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Abstract

We document three stylized facts on marriage and fertility patterns in East Asian societies: (i) their marriage rates are among the highest in the world, but their total fertility is the lowest; (ii) although they have the lowest total fertility, almost all married women have at least one child; and (iii) almost no single women have any children. As these societies have been influenced by Confucianism over millennia, marriage and fertility decisions are potentially shaped by two social norms: the unequal gender division of childcare and the stigma attached to out-of-wedlock births. We present a model incorporating the two social norms, and structurally estimate it using data from South Korea. We find that the social norm of unequal gender division of childcare plays a significant role in the low fertility rates, especially for highly educated women. However, the social stigma attached to out-of-wedlock births has modest effects on the childlessness rate for single women. Our results show that the tension between the persistent gender ideology and the rapid socioeconomic development is the main driving force behind the unique marriage and fertility patterns in East Asian societies.

Key Words: Confucianism; Social norms; Fertility; Demographic transition; East Asian societies

JEL Codes: J11; J12; J13

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1 Introduction

The demographic transition experienced by East Asian societies over the past few decades has been distinctive and drastic.[1] Relative to other regions, East Asian societies have experienced much faster fertility declines, and currently have the lowest fertility levels in the world. In 2016, total fertility rates (TFRs) in South Korea, Hong Kong, Taiwan, Macau, and Singapore are 1.26, 1.19, 1.13, 0.95, and 0.83, respectively; they rank 220th–224th in terms of TFR among 224 countries and territories (Table 1).[2] We document three stylized facts: (i) despite having the lowest fertility levels, marriage rates in these societies are among the highest in the world; (ii) almost all married women have at least one child; and (iii) in contrast, very few single women have any children. These three facts are puzzling because high marriage rates and low childlessness rates of married mothers usually imply high total fertility. Moreover, married women's and single women's fertility decisions do not exhibit such sharp differences in most other societies. These facts imply that in conjunction with the demographic transition, the extensive and intensive margins of fertility have diverged—while the extensive margin (the probability of having a child) has hardly changed, the intensive margin (completed fertility of mothers) has undergone a significant transformation. To fully understand the marriage and fertility patterns in East Asian societies, we must consider marriage decisions and fertility decisions simultaneously, and distinguish between the extensive margin and the intensive margin of fertility.

In studying marriage and fertility decisions, the sociology and demography literature acknowledges the strong influence of two social norms associated with Confucianism (Greenhalgh, 1985; Qian and Sayer, 2016; Fuwa, 2004; Raymo et al., 2015). One social norm is the unequal gender division of childcare within a household. In traditional Confucian culture, the wife's responsibility was to obey her husband, as embodied in the "Three Obediences and Four Virtues," the basic moral

[1] "East Asian societies" refer to China, Japan, South Korea, Hong Kong, Taiwan, Macau, and Singapore in our analyses. Although China is markedly different from the other six in terms of political structure and population-control policies, it has strong cultural connections with them. Moreover, China's marriage and fertility patterns are consistent with those in the other societies.

[2] The total fertility rate is measured by the average number of children who would be born per woman if all women were to live to the end of their childbearing period, and procreate according to a given fertility rate at each age.

principles for women in Confucianism. In much of East Asian societies, this gender ideology has persisted to the 21st century as women normally do most of the housework and childcare (Table 2). The other social norm is the stigma attached to out-of-wedlock births. Although legal and political institutions in East Asia have evolved substantially over the past few decades alongside rapid economic growth, these two norms still remain significant (Raymo et al., 2015).[3]

These social norms may be crucial for explaining the three puzzling facts. In Confucian societies, the purpose of the family is to ensure the continuation of the family line; therefore, producing offspring to pass on the family name is paramount. Since out-of-wedlock births are stigmatized, marriage is a precondition for procreation. Single women are highly unlikely to have children; however, once married, women are expected to produce offspring. The boom in women's education in East Asia in recent decades and the subsequent rise in female labor force participation rates imply that the opportunity cost of raising a child has increased for women, in particular highly educated women. The decrease in fertility that is triggered by these trends may be amplified by the persistence of the unequal gender division of childcare in East Asia, relative to other parts of the world, thereby explaining the low fertility rates of married mothers.

Our first contribution to the literature is to document these stylized facts about East Asian societies, extend the model in Baudin et al. (2015) to explain these facts, and quantitatively evaluate the importance of the two social norms in marriage and fertility decisions. Baudin et al. (2015) endogenize marriage and fertility decisions and distinguish between the extensive and intensive margins of fertility, thereby providing a useful framework to examine the divergence between the extensive and intensive margins of fertility in East Asian societies. To quantify the effects of the social norm of unequal gender division of childcare, we relax the standard assumption that the wife's labor inputs and the husband's labor inputs are perfect substitutes (Becker, 2009; Baudin et al., 2015). Specifically, we introduce a home production function in the form of constant elasticity of substitution (CES) for childcare service. This general home production function allows us to distinguish

[3]The persistence of the Confucian norms originated from the patriarchal, patrimonial, patrilineal, and patrilocal organization of East Asian families, which put women at a severe social and economic disadvantage relative to men within the family. At the same time, the paramount importance of family lineage ascribed a social stigma to out-of-wedlock childbirth.

between the labor division governed by the social norm (i.e., unequal gender division of childcare) from the optimal labor division between a husband and a wife. With this setup, the optimal share of a wife's labor in the total amount of household labor depends on (i) the wife's wage relative to that of her husband and (ii) the degree of complementarity or substitutability between the wife's labor inputs and the husband's labor inputs in the home production function. When the wife's labor inputs and the husband's labor inputs are imperfect substitutes, the optimal share of the wife's labor strictly decreases as her wage (relative to her husband's wage) increases. In reality, the social norm mainly governs spousal time allocation (Raymo et al., 2015): Women do most of the childcare in East Asian societies, regardless of their relative wage, which indicates that intrahousehold time allocation is not efficient (Table 3). In traditional East Asian societies, where the wife's wage was much lower than her husband's, the optimal labor division did not conflict with that governed by the social norm of unequal gender division of childcare. The social norm, therefore, would have had negligible effects on fertility. In modern societies, however, the labor division governed by the social norm deviates from the optimal labor division because of the boom in women's education and the subsequent rise in their relative wage. Consequently, the social norm of unequal gender division of childcare leads to the unnecessarily high cost of raising children.

