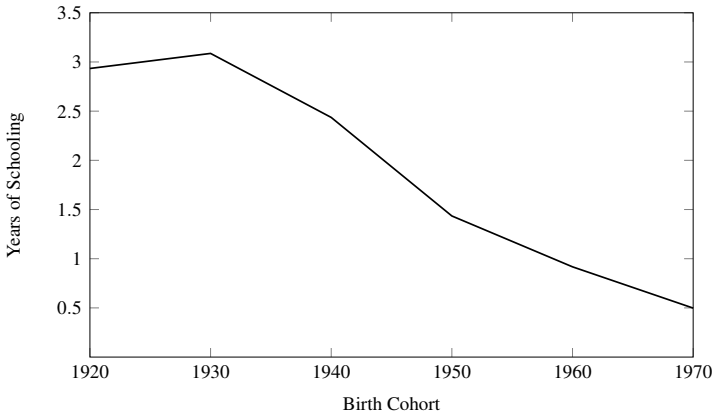
[18] For example, for cohort born in the 1920s, the wage is indexed on the average TFP for the period 1950–1980. For cohorts born in the 1960s and 1970s, we use forecast future TFP under the assumption that the growth rate in the past decade continues in future decades, following Baudin et al. (2015).

Figure D1: Average Educational Attainment of Men and Women by Birth Cohort

(a) Average Educational Attainment of Men and Women



(b) Difference in Educational Attainment between Men and Women



Note. Figure (a) plots the average years of schooling of men and women for each birth cohort in South Korea. Figure (b) plots the gender difference in average years of schooling for each birth cohort in South Korea. Data sources are the 1985, 1990, 2000, 2010, and 2015 censuses of South Korea. Table D5 summarizes how we construct cohort-specific samples for the share of population by education level.

Table D1: Data Sources for Tables 1 and 2

Variable	Definition
Total fertility rate (TFR)	The TFR is the average number of children who would be born per woman if all women were to live to the end of their childbearing years and procreate according to a given fertility rate at each age.
Marriage rate[a]	The marriage rate is defined as the share of those who are married (not including consensual union if it is separately identified in the data) out of the total population aged 45–49.
Childlessness rate[b]	The childlessness rate is defined as the proportion of married (single) women aged 45 and above who do not have any children.
Lists of developing countries[c]	Table 1: Argentina, Bolivia, Brazil, Cambodia, Cameroon, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, Ghana, Haiti, Indonesia, Jamaica, Kenya, Liberia, Malawi, Mali, Mexico, Morocco, Nicaragua, Palestine, Panama, Peru, Rwanda, El Salvador, Senegal, Sierra Leone, South Africa, Tanzania, Thailand, Uganda, Uruguay, Venezuela, Vietnam, and Zambia. Table 2: Costa Rica, Mexico, Uruguay, South Africa, and Tanzania.

Variable	Country	Source	Reference Year
TFR	All	World Factbook 2016 (CIA)	2016
Marriage Rate	China, Japan, Hong Kong, Macau, UK, U.S., Canada, Finland, Spain, Italy	World Marriage Data (UNPD)	China (2013), Japan (2015), Hong Kong (2011), Macau (2016), UK (2011), U.S. (2014), Canada (2016), Finland (2015), Spain (2011), Italy (2016)
	South Korea, Taiwan	Census	South Korea (2015), Taiwan (2010)
	Singapore	General Household Survey	2015
	Developing countries	Baudin et al. (2020)	2004 (mean of 36 countries)
Childlessness Rates[d]	China	2010 Census	2010
	South Korea	2015 Census	2015
	Hong Kong	Demographic Statistics (married)	2016
		Gietel-Basten et al. (2018) (single)	2015
	Taiwan	2010 Census	2010
	Singapore	General Household Survey (married)	2015
		Statistics Singapore (single)	2016
	UK	CLS 1970 British Cohort	2016
	U.S.	NLSY79	2016
	Canada	Edmonston et al. (2009)	2006
	Finland	Rotkirch and Miettinen (2017)	2011
	Spain	Reher (2019)	2011
	Italy	Tocchioni (2018)	2009
Time Spent on Housework	Japan, Hong Kong, U.S., UK, Canada, Finland, Spain, Italy	Gender Statistics of the United Nations	Japan (2006,2014), Hong Kong (2002, 2013) UK (2001, 2015), U.S. (2003, 2015) Canada (2005, 2016), Finland (2000,2010) Spain (2003,2010), Italy (2003, 2014)
	China	China Health and Nutrition Survey	1991, 2012
	South Korea	Time Use Survey	1999, 2014
	Taiwan	Time Use Survey	2004
		Taiwan Social Change Survey	2017

Note.*a*: The marriage rate for developing countries is defined as the share of those who are in the monogamous union out of the total population aged 40–54 (Baudin et al. (2020)). [b]: For Japan, Hong Kong, and Singapore, we report one minus the out-of-wedlock birth rate as the childlessness rate of single women due to data limitations. Age ranges for the childlessness rate vary by countries depending on data availability. [c]: The developing countries in this paper are categorized as low-income, lower-middle-income, and upper-middle-income countries according to the World Bank's criteria in 2010. Table 1 includes the 36 countries that are studied in Baudin et al. (2020). Table 2 includes only five out of the 36 developing countries in Table 1 because time use data are not available for the other 31 countries. [d]: If the sources are different for married and single women, we specify the marital status in parentheses.

Table D2: Data Used for the Estimation

Data Source	Year	Moment
Population and Housing Census (census)	2015	Marriage rate, fertility, education share
Population and Housing Census (administrative data)	2015	Childlessness rate of single women
Single Parent Family Status Survey (SPFS)	2015	Completed fertility of single mothers
Korean Time Use Survey (KTUS)	2009	Proportion of childcare provided by wives
Survey of Labor Conditions by Type of Employment (SLCTE)	1980-2015	Gender wage gap (γ), returns to schooling (ρ)
Household Income and Expenditure (HIE)	2015	Goods cost to maintain single households relative to that for married households (μ^S/μ^M)

Table D3: Proportion of Childcare Provided by Wives by Family Type

Panel A: Married couples living with young children		
	(1)	(2)
Task	Age 20–60	Age 20–40
Routine Housework	0.883	0.881
Childcare	0.801	0.800
Total	0.841	0.839
Panel B: Dual-earner households		
	(1)	(2)
Task	Age 20–60	Age 20–40
Routine Housework	0.862	0.840
Childcare	0.810	0.782
Total	0.849	0.814
Panel C: Dual-earner households living with young children		
	(1)	(2)
Task	Age 20–60	Age 20–40
Routine Housework	0.846	0.841
Childcare	0.743	0.737
Total	0.794	0.788
Panel D: Married couples living with unmarried children		
	(1)	(2)
Task	Age 20–60	Age 20–40
Routine Housework	0.889	0.896
Childcare	0.864	0.863
Total	0.883	0.883

Note. The table shows the proportion of housework provided by wives (routine housework, childcare, and both). Routine housework includes the following activities: cleaning, laundry, food preparation and clean-up, maintenance, and household management. Childcare includes the following activities: physical care for children (feeding, getting the child ready for bed, bathing, etc.), reading to children, playing with children, providing medical care to children, providing home care to sick children, helping with homework or teaching children, picking up and dropping off children, and attending parent-teacher conferences. Panel A is for married couples living with children aged 6 or below. Panel B is for dual-earner households. Panel C is for dual-earner households living children aged 6 or below. Panel D is for married couples living with unmarried children. The sample restriction on wife's age is 20–60 in column (1) and 20–40 in column (2). Data are from the 2009 Korean Time Use Survey (KTUS).

Table D4: Goods Cost of Households by Marital Status

Average Monthly Consumption by Household						
	(1)	(2)	(3)	(4)	(5)	(6)
Consumption	Total	Food	Clothing	Housing	(2)+(3)+(4)	(a)/(b)
Single or Divorced (a)	1,619,801	196,435	98,011	242,638	537,084	**0.663**
Married and Live Together (b)	2,856,041	365,627	183,874	269,781	819,281	
Median Monthly Consumption by Households						
	(1)	(2)	(3)	(4)	(5)	(6)
Consumption	Total	Food	Clothing	Housing	(2)+(3)+(4)	(a)/(b)
Single or Divorced (a)	1,358,933	134,937	78,422	191,601	487,724	**0.662**
Married and Live Together (b)	2,441,867	311,695	146,650	217,336	740,459	

Note. The table shows average (median) monthly expenditures on food, clothing, and housing by households with a wife aged 20-40 in South Korea. Column (6) is the ratio of the sum of expenditures on food, clothing, and housing of single households (Row (a), Column (5)) to that of married households (Row (b), Column (5)). Married households consist of married couples who live together, and do not include married couples who live separately. The unit is the Korean Won. The data source is the Household Income and Expenditure (HIE) 2015.