To quantify the effects of the social stigma of out-of-wedlock births on marriage and fertility decisions, we allow the marginal utility of having children to differ between single and married households in our model. We then introduce a new source of childlessness that is exclusive to single women—social-stigma-driven childlessness—in addition to the natural sterility, poverty-driven, and opportunity-cost-driven childlessness examined in the literature (Baudin et al., 2015; Gobbi, 2018).

We structurally estimate the model using data from South Korean censuses and household surveys, and find that the simulated moments fit the data well. We then conduct counterfactual analyses to investigate the roles of the two social norms in marriage and fertility decisions in South Korea. Our quantitative analysis targets the cohort between the ages of 45 and 70 in the 2015 census of South Korea. This cohort has an average total fertility of 2.03. The results show that

stripping away the social norm of unequal gender division of childcare would increase marriage rates and both margins of fertility, thus raising South Korea's total fertility from 2.03 to 2.26 (an 11.2% increase), which is above the population replacement rate of 2.10. This increase in total fertility can be decomposed into endogenous changes in all three components of total fertility: (i) the marriage rate increases from 0.955 to 0.968; (ii) the childlessness rate for the married women decreases from 2.9% to 1.3%; and (iii) completed fertility of married mothers increases from 2.19 to 2.37. However, the effects of the social norm vary by gender and across education levels. The increases in marriage rates and fertility are larger for highly educated women. In the absence of the social norm, the marriage rate for women with at least a master's degree would increase by 7.8%, the childlessness rate of married women with at least a master's degree would decrease by 75%, and completed fertility of married mothers with at least master's degree would increase by 42%.

We find that the social stigma plays a modest role in accounting for the high childlessness rates for single women. In the absence of the social stigma, the childlessness rate for single women would decrease from 0.98 to 0.95. The decrease is largest for single women with a middle level of education. These women are most affected by the social stigma because they are neither subject to poverty-driven childlessness nor faced with a high opportunity cost of childcare. The social stigma has minimal effects on the marriage rates, completed fertility for married mothers, and the childlessness rates for married women.

Our quantitative analyses shed light on the three stylized facts. The high marriage rate in South Korea is the result of the substantial gains from marriage—primarily the high marginal utility of having children inside marriage. The low total fertility rate for married women can be explained by the high opportunity cost of childcare, which is exacerbated by the social norm of unequal gender division of childcare. The social norm is especially costly for highly educated women; consequently, the impact of the social norm on total fertility is greater for highly educated women than for low-educated women. The childlessness rate for married women is low, due to the engrained notion in Confucian culture that producing offspring is a social responsibility. Conversely, the social stigma associated with out-of-wedlock births is a factor in the high childlessness rate for

single women, in particular those with a middle level of education.

We conclude that the three stylized facts are consequences of the tension between persistence of cultural norms stemming from Confucianism and rapid socioeconomic development in East Asian societies. Along this line, our paper is closely related to the literature on the consequences of culture and social norms on individual and household behaviors (Fernández and Fogli, 2006; Fernández and Sevilla Sanz, 2006; Fernández and Fogli, 2009; Bertrand et al., 2015, 2016). We contribute to this literature by quantitatively evaluating the significant role of social norms in accounting for the unique marriage and fertility patterns in East Asian societies.

Our second contribution is that our study is among the first to systematically investigate the rapid fertility decline in East Asian societies in recent decades. We employ a model to explain the change in fertility for the birth cohorts of 1920–1970. The results of the historical simulation suggest that in the absence of the social norm of unequal gender division of childcare, the decrease in the fertility rate would have been less dramatic. This is especially true for younger cohorts, suggesting that the tension between the persistent gender ideology and rapid socioeconomic development has been escalating over the past few decades. Along this line, our study is closely related to the literature on demographic transition. Prior studies have attributed the decline in fertility to economic development (Galor and Weil, 2000; Franck and Galor, 2015); women's labor force participation (Willis, 1973); the gender wage gap (Galor and Weil, 1996); and investments in children's human capital (Becker et al., 1990). We find that although these factors are still important in determining the timing and speed of the demographic transition, the persistent social norm of unequal gender roles is a critical factor in East Asian societies, where Confucian culture still prevails.[4]

Our paper highlights the importance of unequal gender roles in the demographic transition in East Asia (Doepke and Tertilt, 2016, 2018). Thus, our study is closely related to the literature on women's burden of childcare, women's careers, and low fertility rates in many Southern and

[4]The role of social norms in demographic transition has been stressed by the demography literature (Raymo et al., 2015). Our study differs from this literature, which rarely considers incentives, by modelling the interaction between norms and economic incentives.

Eastern European countries. For example, Feyrer et al. (2008) investigate female labor force participation, females' share of total childcare time, and fertility in high-income countries. De Laat and Sevilla-Sanz (2011) find that men's participation in home production relieves the tension between female labor force participation and child births. Doepke and Kindermann (2019) employ a bargaining framework with imperfect commitment between spouses to explain the negative relationship between fertility and females' share of childcare. We study the effects of females' burden of childcare on marriage and fertility in a cooperative framework.

Our third contribution is to investigate pro-natal policies, which are aimed at mitigating the effects of the social norm of unequal gender division of childcare. We conduct two policy experiments. The first experiment shows that the fertility effects of the social norm can be offset, in terms of average fertility, if the government covers 3.9% of total childcare for each child, for example, by setting up childcare centers. The second experiment shows that the fertility effects can also be offset in terms of average fertility, if the government pays households a childcare subsidy of 3.7% of the average childcare cost for each child, which amounts to USD 2,300 per year for each child. However, both policy experiments show that pro-natal policies are insufficient in boosting fertility for highly educated women.