Table D5: Sample Construction for Fertility and Marriage Rates for Each Birth Cohort

Cohort	Birth Years	Age	Census	Sample	Observations
1920	1921–1930	55–64	1985	2%	33,767
1930	1931–1940	50–59	1990	2%	60,237
1940	1941–1950	50–59	2000	2%	73,978
1950	1951–1960	50–59	2010	10%	552,782
1960	1961–1970	45–54	2015	20%	1191,300
1970	1971–1980	40–45	2015	20%	693,550

Note. The table shows sample construction for 1920–1970 birth cohorts from the 1985, 1990, 2000, 2010, and 2015 censuses of South Korea.

Table D6: Marriage Rates and Fertility in South Korea by Birth Cohorts

Cohort	Married women		Marriage Rate	
	Completed fertility	Childlessness rate	Women	Men
1920	5.443	0.0164	0.999	0.999
1930	4.414	0.0115	0.997	0.998
1940	3.057	0.0121	0.992	0.992
1950	2.232	0.0151	0.981	0.969
1960	1.992	0.0341	0.962	0.920
1970	1.927	0.0536	0.934	0.862

Note. Completed fertility is the number of children of mothers, and the childlessness rate is the proportion of married women who don't have any children. Data sources are the 1985, 1990, 2000, 2010, and 2015 censuses of South Korea. The sample for each cohort is defined in Table D5.

Table D7: Education Share (%) by Birth Cohorts

Cohort	Sex	Years of Schooling						
		0	6	9	12	14	16	18
1920	Women	45.99	41.39	6.56	4.86	0.29	0.92	0
	Men	21.50	42.25	15.08	11.66	1.75	7.75	0
1930	Women	19.48	52.00	15.21	10.70	2.66	2.35	0
	Men	5.67	33.88	19.89	25.70	0.61	14.26	0
1940	Women	6.98	40.29	24.02	21.06	2.23	4.87	0.56
	Men	2.15	20.17	21.78	34.63	4.03	12.94	4.30
1950	Women	1.57	21.63	24.93	37.58	4.43	8.05	1.80
	Men	0.86	11.64	18.16	41.20	7.55	16.05	4.54
1960	Women	0.07	4.39	10.52	52.18	9.87	18.99	3.98
	Men	0.06	2.39	6.23	43.06	11.57	28.48	8.20
1970	Women	0.03	0.29	2.16	46.44	18.52	26.72	5.85
	Men	0.03	0.22	2.01	37.21	17.41	32.88	10.26

Note. The table shows the share (%) of men and women by education level for each birth cohort. The highest education level recorded for the old cohorts (the 1920 and 1930 birth cohorts) is the 4-year college. Data sources are the 1985, 1990, 2000, 2010, and 2015 censuses of South Korea. The sample for each cohort is defined in Table D5.

Appendix E Identification

In this section, we illustrate how model parameters are identified in the SMM estimation. We change one structural parameter at a time, holding other parameters constant at their estimated values and show how this change affects the simulated moments of the model.

There are a total of 10 structural parameters to be identified from the data. The following is an overview of how each parameter is identified. The subsections below provide a detailed illustration of how each parameter is identified in our estimation.

ν is identified from the overall childlessness rate of married women, because it determines the value of childlessness. $\hat{c}$ is identified from the childlessness rate of lowly educated women who are subject to poverty-driven-childlessness. The social stigma parameter, ε_s is identified from the childlessness rate of single women. Since $\underline{\theta}$ has opposite effects on the bargaining power of lowly and highly educated women, $\underline{\theta}$ is identified from the concavity of the female marriage curve. Since δ_m and δ_f are the only parameters that are gender specific, gender difference in marriage rates can identify those two parameters. For instance, since (δ_m, δ_f) have different effects on marriage rates for men and women with different education levels, a hump-shaped relationship between marriage rates and women's education, and an increasing relationship between marriage rates and men's education can be used to separately identify (δ_m, δ_f). μ^M can be identified from the overall marriage rate, because it is related to a gain from marriage through the scale of economy in marriage. Since ϕ determines the marginal cost of having an additional child, differential fertility by women's education can identify ϕ. Since there is a positive income effect on completed fertility, the mean and variation of the completed fertility of married mothers can identify m_a and σ_a.

E.1 μ^M and m_a

Figure E1 shows the response of simulated moments to a 20% increase in the goods cost of maintaining a married household (μ^M) and a 20% decrease in the mean of non-labor income (m_a). Both parameters affect available income for household consumption. The increase in μ^M and the decrease in m_a reduce both margins of fertility through a negative income effect. However, we can separately identify μ^M and m_a because of their different effects on the marriage rates of women with different levels of education. Whereas the decrease in m_a reduces the marriage rates of women at all education levels, the increase in μ^M raises the

marriage rates of highly educated women but reduces those of lowly educated women.

Because $\mu^S = 0.662\mu^M$, the goods cost per person in a single household is greater than that in a married household. Due to the economies of scale in marriage, a larger μ^M makes being single less attractive and marriage more attractive in general. However, the increase in μ^M decreases the marriage rates of the lowly educated women, because it increases their possibility of poverty-driven-childlessness, thus making them less attractive in the marriage market. On the other hand, the increase in μ^M increases the marriage rates of highly educated women who are not subject to poverty driven childlessness.

E.2 ν and ϕ

Figure E2 shows the response of simulated moments to an increase in the preference parameter that determines the utility of having no children (ν) from 6.505 to 9.326 (the U.S. estimate from Baudin et al. (2015)), and a 10% increase in the variable cost of each child (ϕ).

Both an increase in ν and increase in ϕ lower the overall marriage rate and raise the childlessness rate of married women. An increase in ν increases the value of being childless, thus decreasing the value of marriage. Similarly, an increase in ϕ raises the cost of childcare, thus decreasing an incentive to have children. Therefore, both an increase in ν and increase in ϕ decrease the marriage rates of men and women and increase the childlessness rates of married women.

However, ν and ϕ have different effects on the marriage rates of men with different levels of education. The increase in ϕ uniformly decreases marriage rates for men across all education levels, whereas the increase in ν decreases the marriage rate disproportionately more for highly educated men. Highly educated men are likely to be matched with women whose education level is generally lower than theirs, and marriage leads to sharing their income with them. With a low value of having a child after the increase in ν, sharing income with their spouse becomes more costly especially for highly educated men. On the other hand, the increase in ϕ mainly affects the intensive margin of fertility and only slightly affects the extensive margin. As shown in Panel (a) of Figure E2, the increase in the childcare cost (ϕ) does not lead to a significant increase in the childlessness rate for married mothers. That is, even with the increase in ϕ, most couples have at least one child. In contrast to the case with the increase in ν, sharing income with their spouse is not particularly more costly for highly educated men when they have at least one child because of the huge gain from having a child (small ν).

E.3 δ_m, δ_f, and $\underline{\theta}$,

Figures E3 and E4 show the response of simulated moments to an increase of δ_f by 0.1, to a decrease of δ_m by 0.1, and to an increase in the bargaining parameter ($\underline{\theta}$) from 0.225 to 0.864 (the U.S. estimate from (Baudin et al. (2015)). An increase of δ_f by 0.1 and a decrease of δ_m by 0.1 have similar effects on the childlessness rate and completed fertility of married mothers. However, the change in δ_f and δ_m have different effects on marriage rates of men and women.

An increase in the cost of being single increases the overall marriage rate, but depending on whether it is because of the increase in δ_m or δ_f, it has different effects on the marriage rates of men and women with different levels of education. For instance, an increase in δ_f implies greater time cost of being single for women, thus increasing the marriage rate for both men and women. A decrease in δ_m implies lower time cost of being single for men, thus decreasing the marriage rate for both men and women. However, the effects of δ_f on the marriage rates increase by education for women and decrease by education for men, whereas the effects of δ_m on the marriage rates decrease by education for women and increase by education for men (Panel (c) and (d) of Figure E3).

Similar to the case with the increase in δ_m, an increase in the bargaining parameter $\underline{\theta}$ reduces the marriage rates of men and women across all education levels (Panel (c) and (d) of Figure E4). However, since the increase in $\underline{\theta}$ raises the bargaining power of lowly educated women but lowers that of highly educated women, it has uneven effects on marriage rates for women with different education levels. As the bargaining power of lowly educated women increases with the increase in $\underline{\theta}$, their marriage offers are more likely to be rejected in the marriage market. On the other hand, as the bargaining power of highly educated women decreases with the increase in $\underline{\theta}$, highly educated women are more likely to reject men's offers. In sum, the increase in $\underline{\theta}$ decreases marriage rates, disproportionately more for lowly and highly educated women. These uneven effects on marriage rates can help to identify $\underline{\theta}$ separately from δ_m and δ_f.