The paper proceeds as follows. Section 2 describes the three facts about marriage and fertility in East Asian societies. Section 3 sets up the model, and Section 4 estimates the model parameters. Section 5 conducts counterfactual analyses, and Section 6 discusses other potential social norms in East Asian societies and the limitations of the model. Section 7 concludes.

2 Motivation

In this section, we first describe three facts about marriage and fertility in East Asian societies. We then introduce two social norms associated with Confucianism, which may be critical for explaining these facts.

2.1 Three Stylized Facts on Marriage and Fertility in East Asian Societies

Total fertility rates (TFRs) have decreased dramatically over the past five decades in the East Asian societies, which now have the lowest fertility levels in the world (columns (1)–(2) in Table 1). The average TFR of seven East Asian societies has decreased by 75 %, from 4.82 in 1960 to 1.19 in 2016. In particular, TFRs for South Korea, Hong Kong, Taiwan, Macau, and Singapore in 2016 are 1.26, 1.19, 1.13, 0.95, and 0.83, respectively, and they rank 220th-224th among 224 countries and territories.[5]

Alongside this drastic demographic transition, these East Asian societies have experienced rapid industrialization and economic growth since the 1960s. Between 1960 and 2016, the Four Asian Tigers—Hong Kong, Singapore, South Korea, and Taiwan—experienced an average annual growth rate of GDP per capita of 7.5%. Meanwhile, educational attainment in these four societies has also increased substantially. Specifically, between 1960 and 2015, the average number of schooling years increased from 2.77 to 12.53 for women, and increased from 5.48 to 12.76 for men.[6] The neoclassical economic theory of fertility suggests that these socioeconomic changes in East Asian societies have increased the opportunity cost of raising children, and have thus lead to a rapid decline in fertility (Becker and Barro, 1988; Doepke, 2004; Galor and Weil, 1996). However, one may have difficulty reconciling the following three facts about marriage and fertility in East Asian societies.

Fact 1: ***Although marriage rates in East Asian Societies are among the highest in the world, their total fertility rates are among the lowest.*** Columns (3)–(4) in Table 1 show that marriage rates in East Asian societies are among the highest in the world around 2015. Among East Asians aged 45–49, 83.4% of men and 82.0% of women are married. In contrast, among their counterparts in a number of western societies, 63.5% of men and 65.1% of women are married.[7] Marriage rates in East Asia are also higher than in developing countries where 80.2% of men and 68.1% of women

[5]Low fertility levels in East Asian societies have persisted since the early 2000s.

[6]Data on GDP per capita are from the World Bank, and data on educational attainment for the population aged 15 and older is from Barro & Lee's dataset.

[7]The western societies cited here are the U.S., the UK, Canada, Finland, Spain, and Italy.

are married.[8] On the other hand, the TFRs in East Asian societies are the lowest in the world (columns (1)–(2)).

Fact 2: ***Although their total fertility rates are among the lowest, almost all married women have at least one child.***

Column (5) shows that around 2015, the average childlessness rate for married women in East Asian societies was 3.7%, which was much lower than the rate in the selected western societies (11.1%), and slightly lower than the rate in developing countries (5.4%).

Fact 3: ***Almost no single women have any children in East Asian societies.*** Column (6) shows that around 2015, the average childlessness rate for single women in East Asian societies was 96.2%, which was substantially higher than the rates in the selected western societies (49.7%) and developing countries (42.3%).

These facts seem puzzling given the following decomposition of total fertility F in a population:

$$F = m(1-c^M)n^M + (1-m)(1-c^S)n^S, \tag{1}$$

where m is the marriage rate; c^M and c^S are the childlessness rates of married women and single women, respectively; and n^M and n^S are completed fertility of married mothers and single mothers, respectively. This decomposition indicates that high total fertility (F) is associated with a high marriage rate (m) and a low childlessness rate of married mothers (c^M) as $\partial F/\partial m > 0$ and $\partial F/\partial c^M < 0$. However, the correlations predicted by the decomposition are inconsistent with Facts 1 and 2. Fact 3 is also puzzling. In East Asia, the fertility decisions of married women is starkly different from those of single women. In contrast, in the U.S. and the 36 developing countries in Baudin et al. (2015, 2020), the childlessness rates of married women and single women are positively correlated. Therefore, we should simultaneously endogenize the marriage decision (m) and fertility decision at both the extensive margin (c^M and c^S) and the intensive margin (n^M and n^S) to explain the three facts.

[8] The developing countries comprise the 36 developing countries studied by Baudin et al. (2020).

2.2 Two Social Norms Related to Confucianism

The sociology and demography literature suggests that Confucian culture persists in East Asian societies, despite rapid economic growth and progress in legal and political institutions in the past few decades (Greenhalgh, 1985; Qian and Sayer, 2016; Fuwa, 2004). Raymo et al. (2015) find that the family expectations and obligations regulated by Confucianism have experienced very little change over the past few decades. In contrast, western societies have experienced fundamental attitudinal shifts toward more equal gender roles in housework over the same period (Goldscheider et al., 2015).

The basic principles of Confucian ethics are the *Three Cardinal Guides*: The ruler guides his subject, the father guides his son, and the husband guides his wife. The basic moral principles for women in Confucianism are the *Three Obediences and Four Virtues*, which state that the wife's responsibility is to obey her husband. Raymo et al. (2015) conclude that this gender ideology still prevails in East Asian societies today. In addition, out-of-wedlock births remains taboo in these societies. We conjecture that the tension between the persistence of Confucian culture and rapid economic development over the past few decades has culminated in the marriage and fertility patterns observed in contemporary East Asian societies. Specifically, our analyses focus on two social norms related to Confucianism: the unequal gender division of childcare and the stigma attached to out-of-wedlock births. Section 6 considers other potential social norms related to Confucianism.