To sum, the uneven effects of $\underline{\theta}$, δ_f, and δ_m on the childlessness rates of married women and the marriage rates for men and women with different levels of education separately help to identify these three parameters.

E.4 $\hat{c}$ and σ_a

Figure E5 shows the response of simulated moments to a 20% increase in $\hat{c}$ and a 20% decrease in σ_a. Neither the increase in $\hat{c}$ nor the decrease in σ_a has any significant effects on the completed fertility of

married mothers. However, the increase in $\hat{c}$ has uneven effects on the marriage rates and childlessness rates of married women with different level of education, but the decrease in σ_a has uniform effects on marriage rates for men and women at all education levels. These two effects help to separately identify these two parameters.

Since $c_f < \hat{c}$—the condition for poverty-driven-childlessness —binds only for very poor households, an increase in $\hat{c}$ has negligible effects on the overall marriage rate, except for women with no schooling. Also, the increase in $\hat{c}$ raises the childlessness rates of lowly educated married women. Thus, $\hat{c}$ is identified from the decreasing part of the U-shaped childlessness rate of married women.

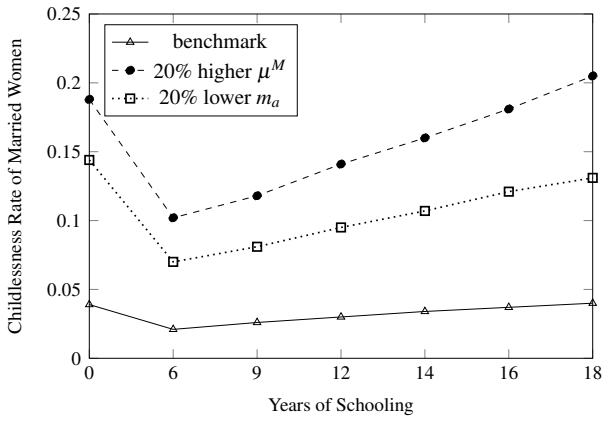
On the other hand, the decrease in σ_a lowers the variation of non-labor income, thus making men and women more equal in terms of non-labor income. For any given pair of wage rates (w_f, w_m), the increase in non-labor income equality on average makes marriage valuable for both spouses, because they now have to contribute their non-labor income more equally for their household consumption. Thus, the decrease in σ_a leads to a uniform increase in marriage rates for both men and women across education.

E.5 ε^S

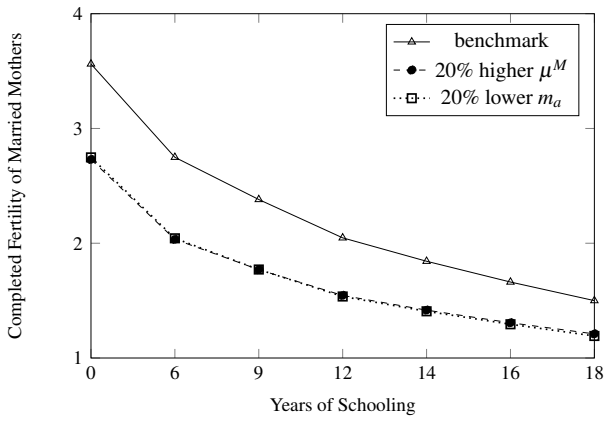
Removing the social stigma on single mothers by assuming $\varepsilon^S = 1$ decreases the childlessness rates of single women from 0.982 in the benchmark simulation to 0.957. However, removing the social stigma does not substantially affect marriage rates for men and women, childlessness, and completed fertility of married women for all education levels. ε^S can thus be identified from the childlessness rate of single mothers.

Figure E1: Identification of μ^M and m_a

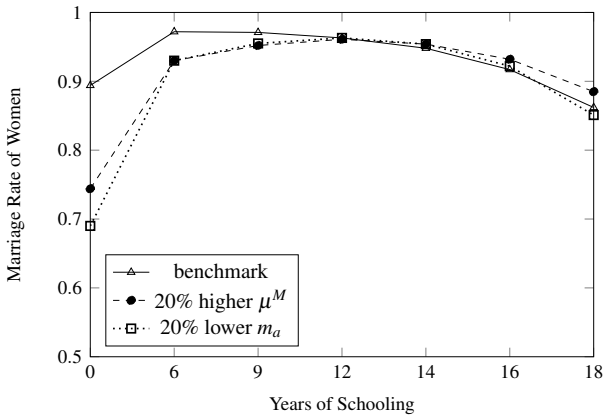
(a) Childlessness Rate of Married Women



(b) Completed Fertility of Married Mothers



(c) Marriage Rate of Women



(d) Marriage Rate of Men

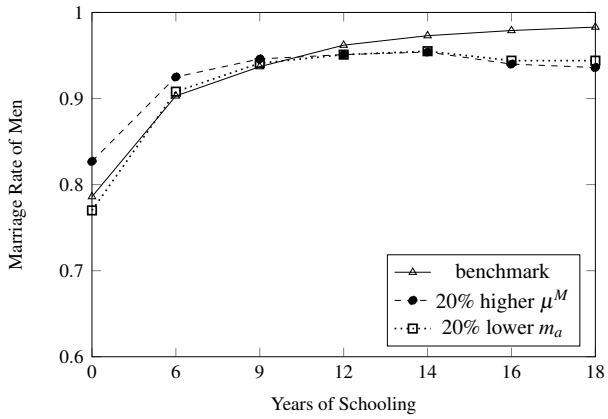
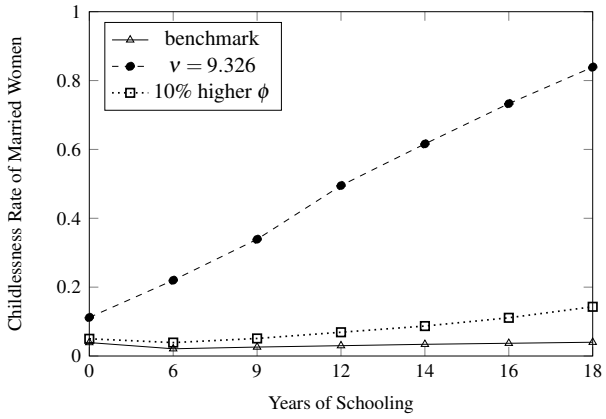
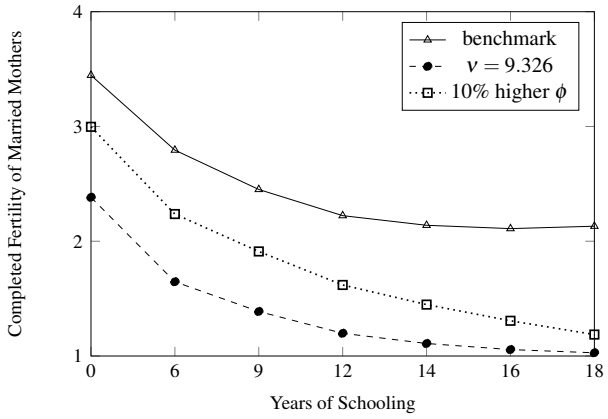


Figure E2: Identification of ν and ϕ

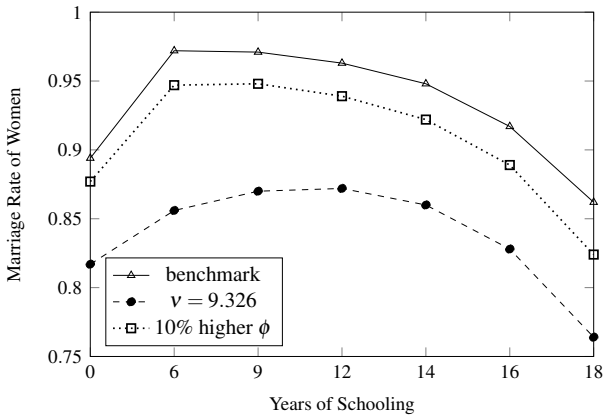
(a) Childlessness Rate of Married Women



(b) Completed Fertility of Married Mothers



(c) Marriage Rate of Women



(d) Marriage Rate of Men

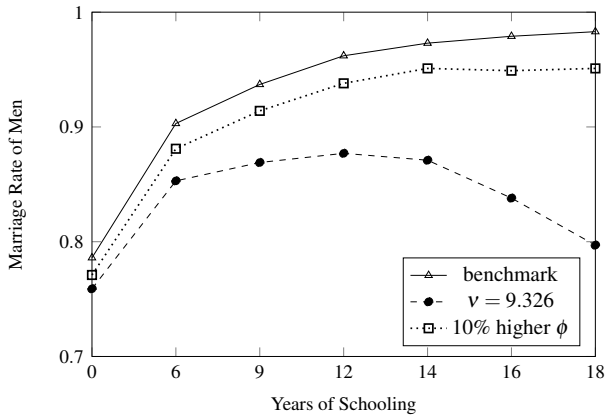
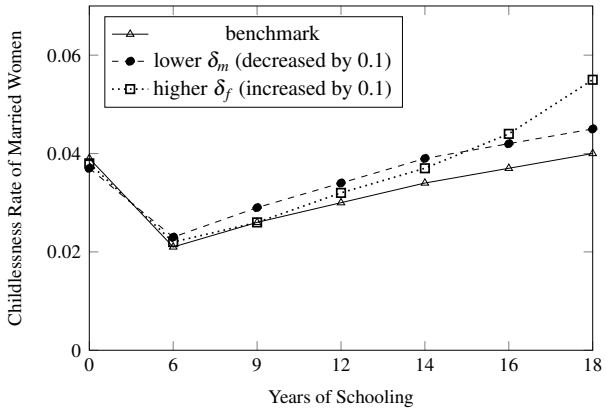
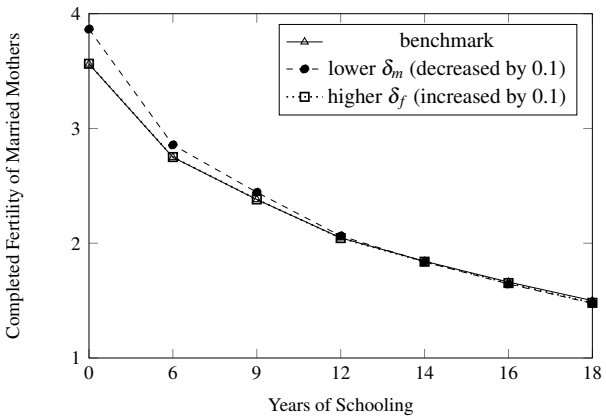


Figure E3: Identification of δ_m and δ_f

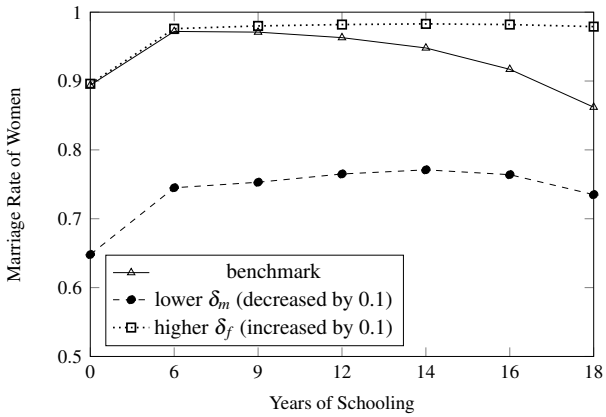
(a) Childlessness Rate of Married Women



(b) Completed Fertility of Married Mothers



(c) Marriage Rate of Women



(d) Marriage Rate of Men

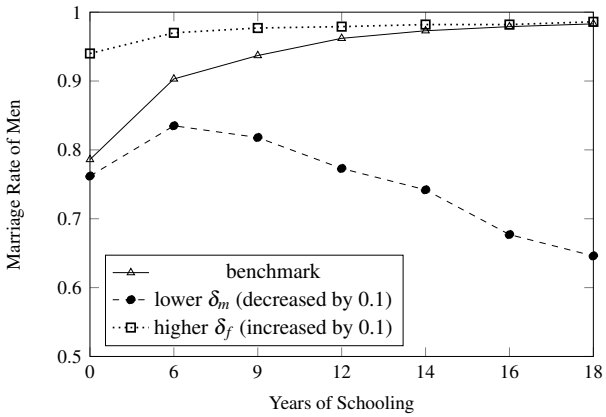


Figure E4: Identification of $\underline{\theta}$

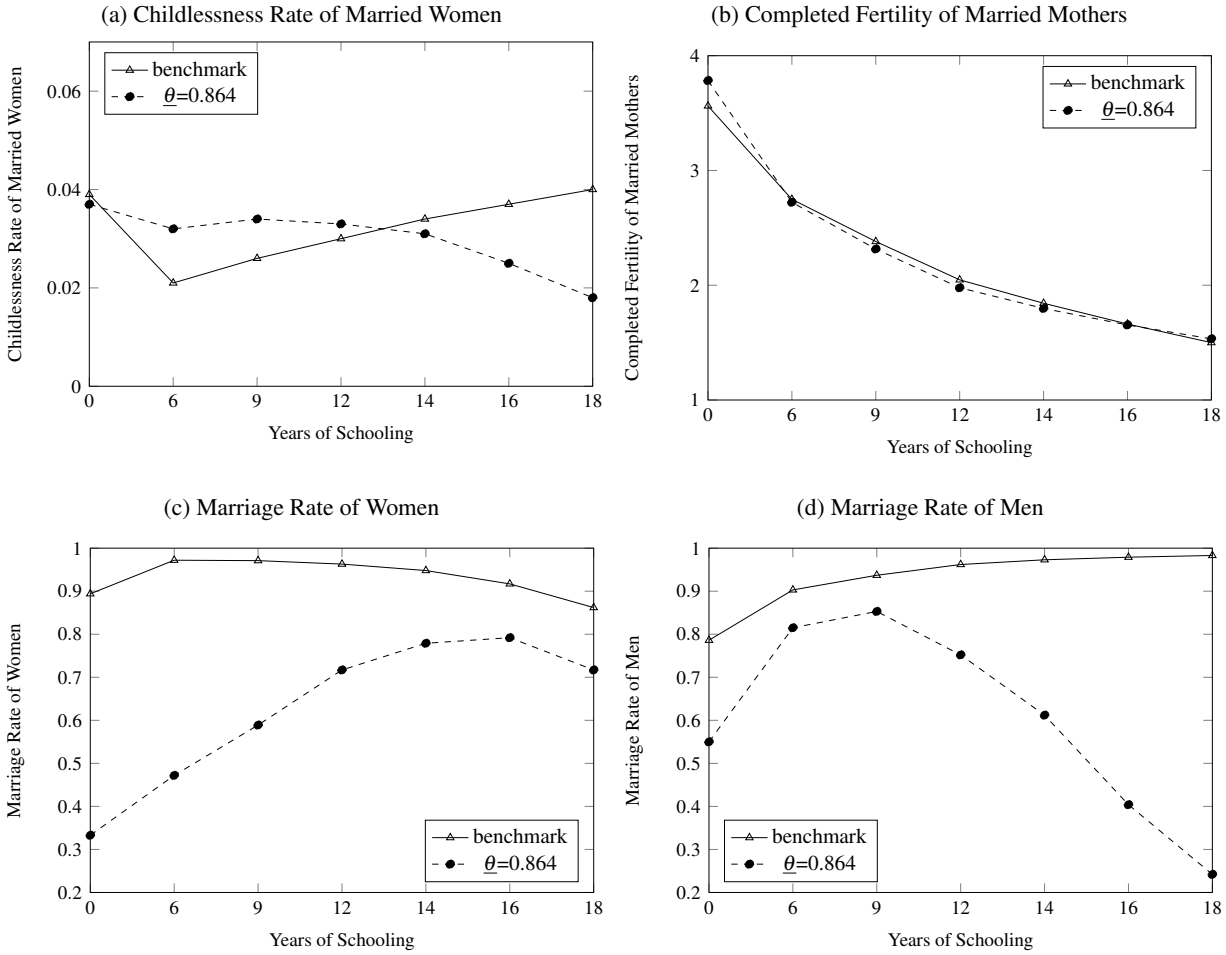
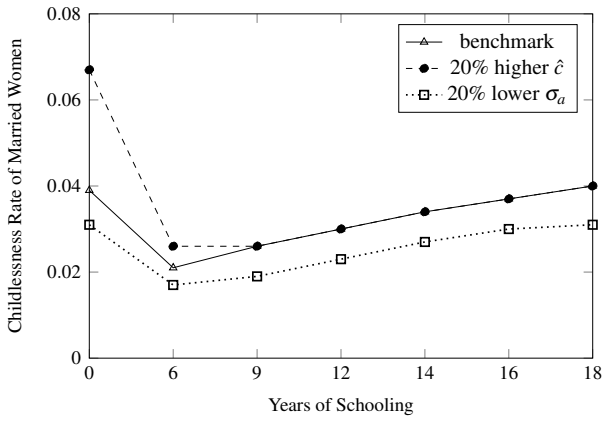
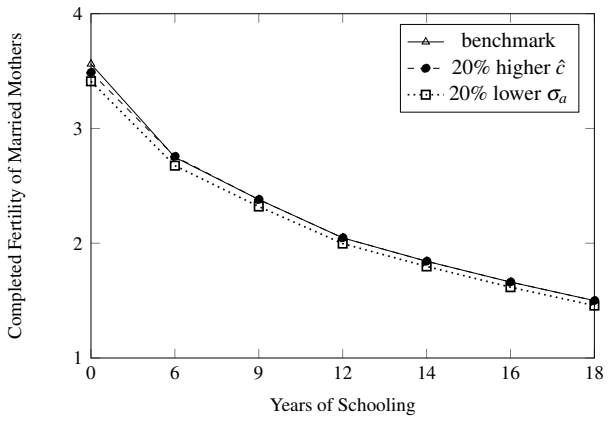