Unequal gender division of childcare: In patrilineal and patriarchal East Asian societies, women do most of the domestic housework and childcare (Greenhalgh, 1985; Tsuya et al., 2000; Qian and Sayer, 2016). Table 2 shows the number of weekly hours spent on housework by gender in East Asian societies, developing countries, and western countries. On average, women in Japan, South Korea, Hong Kong, Taiwan, and China are responsible for 80% of the housework, which is 20 percentage points higher than their counterparts in the U.S., the UK, Canada, and Finland.[9] The proportion of housework borne by women in East Asia is also higher than that borne by their

[9]With respect to the proportion of housework borne by women, East Asian societies are similar to Spain and Italy, which have more traditional gender roles than many other western countries.

counterparts in developing countries. Importantly, this proportion has remained consistently high in East Asian societies over the past few decades. Appendix A.1 describes the social norm of unequal gender division of childcare in detail. Data from the Korean Time Use Survey (KTUS) show that the gender division of housework within a married household in South Korea does not systematically vary across couples' education levels (Table 3).[10] We thus conclude that the gender ideology in Confucian culture has persistently regulated the gender division of housework, of which childcare is a major component for young married couples.

Stigma attached to out-of-wedlock births: Out-of-wedlock births have historically been stigmatized 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). However, events over the past century—industrialization, economic development, and in particular the advent of female contraception and the legalization of abortion—have led to a gradual acceptance of out-of-wedlock births in western societies (Akerlof et al., 1996; Fernández-Villaverde et al., 2014). In modern East Asian societies, by contrast, childbearing outside of marriage is still stigmatized (Dommaraju and Jones, 2011; Ochiai, 2011; Raymo et al., 2015). Consistent with this norm, column (6) of Table 1 shows that almost no single women have any children in East Asian societies, which is a sharp contrast with the fertility patterns for single women in other societies. In addition, of all OECD countries, Japan and South Korea have the lowest proportions of birth outside marriage—2.3% and 1.9% in 2015, respectively; the average proportion for the remaining 33 OECD countries for which data are available is 41.5% (Appendix A.2).[11]

The sociology and demography literature (Greenhalgh, 1985; Qian and Sayer, 2016; Fuwa, 2004; Raymo et al., 2015) conjectures that these two social norms may be crucial for explaining the three facts about marriage and fertility in East Asian societies. In Confucian culture, producing offspring to carry on one's family name is a social responsibility.[12] As out-of-wedlock births are

[10] Appendix Table A1 shows that the unequal gender division of childcare is also present for dual-earner married couples in South Korea. Furthermore, the gender division of housework within a dual-earner married household also does not systematically vary across couples' education levels.

[11] Data are based on the OECD's fertility indicator.

[12] "There are three ways to be unfilial; having no sons is the worst," according to Mencius, who was considered the "second sage" after Confucius.

stigmatized, women are unlikely to produce offspring outside marriage. Hence East Asian societies have high marriage rates, low childlessness rates for married women, and high childlessness rates for single women. On the other hand, as East Asian women have become more educated, the opportunity cost of their time spent on childcare has increased. This increase in opportunity cost could have been further exacerbated by the social norm of unequal gender roles. To reconcile the high opportunity cost with the social norm of the disproportionate burden of childcare, women choose to have fewer children. Hence East Asian societies have low fertility rates. We develop a structural model to test the conjecture and quantitatively evaluate the importance of the two social norms in marriage and fertility decisions.

3 The Model

We require a model that simultaneously endogenizes marriage and fertility decisions and distinguishes between the extensive and intensive margins of fertility. We build on the framework proposed by Baudin et al. (2015), and modify it by incorporating the two social norms in the model.

3.1 Model Setup

The model is composed of heterogeneous individuals who are characterized by a triplet of state variables: gender $i = (m$ [man], f [woman]), wage w_i, and non-labor income a_i. Each individual enters a two-stage game. In the first stage, individuals do not know whether they are naturally sterile, and are randomly matched with possible marriage partners; they decide whether to marry or not after comparing the utility of being married and single. In the second stage, individuals discover whether they are fertile or sterile, and decide whether to have children, and if so, the number of children; they also decide on their consumption of other goods.

The utility of an individual of gender i and marital status $J = (M$[married], S[single]) is

$$u(c_i^J, n) = ln(c_i^J) + ln(\nu + \varepsilon^J n), \tag{2}$$

where c_i^J is individual i's consumption when his/her marital status is J, and $n \geq 0$ is an integer representing the number of children individual i has. Following Baudin et al. (2015), we assume that single women can have children and single men cannot. That is, men have to get married in order to have children. The preference parameter $v > 0$ determines the utility of having no children. The parameter $\varepsilon^J > 0$ determines the marginal utility of having children, which depends on marital status J.[13] Utility increases as the number of children increases. Baudin et al. (2015) use the same value of ε for both married women and single women. However, we allow for the possibility that married women and single women experience different utilities of having children by letting ε vary by marital status J. If single mothers experience the social stigma attached to out-of-wedlock births, the estimated value of ε^S would be lower than that of ε^M.

We use χ_m and χ_f to denote the proportion of men and women, respectively, who are naturally sterile. Natural sterility is assumed to be uniformly distributed across education levels. Childlessness may also be driven by poverty; a minimum amount of consumption $\hat{c}$ is necessary in order for a woman to procreate:

$$c_f < \hat{c} \Rightarrow n = 0. \tag{3}$$

When an individual gets married, he/she has one unit of labor endowment to be allocated between work and childcare. A single individual of gender i is endowed with $1 - \delta_i$ unit of labor, where δ_i is the time cost of being single. The wage rate, w_i, depends on education and gender. In addition to labor income, each individual has non-labor income $a_i > 0$, which follows a log-normal distribution of mean m_a and variance σ_a^2, and which is independent of gender, education, and marital status. Furthermore, each household has to pay a goods cost μ^J, which depends on marital status.

[13] The preference parameter ε^J is similar to γ in De la Croix and Delavallade (2018), which is used to capture the religious preference for fertility.

3.2 Home Production of Childcare

Having children entails costs in terms of forgone labor income. For married households, childcare service (L^M) is produced by a husband's labor and/or a wife's labor, denoted by l_m and l_f, respectively. The home production function for childcare is in a CES form:

$$L^M(l_m, l_f) = A^M \left({l_m}^{\psi} + {l_f}^{\psi} \right)^{\frac{1}{\psi}}, \tag{4}$$

where $\psi \leq 1$.

For single mothers, the home production function of childcare service (L^S) becomes linear in l_f, as follows:

$$L^S = A^S l_f. \tag{5}$$

We allow different levels of productivity for married households and single mothers such that $A^S \neq A^M$.

We further assume that the total amount of childcare required to raise n children is

$$F(n) = \phi n, \tag{6}$$

where ϕ is the variable cost of raising a child.

The cost-minimization problem for a married household with n children is

$$\min_{l_m, l_f} w_m l_m + w_f l_f, \tag{7}$$

subject to

$$A^M ({l_m}^{\psi} + {l_f}^{\psi})^{\frac{1}{\psi}} = \phi n, \tag{8}$$

$$0 \leq l_m \leq 1, \quad 0 \leq l_f \leq 1. \tag{9}$$

Using first-order conditions with respect to l_m and l_f, we have

$$\left(\frac{l_m}{l_f}\right) = \left(\frac{w_m}{w_f}\right)^{\frac{1}{\psi-1}}. \tag{10}$$

The optimal l_m^* and l_f^* for a married couple are, respectively,

$$l_m^* = \frac{w_m^{\frac{1}{\psi-1}}}{\left(w_m^{\frac{\psi}{\psi-1}} + w_f^{\frac{\psi}{\psi-1}}\right)^{\frac{1}{\psi}}} \frac{1}{A^M} \phi n, \tag{11}$$

$$l_f^* = \frac{w_f^{\frac{1}{\psi-1}}}{\left(w_m^{\frac{\psi}{\psi-1}} + w_f^{\frac{\psi}{\psi-1}}\right)^{\frac{1}{\psi}}} \frac{1}{A^M} \phi n. \tag{12}$$

Let α be the proportion of the wife's labor l_f in the total amount of household labor in childcare, where $\alpha = l_f/(l_f + l_m)$. Following equation (10), the optimal proportion of time spent on childcare by the wife, denoted by α^*, strictly decreases in her relative wage. That is, $\partial\alpha^*/\partial(w_f/w_m) < 0$.

3.3 Cost of the Social Norm of Unequal Gender Division of Childcare

The gender division of childcare in East Asian societies is regulated by social norms. Table 3 shows that intrahousehold time allocation between a husband and a wife does not vary across spousal education level in South Korea. This pattern contrasts with the first-order condition of optimally allocating childcare time between a husband and a wife (equation (10)). It also contrasts with the pattern of gender division of childcare in the U.S. and other western countries (Gobbi, 2018; Doepke and Kindermann, 2019). For example, Table 1 in Gobbi (2018) shows that time spent on childcare by the wife relative to time spent by the husband is significantly correlated with the education level of the wife relative to that of the husband. We conduct a regression analysis in Appendix A1, and find that the gender division of childcare is uncorrelated with cohort indicators as well as spousal education levels. Thus, the persistent gender division of childcare in East Asian societies is likely to be strongly influenced by social norms. Social norms, defined as the informal

rules that govern behavior in societies, are persistent and are not very responsive to changes in the socioeconomic environment.[14]

When the social norm applies, the proportion of time spent on childcare by the wife, α, is no longer a choice variable for the household, but it is exogenously set to the value of α' as dictated by the social norm. The husband's labor and the wife's labor following α' are respectively denoted by $l_m(\alpha')$ and $l_f(\alpha')$. Following from equation (4):

$$l_m(\alpha') = \zeta_1 \frac{1}{A^M} \phi n, \tag{13}$$

$$l_f(\alpha') = \zeta_2 \frac{1}{A^M} \phi n, \tag{14}$$

where $\zeta_1 = 1/\left\{ \left[(\alpha'/(1-\alpha'))^{\psi} + 1 \right]^{1/\psi} \right\}$ and $\zeta_2 = \alpha'/\left\{ (1-\alpha') \left[(\alpha'/(1-\alpha'))^{\psi} + 1 \right]^{1/\psi} \right\}$, both of which are constants.

The social norm of unequal gender division of childcare within a household can lead to households incurring unnecessarily large costs of raising children. Denote $C(\alpha^*)$ as the cost of childcare when spouses follow the optimal division rule α^*. That is, $C(\alpha^*) = w_m l_m(\alpha^*) + w_f l_f(\alpha^*)$. Similarly, $C(\alpha') = w_m l_m(\alpha') + w_f l_f(\alpha')$ is the cost when spouses follow the social norm. We define $C(\alpha') - C(\alpha^*)$ as the cost of the social norm when households deviate from the optimal gender division of childcare. The cost of the social norm has the following property:

$$\frac{\partial [C(\alpha') - C(\alpha^*)]}{\partial w_f} |_{\alpha' > \alpha^*} > 0 \tag{15}$$

The cost of the social norm increases with w_f, when $\alpha' > \alpha^*$.[15] As women's education increases relative to men's in modern societies, the wages of women (w_f) increase, pushing up the cost of the social norm.

[14] The intrahousehold childcare division could be affected by other factors, such as home production technology. However, we believe that this factor is less important in South Korea, as Appendix A1 shows that the gender division of childcare persisted across many decades, during which home production technology has advanced tremendously.

[15] As women disproportionately bear the burden of childcare in East Asian societies, the condition ($\alpha' > \alpha^*$) holds for most married households.