Figure E5: Identification of $\hat{c}$ and σ_a

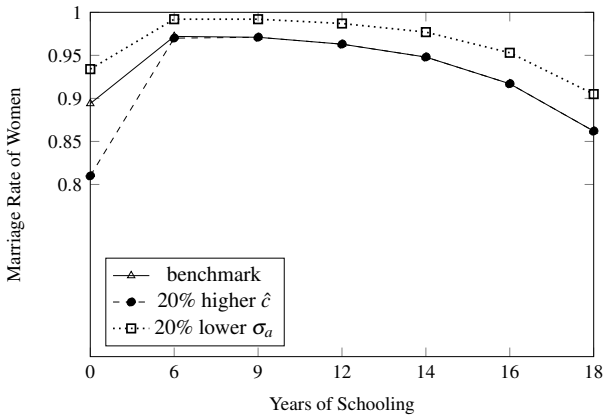
(a) Childlessness Rate of Married Women



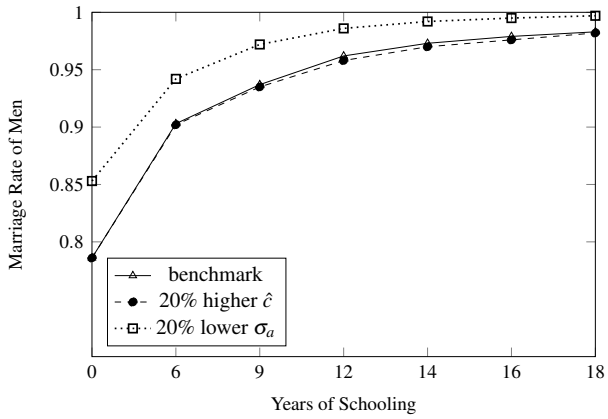
(b) Completed Fertility of Married Mothers



(c) Marriage Rate of Women



(d) Marriage Rate of Men



Appendix F Robustness Checks

In this section, we perform five robustness checks.

F.1 Gender Division of Childcare within a Household

In the first robustness check, we set α' at a value different from that used in the main estimation, re-estimate the model, and conduct the counterfactual analysis with the new estimates. The average α' ($\equiv l_f/(l_f+l_m)$) obtained from the 2009 KTUS ranges from 0.74 to 0.86 for different types of households. In the benchmark estimation, we set $\alpha' = 0.801$, the average proportion of childcare provided by wives for households with children aged 6 or below. In the robustness check, we set $\alpha' = 0.849$, the average proportion of childcare provided by wives for dual-earner households. Column (1) of Table F1 shows the estimation results. To match the empirical marriage rates with more unequal division of childcare within a household (i.e., a larger value of α'), the estimates for goods cost to support a household (μ^M) and the variable cost of raising a child (ϕ) decrease in the new estimation results. A larger value of α' implies more unequal gender division of childcare within a household, thus increasing the cost of social norm. Total fertility would increase by 17.22% without the social norm of unequal gender division of childcare when $\alpha' = 0.849$.

F.2 Elasticity Parameter in the Home Production Function

The elasticity parameter in the home production function (ψ) in the benchmark estimation is 0.465, which is obtained from the data on the ratio of women's wage to men's for the 1920 birth cohort. In the robustness check, we use a value for ψ obtained from data for the 1940 birth cohort. We use the 1940 birth cohort because the gender wage gap for the 1930 birth cohort does not significantly differ from that for the 1920 birth cohort. From the data for the 1940 cohort, we have $\psi = 0.553$, implying an elasticity of substitution of 2.237, higher than that in our main estimation (1.87). Column (2) shows the estimation results. With a higher value of ψ, the estimate for the variable cost of raising a child ϕ decreases. Total fertility would increase by 9.96% without the social norm. Given that l_f and l_m are imperfect substitutes, a higher elasticity of substitution lowers the cost of the social norm.

Knowles (2013) estimates a CES home production function for western countries and obtains an elasticity of substitution of 3.03, which implies that the estimated value of ψ is 0.670. We adopt $\psi = 0.670$ in

another robustness check and report the simulation results in Column (3). We find that our main results are robust with the home production function with the estimate from Knowles (2013).

F.3 Household-maintenance-goods Cost

We assume that the goods cost for maintaining a married household is different from that for a single household. A larger value of μ^S/μ^M implies greater economy of scale in marriage, which increases gains from marriage in our model. From the median expenditures on housing, clothes, and food of married and single households in the 2015 Household Income and Expenditure (HIE) survey, we have $\mu^S/\mu^M = 0.662$, which is used for the benchmark estimation. It must be noted that we do not find significant variations in μ^S/μ^M in the data (Table D4).

In the third robustness check, we assume $\mu^S/\mu^M = 0.5$. Since $\mu^S/\mu^M = 0.5$ implies zero economy of scale in marriage, this setting is useful for understanding the role of the economy of scale in marriage in fertility and marriage decisions. Column (4) shows the results. In this case, marriage would be less attractive for both men and women. Without the economy of scale in marriage, the time costs of being single for both men (δ_f) and women (δ_m) increase, thus raising their incentive to get married. Also, the minimum consumption required to procreate $\hat{c}$ decreases from 0.190 to 0.183 to raise the marriage rate for lowly educated women. As a result, the percentage of poverty-driven-childlessness for single women decreases from 32.7% in the benchmark estimation to 15.1% in the robustness check.

F.4 Extra Value of a First Child for the Married

To capture the extra value of a first child for married couples in East Asia, related to the social responsibility of passing on a family name in Confucian culture, we use the following utility function for the married couple.

$$u(c_i^M, n) = ln(c_i^M) + ln(\nu + I(n > 0) + \varepsilon^M I(n > 1)(n-1)), \tag{13}$$

where $I(\cdot)$ is an indicator function, which takes a value of one if the condition inside the parentheses holds, and zero otherwise. The utility function for single women is the same as in the benchmark model:

$$u(c_i^S, n) = ln(c_i^S) + ln(\nu + \varepsilon^S n). \tag{14}$$

The parameter that determines the marginal value of having a first child for married couples is normalized to be one. If $\varepsilon^M < 1$, the marginal value for the first child is larger than that for subsequent children, supporting the social norm of passing on the family name. Furthermore, if $\varepsilon^S < \varepsilon^M$, the marginal value of a child for single mothers is smaller than for married mothers, supporting the social stigma attached to out-of-wedlock child birth. We estimate ε^M and compare it with one and ε^S.

To identify ε^M, the percentage of couples with one child for each education level of married mothers is added as an additional empirical moment to be matched in the estimation. The last column of Table F1 tabulates the estimation result. ε^M is estimated to be 0.943, which is lower than one but much higher than 0.807, the estimated value for ε^S. This result shows that there is an extra value of the first child for East Asian parents related to the social responsibility associated with the family name. Our main quantitative results are robust with the new utility function. Moreover, the counterfactual results with respect to the two social norms are also robust.

F.5 Assortative Matching

In the benchmark model, we assume individuals are randomly matched with possible partners for marriage. The degree of assortative matching is high in reality, because people meet several possible partners with similar levels of education. To model this type of search in the marriage market requires a dynamic framework. However, it is difficult for our model to simultaneously account for a high degree of endogenous assortativeness and a reasonable marriage rate, as discussed in Baudin et al. (2015). To evaluate to what extent our model accounts for assortativeness of marriage matching in the data, we follow Baudin et al. (2015) and calculate the degree of assortativeness relative to random matching. Let $\pi(i,j)$ be the number of couples in which the wife has an education level i and the husband has an education level j ($i,j \in \{1,\cdots,7\}$). Define $I_1(i,j)$ to be

$$I_1(i,j) = \frac{\pi(i,j)}{\sum_j \pi(i,j)}. \tag{15}$$

Then, $I_1(i,j)$ gives the proportion of men of education j having married a woman of education i. $I_1(i,j)$ can be interpreted as the likelihood of marrying a woman of education level i conditional on being a man of

education level j. Next, define $I_2(i,j)$ as follows.

$$I_2(i,j) = \frac{\sum_i \pi(i,j)}{\sum_{i,j} \pi(i,j)}, \tag{16}$$

which gives us the share of women of education level i in the total population of married couples. Conditional on being married, $I_2(i,j)$ is the likelihood of marrying a woman of education level i conditional on being a man of education level j when the matching is completely random. Previous studies use $I_A(i,j) = I_1(i,j)/I_2(i,j)$ as a measure for the assortativeness in marriage matching. If $I_A(i,j)$ is greater (smaller) than one, the marriage matching between women of education level i and men of education level j presents a positive (negative) assortativeness in the matching. A higher value of $I_A(i,j)$ implies a stronger positive assortativeness in marriage matching.