3.4 Fertility and Consumption Decisions

We solve the model by backward induction. First, we consider individuals' fertility and consumption decisions, taking marital status as given. When the gender division of childcare is regulated by the social norm, the budget constraints for a single man $b_m\left(c_m^S\right)$, a single woman $b_f\left(c_f^S, n\right)$, and a married household $b\left(c_f^M, c_m^M, n\right)$ are, respectively,

$$\begin{aligned} b_m\left(c_m^S\right) &= c_m^S - (1-\delta_m) w_m - a_m + \mu^S \leq 0, & (16) \\ b_f\left(c_f^S, n\right) &= c_f^S + \frac{\phi}{A^S} w_f n - \left(1-\delta_f\right) w_f - a_f + \mu^S \leq 0, & (17) \\ b\left(c_f^M, c_m^M, n\right) &= c_f^M + c_m^M + \frac{\phi}{A^M}\left(\zeta_1 w_m + \zeta_2 w_f\right) n - w_m - w_f - a_f - a_m + \mu^M \leq 0. & (18) \end{aligned}$$

We assume a collective decision model for married households. The husband and wife jointly decide how much to consume (c_m^M, c_f^M) and how many children to have (n) to maximize the following objective function:

$$U\left(c_f^M, c_m^M, n\right) = \theta(w_f, w_m) u\left(c_f^M, n\right) + [1 - \theta(w_f, w_m)] u\left(c_m^M, n\right), \quad (19)$$

where $\theta(w_f, w_m)$, the wife's bargaining power, is given by:

$$\theta\left(w_f, w_m\right) \equiv \frac{1}{2}\underline{\theta} + (1-\underline{\theta})\frac{w_f}{w_f + w_m}, \quad (20)$$

where $\underline{\theta}/2$ is the lower bound of the wife's bargaining power.

Married couples make fertility and consumption decisions to maximize equation (19) subject to equation (18). Single women maximize equation (2) subject to equation (17). Single men only make consumption decisions to maximize $ln(c_m^M) + ln(\nu)$ subject to equation (16). The maximum number of children a single woman and a married woman can have are, respectively,

$$n^S = \frac{A^S(1-\delta_f)}{\phi},\ n^M = \frac{A^M}{\zeta_2 \phi}, \quad (21)$$

which are derived from their labor-endowment constraints.

3.5 Marriage Decisions

We now turn to individuals' marriage decisions. Single men have three options once they are randomly matched with a possible spouse in the marriage market: (i) single with no children; (ii) married with no children; and (iii) married with children. The value functions are, respectively,

$$V_m^S \equiv \left\{\max \ln(c_m^S)+\ln(v) \quad s.t \quad b_m\left(c_m^S\right)\leq 0\right\}, \tag{22}$$

$$V_m^{M,N} \equiv \left\{\max \ln(c_m^M)+\ln(v) \quad s.t \quad b\left(c_f^M,c_m^M,0\right)\leq 0\right\}, \tag{23}$$

$$V_m^{M,Y} \equiv \left\{\max \ln(c_m^M)+\ln(v+\varepsilon^M n) \quad s.t \quad b\left(c_f^M,c_m^M,n\right)\leq 0\right\}, \tag{24}$$

where the second superscript indicates whether the individual has any children (Y) or not (N).

Men choose to marry with the randomly matched partner if and only if

$$\left[\chi_m+(1-\chi_m)\chi_f\right]V_m^{M,N}+(1-\chi_m)(1-\chi_f)V_m^{M,Y}\geq V_m^S. \tag{25}$$

On the left-hand side, the first term is the expected value of being married with no children due to natural sterility, and the second term is the expected value of being married with the possibility of having children. That is, men choose to marry when the expected value of being married is at least as great as the expected value of being single.

Single women have four options once they are randomly matched with a possible spouse in the marriage market: (i) single with no children; (ii) single with children; (iii) married with no

children; and (iv) married with children. The value functions are, respectively,

$$V_f^{S,N} \equiv \left\{\max \ln(c_f^S)+\ln(v) \quad s.t \quad b_f\left(c_f^S,0\right)\leq 0\right\}, \tag{26}$$

$$V_f^{S,Y} \equiv \left\{\max \ln(c_f^S)+\ln(v+\varepsilon^S n) \quad s.t \quad b_f\left(c_f^S,n\right)\leq 0\right\}, \tag{27}$$

$$V_f^{M,N} \equiv \left\{\max \ln(c_f^M)+\ln(v) \quad s.t \quad b\left(c_f^M,c_m^M,0\right)\leq 0\right\}, \tag{28}$$

$$V_f^{M,Y} \equiv \left\{\max \ln(c_f^M)+\ln(v+\varepsilon^M n) \quad s.t \quad b\left(c_f^M,c_m^M,n\right)\leq 0\right\}. \tag{29}$$

Similarly, women choose to marry if and only if

$$\left[\chi_f+(1-\chi_f)\chi_m\right]V_f^{M,N}+(1-\chi_f)(1-\chi_m)V_f^{M,Y}\geq \chi_f V_f^{S,N}+(1-\chi_f)V_f^{S,Y}. \tag{30}$$

A randomly matched pair would get married if and only if both the man and the woman agree to do so; that is, both equations (25) and (30) hold.

3.6 Decomposition of Childlessness

We have thus far introduced natural sterility and poverty-driven childlessness for both married women and single women. One type of childlessness that is exclusive to single women is driven by the social stigma discussed in Section 2.2. The condition for social-stigma-driven childlessness is given by

$$V_f^S(n\geq 1|\varepsilon^S=\varepsilon^M,w_f,a_f) > V_f^S(n=0|\varepsilon^S=\varepsilon^M,w_f,a_f), \tag{31}$$

$$V_f^S(n=0|\varepsilon^S<\varepsilon^M,w_f,a_f) \geq V_f^S(n\geq 1|\varepsilon^S<\varepsilon^M,w_f,a_f), \tag{32}$$

$$c_f^S \geq \hat{c}. \tag{33}$$

That is, if a single woman with wage w_f and non-labor income a_f who would prefer having children in the absence of the social stigma (i.e., $\varepsilon^S=\varepsilon^M$) chooses not to have any children in the presence of the social stigma, we call this type of childlessness social-stigma-driven childlessness.

Another type of childlessness is driven by the high opportunity cost of raising a child. For married women with wage w_f and non-labor income a_f , the condition for this type of childlessness is given by

$$V_f^M(n \geq 1|w_f, a_f) \leq V_f^M(n = 0|w_f, a_f), \tag{34}$$

$$c_f^M \geq \hat{c}. \tag{35}$$

For single women with wage w_f and non-labor income a_f, the condition for this type of childlessness is given by

$$V_f^S(n \geq 1|\varepsilon^S = \varepsilon^M, w_f, a_f) \leq V_f^S(n = 0|\varepsilon^S = \varepsilon^M, w_f, a_f), \tag{36}$$

$$c_f^S \geq \hat{c}. \tag{37}$$

That is, even in the absence of the social stigma, a single woman whose consumption is above $\hat{c}$ may choose to be childless because of the high opportunity cost associated with a high wage rate w_f. Technical details of the decomposition of sources of childlessness for single women are presented in Appendix B.

4 Model Estimation

In this section, we estimate model parameters using data from South Korean censuses and household surveys.[16] The main dataset is the 20 percent sample of the 2015 population and housing census of South Korea. We restrict the sample to women who are either “ever married, spouse present" or “never-married." We further restrict the sample to those aged 45–70 as they have completed their life-cycle fertility. The educational attainment of individuals in the census is catego-

[16]Because of data availability, our main estimation is conducted using the South Korean census and household survey data. Estimation results using data for Taiwan are in Appendix C. Population censuses in Hong Kong, Singapore, Macau, and Japan either do not contain information on fertility or are not publicly available. Population censuses in China include fertility information for women aged 15–45, but the Chinese have been subject to strict population control policies since 1979.

rized into seven levels: no schooling, primary school, middle school, high school, 2-year college, 4-year college, and master's or doctoral degrees.

We have 17 parameters, which are categorized into two groups. One group of parameters is estimated directly from the data, and the other group is estimated from the model using the simulated method of moments (SMM) where empirical moments on marriage rates and fertility rates are matched by education levels. Appendix D.2 describes all the datasets used in the estimation and Appendix E discusses the identification for the SMM estimation.

4.1 Parameters Estimated Directly from the Data

Of the 17 model parameters, seven are estimated directly from the data and are listed in Panel A, Table 4. The table reports the parameter estimates and compares them with their counterparts in Baudin et al. (2015) for the U.S. and those in Baudin et al. (2020) for 36 developing countries.

The following two Mincerian wage equations are used to compute wages for males and females:

$$\begin{aligned} w_m(e) &= z\exp(\rho e), \\ w_f(e) &= \gamma z\exp(\rho e), \end{aligned} \tag{38}$$

where e denotes the number of schooling years associated with each education level,[17] γ the gender wage gap, and ρ the Mincerian rate of return to schooling. We use z as a normalization factor to capture the trend in total factor productivity (TFP) when we conduct historical simulations in Section 5.6. The estimates for γ and ρ are 0.704 and 0.069, respectively, from the 1980–2015 Survey of Labor Conditions by Type of Employment (SLCTE) data. Our estimate of γ is 0.704, which is lower than the estimate for the U.S. (0.869) and the mean value of the estimates for the 36 developing countries (0.786). South Korea's sizable gender wage gap, relative to that of other countries, indicates gender inequality, which could be partially due to the patriarchy prevalent in East Asian societies. Our estimate of ρ is 0.069, which is lower than the estimate for the U.S. (0.092) but is greater than the estimate for the 36 developing countries (0.05).

[17] The seven educational levels correspond to 0, 6, 9, 12, 14, and 18 years of schooling.

Using the 2009 Korean Time Use Survey (KTUS), we obtain the proportion of time spent by a wife on childcare when the allocation of time is governed by the social norm, $\alpha' \equiv l_f/(l_f+l_m)$. We find that α' ranges from 0.74 to 0.86 for different types of households.[18] We use 0.801 for α', which is the average proportion for married couples with children below schoolgoing age.[19] To estimate the elasticity parameter ψ in the CES home production function (equation (4)), we use the first-order condition derived from the cost-minimization problem (equation (10)):

$$ln(\frac{l_m}{l_f}) = \frac{1}{\psi-1}[ln(w_m) - ln(w_f)]. \tag{39}$$

We use the wage rates of men and women from the 1920 birth cohort to compute ψ for the following reason. The 1920 cohort is the first generation in South Korea that started working and forming households after Korea's independence in 1945 and the Korean War in 1950. Individuals in this cohort also completed their education before the economic take-off. For this cohort, women had much less education than men, and the gender wage gap is large. Thus, we assume that the unequal gender division of childcare is efficient for this cohort such that $l_f/(l_m+l_f) = \alpha' = 0.801$.[20] This unequal gender division in the pre-industrialization period arose as a social norm, and has persisted in modern South Korea to this day. Using the mean values for w_m and w_f for the 1920 birth cohort from the SLCTE, we find that $\psi = 0.465$, which is in line with Knowles (2013); in other words, l_f and l_m are imperfect substitutes. The implied elasticity of substitution, however, is 1.87, which is lower than the 3.03 in Knowles (2013). In Appendices F.1 and F.2, we use different values of α' and ψ to verify the robustness of our quantitative results.

The ratio of the household-maintenance-goods cost for single households to that for married households, μ^S/μ^M, is estimated to be 0.66, using the 2015 Household Income and Expenditure data. This statistic implies that there is a certain degree of economies of scale in marriage in South

[18] Appendix Table A1 tabulates the average values of α' for different types of households.

[19] 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.

[20] When we use the estimate of ψ to quantify the effect of the social norm, we further assume that home production technology is the same across birth cohorts.