Panel A of Table F2 tabulates the number of marriage matches observed in the 20% sample from the 2015 census of South Korea ($\pi(i,j)$), and Panel B tabulates $I_A(i,j)$, which is calculated from marriage matching in the data. To compare the assorativeness in marriage matching in the data with that in our benchmark simulation, we also calculate $I_A(i,j)$ from the simulated distribution of marriage matching by couple's education (Panel A of Table F3). Following Baudin et al. (2015), to identify to what extent the assortativeness in the marriage matching in the data is explained by the benchmark simulation, we regress each cell in Panel B of Table F2 on the corresponding cell in Panel A of Table F3. The R^2 of the linear regression is 0.30, which implies that our model with random matching accounts for 30% of the variation in the assortativeness of matching. The R^2 in our model is significantly higher than that in Baudin et al. (2015) who find that 13.8% of the assortativeness in the marriage matching observed in the data in the U.S. is explained by their model.

To match the assortativeness with a static model, one imperfect solution proposed by Fernández-Villaverde et al. (2014) is to assume an exogenous proportion λ of the female population draws a possible match from her education category, while $1-\lambda$ from the total population. We adopt this method in our robustness analyses. Columns (6)-(7) in Table F1 report quantitative analysis results when we assume $\lambda = 0.2$ and $\lambda = 0.5$, respectively. Panels B and C in Table F3 tabulate $I_A(i,j)$ when $\lambda = 0.2$ and $\lambda = 0.5$, respectively. In both cases, our model explains more than 95% of the assortativeness in the marriage matching in the data.

Changes in λ affect the estimates of the model parameters substantially, because marriage matching

has significant effects on the gains from marriage for each education group. For instance, when assortative matching exists in the marriage market, lowly educated women are more likely to be matched with lowly educated men. To match the marriage rates of lowly educated men and women, the goods cost to support a household (μ^M) decreases from 0.680 to 0.583 when λ changes from 0 to 0.2. Also, the parameter that determines the minimum level of the bargaining power of a wife ($\underline{\theta}$) increases from 0.225 to 0.478 as λ changes from 0 to 0.2. This is because an increase in assortativeness in marriage matching reduces the gains from marriage for lowly educated women. Thus, $\underline{\theta}$ must increase to match the marriage rates of the lowly educated women.

Although λ affects the parameter estimates significantly, using different values for λ does not substantially change the effects of social norms on both margins of fertility. The effects of social norms on total fertility are 11.53% and 11.03% when $\lambda = 0.2$ and $\lambda = 0.5$, respectively. The decomposition results of the childlessness rate of single women also remain similar to the benchmark simulation with different values of λ. Overall, our main quantitative results remain robust whether we assume random matching or assortative matching in the marriage market.

Table F1: Robustness of the Model

		α	ψ		μ^S/μ^M	value of first child	marriage matching	
benchmark		0.801	0.465		0.662		random	
Robustness checks		0.870	0.553	0.670	0.500		assortative (λ) 0.2	0.5
structural parameters	benchmark	(1)	(2)	(3)	(4)	(5)	(6)	(7)
m_a	0.296	0.290	0.294	0.216	0.283	0.274	0.332	0.350
σ_a	0.273	0.264	0.231	0.322	0.257	0.311	0.288	0.338
ν	6.505	6.500	6.749	6.886	6.435	6.443	6.837	6.875
$\hat{c}$	0.190	0.207	0.205	0.160	0.183	0.172	0.124	0.113
μ^M	0.680	0.654	0.664	0.563	0.687	0.657	0.583	0.568
δ_m	0.003	0.0047	-0.116	-0.023	0.161	-0.042	0.050	0.083
δ_f	-0.080	-0.088	-0.0013	-0.087	0.076	-0.055	-0.046	0.002
$\underline{\theta}$	0.225	0.232	0.284	0.024	0.136	0.118	0.478	0.578
ϕ	0.399	0.388	0.327	0.244	0.394	0.372	0.417	0.471
ε^S	0.892	0.890	0.873	0.915	0.900	0.807	0.856	0.771
ε^M	-	-	-	-	-	0.943	-	-
objective function $f(p)$	0.273	0.371	0.394	0.205	0.354	1.670	0.245	0.420
Effect of removing the social norm on total fertility (% increase)	11.21	17.22	9.96	8.90	11.82	11.18	11.53	11.03
Decomposition of childlessness (single)								
poverty-driven (%)	32.7	24.66	28.29	15.30	15.09	41.25	28.92	20.05
social-stigma-driven (%)	2.19	2.40	4.43	1.85	2.21	0.49	2.43	4.89
opportunity-cost-driven (%)	62.82	70.63	64.98	80.55	80.40	51.90	66.35	72.75
natural sterility (%)	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49
total (%)	98.20	98.20	98.20	98.20	98.20	98.20	98.20	98.20

Note. The table shows how estimates for structural parameters, model fit, effect of removing the social norm on total fertility of married mothers, and the decomposition of sources of childlessness for single women change when we change the values of the parameters ($\alpha, \psi, \mu^S/\mu^M$) that we estimate directly from the data (Columns (1)–(4)), when we modify the model to identify the extra value of the first child for married couples (Column (5)), and when we assume assortative marriage matching (Columns (6)–(7)).

Table F2: Assortative Marriage Matching in the Data

Panel A: Marriage per Education Category (Data)							
	Husband						
Wife	0	6	9	12	14	16	18
0 (no schooling)	5,380	4,692	1,625	964	63	62	13
6 (primary school)	3,541	82,774	37,471	20,906	1,220	1,203	212
9 (middle school)	1,034	14,964	88,502	70,922	4,407	4,071	655
12 (high school)	772	9,245	24,397	284,182	48,149	71,157	10,907
14 (two-year college)	55	631	1,433	14,540	17,095	29,450	6,800
16 (four-year college)	48	494	1,026	10,613	7,469	82,858	26,516
18 (master's or doctoral)	2	59	92	880	855	8,347	10,137
Panel B: Extent of Assortativeness in Marriage (Data)							
	Husband						
Wife	0	6	9	12	14	16	18
0 (no schooling)	39.309	3.290	0.832	0.189	0.063	0.025	0.019
6 (primary school)	2.248	5.043	1.667	0.357	0.106	0.042	0.026
9 (middle school)	0.524	0.728	3.143	0.966	0.305	0.113	0.065
12 (high school)	0.161	0.185	0.356	1.591	1.371	0.815	0.448
14 (2-year college)	0.073	0.081	0.134	0.522	3.121	2.162	1.779
16 (4-year college)	0.035	0.034	0.052	0.207	0.740	3.300	3.764
18 (master's or doctoral)	0.009	0.026	0.030	0.109	0.536	2.105	9.114

Note. Panel A tabulates the number of marriage matches observed in the data ($\pi(i,j)$). Panel B tabulates assortativeness in marriage matching ($I_A(i,j)$) calculated from the marriage matching observed in the data. Data is the main sample of the paper constructed from the 20% sample of the 2015 census of South Korea.

Table F3: Assortative Marriage Matching in Model Simulations

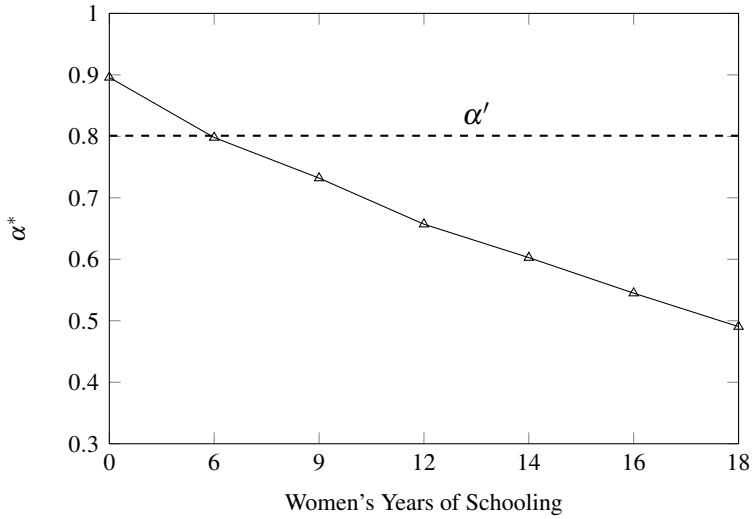
Panel A: Benchmark Simulation ($\lambda = 0$)							
	Husband						
Wife	0	6	9	12	14	16	18
0 (no schooling)	1.266	1.033	0.948	0.879	0.987	0.971	1.032
6 (primary school)	1.154	1.019	0.975	0.898	0.963	0.923	0.970
9 (middle school)	1.110	1.011	0.986	0.908	0.963	0.935	0.969
12 (high school)	0.975	0.991	0.981	0.935	0.978	0.959	0.979
14 (2-year college)	0.896	0.956	0.987	0.945	0.999	0.991	1.006
16 (4-year college)	0.753	0.891	0.955	0.991	1.028	1.025	1.038
18 (master and doctorate)	0.643	0.795	0.906	0.978	1.051	1.073	1.095
Panel B: Assortative Matching ($\lambda = 0.2$)							
	Husband						
Wife	0	6	9	12	14	16	18
0 (no schooling)	15.478	0.847	0.798	0.752	0.791	0.763	0.803
6 (primary school)	0.939	2.950	0.809	0.767	0.791	0.754	0.770
9 (middle school)	0.850	0.829	2.208	0.779	0.769	0.769	0.771
12 (high school)	0.720	0.772	0.793	1.245	0.789	0.789	0.793
14 (2-year college)	0.587	0.715	0.773	0.803	0.818	0.818	0.819
16 (4-year college)	0.471	0.624	0.726	0.795	1.833	1.833	0.855
18 (master and doctorate)	0.334	0.501	0.647	0.776	0.891	0.891	5.140
Panel C: Assortative Matching ($\lambda = 0.5$)							
	Husband						
Wife	0	6	9	12	14	16	18
0 (no schooling)	29.302	0.503	0.501	0.477	0.508	0.491	0.482
6 (primary school)	0.512	5.174	0.506	0.481	0.509	0.489	0.467
9 (middle school)	0.484	0.490	3.739	0.482	0.512	0.489	0.465
12 (high school)	0.431	0.465	0.494	1.561	0.514	0.498	0.482
14 (2-year college)	0.373	0.479	0.479	0.487	5.894	0.509	0.490
16 (4-year college)	0.295	0.458	0.458	0.482	0.521	2.833	0.513
18 (master and doctorate)	0.239	0.423	0.423	0.468	0.521	0.532	9.923

Note. Panel A tabulates assortativeness in marriage matching ($I_A(i,j)$) calculated from the benchmark simulation of the model with $\lambda = 0$. Panels B and C tabulate $I_A(i,j)$ calculated from the counterfactual simulation of the model when we assume $\lambda = 0.2$ and $\lambda = 0.5$, respectively.

Appendix G Cost of the Social Norm by Education Level

In this section, we compute the optimal proportion of childcare provided by wives (α^*) and the cost of social norm ($C(\alpha') - C(\alpha^*)$) by the education levels of a married couple in our benchmark simulation and present the results in Tables G1–G2, respectively. Figure G1 compares the optimal proportion of childcare provided by wives (α^*) with the proportion governed by the social norm (α') for each education level.

Figure G1: Optimal Proportion of Wife's Labor in Childcare (α^*) by Women's Education



Note. The figure plots α^* (solid line with triangle) by women's education, based on the simulated distribution of education pair of a husband and a wife. The dashed line is α' which is governed by the social norm on the unequal gender division of childcare.

Table G1: Optimal Proportion of Childcare Provided by Wives (α^*) by Education

Wife	Husband							
	0	6	9	12	14	16	18	Conditional Mean
0 (no schooling)	0.658	0.806	0.859	0.900	0.921	0.938	0.951	0.896
6 (primary school)	0.472	0.658	0.739	0.806	0.843	0.874	0.900	0.798
9 (middle school)	0.378	0.567	0.658	0.739	0.785	0.825	0.859	0.732
12 (high school)	0.293	0.472	0.567	0.658	0.714	0.763	0.806	0.657
14 (2-year college)	0.242	0.409	0.504	0.600	0.658	0.714	0.763	0.603
16 (4-year college)	0.198	0.348	0.440	0.536	0.599	0.658	0.714	0.545
18 (master's or doctoral)	0.161	0.293	0.378	0.472	0.536	0.544	0.599	0.658

Note. The table tabulates α^* for each education pair of a husband and a wife in the benchmark simulation. The conditional mean refers to the mean values of α^* for women with a specific education. The conditional mean is computed using the simulated distribution of education pairs of married households.

Table G2: Cost of the Social Norm ($C(\alpha') - C(\alpha^*)$) by Education

Wife	Husband							
	0	6	9	12	14	16	18	Conditional Mean
0 (no schooling)	0.069	0.076	0.083	0.092	0.100	0.109	0.12	0.095
6 (primary school)	0.100	0.104	0.108	0.115	0.121	0.129	0.139	0.118
9 (middle school)	0.124	0.125	0.128	0.133	0.138	0.145	0.154	0.135
12 (high school)	0.153	0.152	0.153	0.157	0.161	0.166	0.174	0.159
14 (2-year college)	0.178	0.174	0.174	0.177	0.18	0.185	0.191	0.179
16 (4-year college)	0.206	0.200	0.199	0.201	0.203	0.206	0.212	0.203
18 (master's or doctoral)	0.239	0.232	0.229	0.229	0.23	0.232	0.237	0.231

Note. The table tabulates the cost of social norm defined as $C(\alpha') - C(\alpha^*)$ for each education pair of a husband and a wife in the benchmark simulation. The conditional mean refers to the mean values of $C(\alpha') - C(\alpha^*)$ for women with a specific education. The conditional mean is computed using the simulated distribution of education pairs of married households.

Appendix H Counterfactual Analysis Using U.S. Parameter Estimates

H.1 Counterfactual Analysis Using U.S. Estimate of α'

Figure H1 (a) shows our model prediction for childlessness rates when α' is replaced by the U.S. estimate (α^{US}), holding other parameters to their estimated values. More equal gender division of childcare decreases the childlessness rate for highly educated women as in the case with the optimal sharing rule (α^*), but it increases the childlessness rate for women with no schooling.

Figure H1 (b) shows our model prediction for the completed fertility of married mothers. Completed fertility for married mothers with α^{US} is 2.047, lower than 2.249 in the benchmark simulation. As with the childlessness rate, completed fertility for lower educated women decreases, but that for highly educated women increases. For women who have an master's or doctoral degree, completed fertility increases from 1.5 (the benchmark) to 2.06, a slightly smaller increase than in the case of the optimal division.

More equal gender division of childcare has positive effects on both margins of highly educated women but negative effects on those of lowly educated women. This is because α^{US} is generally closer to the optimal α^* for highly educated women than α', but is further away from α^* for lowly educated women due to the difference in wage rates between the two groups of women.

Figure H1 (c) and (d) show our model predictions for the marriage rates of men and women with α^{US}. More equal division lowers marriage rates for lowly educated women but increases those for highly educated women. On the other hand, it increases marriage rates for lowly educated men but decreases those for highly educated men.

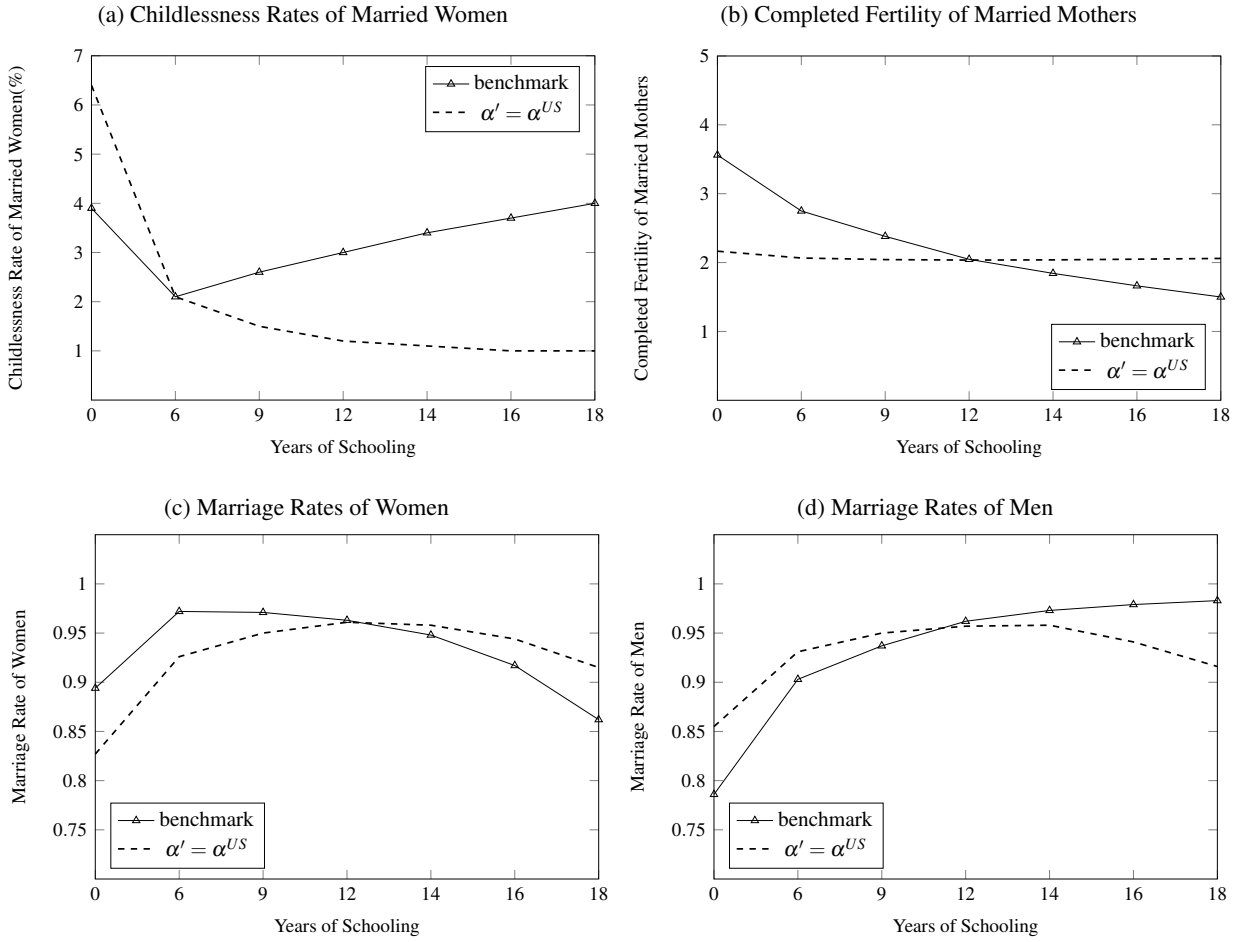
In summary, total fertility in the counterfactual experiment with α^{US} is 1.90, which is lower than 2.03 in the benchmark simulation. However, more equal sharing rule boosts marriage and fertility rates for highly educated women, but decreases those for lowly educated women. This result is different from the case with an optimal sharing rule with α^*, because optimal division increases marriage and fertility rates for women across all levels of education but to different degrees.

H.2 Counterfactual Analysis Using Other U.S. Parameter Estimates

Marriage and fertility patterns differ widely between East Asian and western societies. Besides the two social norms, are there other factors that drive these differences? Row (a) in Table H1 shows our benchmark

simulation moments regarding marriage and fertility for South Korea using our model, and Row (b) shows corresponding simulation moments for the U.S. from Baudin et al. (2015). We conduct the counterfactual analysis, in which Korean parameter estimates are all replaced by U.S. parameter estimates, using our model and the empirical distribution of education levels for men and women from South Korea. The simulated moments are reported in Row (c). Despite the different model structures of the two papers and different empirical distributions of education levels between the two countries, the moments simulated with the U.S. parameter estimates are very close to those from Baudin et al. (2015). Rows from (d) to (k) tabulate the simulated moments in the counterfactual analyses when only one parameter in ν, $\underline{\theta}$, γ, and ϕ is replaced with the U.S. counterpart and the mean values of the estimates for South Korea and the U.S., keeping all other parameters at the benchmark values.

Figure H1: Counterfactual Analysis in South Korea: Using U.S. Estimate of α'



Note: Each figure in (a)–(d) plots fertility or marriage rates in the benchmark simulation (solid line with triangles) and in the counterfactual simulation (dashed line) when we use the U.S. estimate of α'.

Table H1: Counterfactual Analysis in South Korea: U.S. Parameter Estimates and Other Social Norms

	Marriage Rates	Childless -ness rates for married women	Complete fertility for married mothers	Childless -ness rates for single women	Completed fertility for single mothers
(a) Korea moments (2015)	0.955	0.029	2.192	0.982	1.213
(b) U.S. moments (1990)	0.928	0.080	3.304	0.746	2.726
(c) All U.S. parameters	0.892	0.095	3.582	0.787	2.787
(d) ν^{US}	0.859	0.457	1.381	0.999	1.175
(e) mean of ν^{US} and ν^{Korea}	0.901	0.147	1.659	0.998	1.207
(f) $\underline{\theta}^{US}$	0.657	0.032	2.068	0.999	1.007
(g) mean of $\underline{\theta}^{US}$ and $\underline{\theta}^{Korea}$	0.858	0.029	2.174	0.998	1.089
(h) γ^{US}	0.923	0.033	1.893	0.994	1.146
(i) mean of γ^{US} and γ^{Korea}	0.942	0.032	2.029	0.989	1.151
(j) ϕ^{US}	0.986	0.011	3.474	0.866	1.347
(k) mean of ϕ^{US} and ϕ^{Korea}	0.974	0.015	2.753	0.949	1.297

Note. The table summarizes counterfactual analyses in which U.S. parameter estimates from Baudin et al. (2015) replace the Korean parameters. Row (a) shows our benchmark simulation moments regarding marriage and fertility for South Korea using our model. Row (b) shows corresponding simulation moments for the U.S. in Baudin et al. (2015). Row (c) presents simulation moments in the counterfactual analyses in which the Korean parameter estimates are all replaced by U.S. parameter estimates, using our model and the empirical distribution of education levels for men and women from South Korea. Row (d) tabulates simulated moments in the counterfactual analysis when we replace the benchmark estimate of ν for South Korea (ν^{Korea}) with the estimate for the U.S. (ν^{US}), keeping all other parameters at the benchmark values. Row (e) tabulates simulated moments in the counterfactual analysis when we replace the benchmark estimate of ν for South Korea (ν^{Korea}) with the mean value of the estimates of ν for South Korea and the U.S., keeping all other parameters at the benchmark values. Rows from (f) to (k) tabulate the simulated moments in the counterfactual analyses when only one parameter in $\underline{\theta}$, γ, and ϕ is replaced with the U.S. counterpart and the mean values of the estimates for South Korea and the U.S., keeping all other parameters at the benchmark values.

Appendix I Model Limitations

In our model, we assume that married couples always agree on fertility. The norm of unequal gender division of childcare restrains optimally allocating childcare between husband and wife, raises the opportunity cost of childrearing, and consequently lowers fertility. In practice, however, many couples disagree on having children. Doepke and Kindermann (2019) show that a wife's desire for children is weaker than her husband if she does most of the childcare. In addition, couples may have difficulty reaching a consensus on fertility—a prerequisite for a birth—because the husband is unable to make a binding commitment for future transfers to his wife. In this case, the norm of unequal gender division of childcare decreases fertility through the channel of imperfect commitment and disagreement between husband and wife. Gobbi (2018) also shows that imperfect commitment leads to underinvestment in childcare. To account for imperfect commitment and disagreement, we need a bargaining model (Doepke and Kindermann, 2019) or a semi-cooperative model (Gobbi, 2018).

We use the current model for two reasons. First, it accounts for both fertility and marriage decisions. The implication of imperfect commitment for marriage can be complicated. Bhaskar et al. (2020) study the consequences of imperfect commitment for equilibrium premarital investments and marriage matching, but not fertility. Second, the model is based on Baudin et al. (2015), who distinguish the intensive and extensive margins of fertility. Adoption of their model framework allows us to make a direct and useful comparison with existing parameterizations for other countries. We exercise caution with regard to alternative channels through which the gender norm that is biased against women in childcare affects fertility.

We simplify labor supply decisions in the model, in which an individual's labor supply is treated as the time endowment minus childcare time. Thus, labor supply changes along the intensive margin only. Adda et al. (2017) decompose females' career cost of children into multiple dimensions: labor force participation, loss of skills, lost earnings opportunities, and occupational selection. The norm of unequal gender division of childcare may interact with these multiple dimensions of female labor supply decisions, which would affect fertility decisions in a subtler way than that considered in our paper. We discussed females' labor market performance in South Korea in Section A.3.3, and relegate the potential extension of endogenous labor supply to future studies.

We assume that individuals are randomly matched with possible partners for marriage. Thus, our model

accounts for only 30% of the variation in the assortativeness of matching in the data; this is higher than the 13.8% in Baudin et al. (2015). The degree of assortative matching is high in reality, because people meet several possible partners with similar levels of education. Modelling this type of search in the marriage market requires a dynamic framework. It would be difficult for our static model to simultaneously account for a high degree of endogenous assortativeness and a reasonable marriage rate, as discussed in Baudin et al. (2015). To match the assortativeness with a static model, a solution proposed by Fernández-Villaverde et al. (2014) is to assume an exogenous fraction of λ of the female population draws a possible match from her education category, and $1-\lambda$ from the total population. We adopt this method in our robustness analyses (Appendix F.5). Columns (6)–(7) in Table F1 in Appendix F report the quantitative analysis results when we assume $\lambda = 0.2$ and $\lambda = 0.5$, respectively. Our results remain robust. In both cases, our model explains more than 95% of the variation in the assortativeness of matching in the data (Tables F2 and F3 in Appendix F).

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