Korea. In Appendix F.3, we conduct a robustness check using different values of μ^S/μ^M. Natural sterility parameters χ_f and χ_m are set to be identical and fixed at 0.5%, which implies that the natural sterility rate for married households, $\chi_f + (1-\chi_f)\chi_m$, is 0.998%.

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)): $A^S l_f^S = n\phi$; and (ii) labor input in home production for married mothers when the social norm governs the intrahousehold division of childcare (equation (14)): $A^M l_f^M(\alpha') = \zeta_2 n\phi$, where l_f^S and l_f^M are labor inputs in home production for single mothers and married mothers, respectively. We then have

$$\frac{A^S}{A^M} = \frac{l_f^M(\alpha')}{l_f^S}\frac{1}{\zeta_2}. \tag{40}$$

Using the mean values of l_f^S and $l_f^M(\alpha')$ from the 2009 KTUS, we find that $A^S/A^M = 2.035$.

4.2 Simulated Method of Moments

The remaining ten parameters are estimated using SMM by minimizing the distance between empirical and simulated moments. The objective function is

$$f(p) = [d - s(p)]W[d - s(p)]', \tag{41}$$

where d is a vector of empirical moments and $s(p)$ is a vector of simulated moments using a vector of model parameters p. The weight matrix W is a diagonal matrix with $1/d^2$ as elements. We have 30 empirical moments. Table 5 lists 28 of them: completed fertility of married mothers, childlessness rates for married women, and marriage rates for men and women in seven education categories. These empirical moments are obtained from the 20% sample of the 2015 South Korean population and housing census. The remaining two empirical moments are completed fertility for single mothers and the childlessness rate for single women. Completed fertility for single mothers is 1.15 based on the 2015 Single Parent Family Status Survey (SPFS). The childlessness rate for

single women is 0.982, based on the 2015 South Korean census. When minimizing the objective function, we impose the constraint of precisely matching the average simulated childlessness rate for single women to its empirical counterpart. We impose this constraint because we will subsequently decompose the sources of childlessness for single women, in order to investigate the role of the social stigma in accounting for the high childlessness rate of single women in South Korea.

When simulating the model, 100,000 women are drawn from each education category. Each woman is matched with a potential husband randomly drawn from the empirical distribution of education levels for men. In addition to labor income, which is obtained from the Mincerian equation (equation (38)), non-labor income is drawn from a log-normal distribution with mean m_a and variance σ_a^2. We then calculate simulated moments for each education category by averaging fertility and marriage outcomes across these 100,000 women. Standard errors are bootstrapped.

4.3 Parameters Estimated from the Simulated Method of Moments

Panel B in Table 4 presents the remaining ten parameters estimated from SMM and compares them with their counterparts in Baudin et al. (2015) for the U.S. and those in Baudin et al. (2020) for the 36 developing countries. The mean and variance of non-labor income, m_a and σ_a^2, are 0.296 and 0.273, respectively. The goods cost for maintaining a married household, μ^M, is estimated to be 0.680; accordingly, μ^S is 0.450. The minimum consumption level to be able to procreate, $\hat{c}$, is estimated at 0.190.

The preference parameter that determines the utility of remaining childless ν is estimated to be 6.505, which is much lower than the estimate for the U.S. (9.362) and the mean value of the estimates for 36 developing countries (9.367). The low value of ν implies a high marginal utility of having children, which potentially stems from the emphasis placed on passing on the family name in East Asian societies.

The time costs of being single for men and women, δ_m and δ_f, are 0.003 and -0.080, respectively. $\delta_m > \delta_f$ implies that men are less capable of doing housework, and therefore marriage is more beneficial for men than for women. The parameter that determines a wife's bargaining

power for consumption, $\underline{\theta}$, is estimated to be 0.225, which is much lower than the estimate for the developing countries (0.442) and the estimate for the U.S (0.864). Coupled with a high value of α', this low bargaining power indicates deep-seated gender inequality within South Korean households relative to households in other countries. The parameter that determines the variable cost of raising each child ϕ is estimated to be 0.399, such that the effective variable time cost of raising a child for married mothers is 0.162 ($\phi\zeta_1$), which is comparable to 0.168, the cost of raising a first child for married couples in the U.S. ($(\phi+\eta)\alpha$).[21]

Finally, the social stigma parameter, ε^S, is estimated to be 0.891 when ε^M is normalized to be one. Single mothers thus have lower marginal utility of having children than married mothers, which is consistent with the social stigma associated with single motherhood in South Korea.

4.4 Model Fit

Our estimated model well matches the marriage and fertility patterns observed in South Korea. Figure 1 (a) compares the simulated childlessness rates for married women across education levels (dashed line) with their empirical counterparts (solid line with triangles). The childlessness rate for married women in South Korea shows a U-shaped pattern across education levels, although its overall level is much lower than that for other countries. This pattern suggests that for low-educated women in South Korea, childlessness is still driven by poverty. Figure 1 (b) depicts completed fertility for married mothers; we observe a monotonically decreasing pattern across education levels. Figures 1 (c) and (d), respectively, depict marriage rates for women and for men. Our model well reproduces the relationship between marriage rates and education; the correlation between marriage rate and education level is hump-shaped for women and positive for men. The simulated childlessness rate for single women and completed fertility for single mothers are 0.982 and 1.21, respectively, which are very similar to their empirical counterparts of 0.982 and 1.15.[22]

[21] Baudin et al. (2015) assume that there is a fixed cost in raising children η, which our model dispenses with. Consequently, the time cost of raising the first child in Baudin et al. (2015) is higher than that of raising subsequent children.

[22] In Figure 1 (b), the gap between the data and the model prediction for completed fertility of highly educated married mothers can be attributed to our assumption that the rate of return to schooling (ρ) is constant at different

5 Counterfactual Analyses

5.1 The Social Norm of Unequal Gender Division of Childcare

What are the effects of the social norm of unequal gender division of childcare on marriage and fertility? To answer this question, we perform a counterfactual experiment where we assume that time spent on childcare is optimally allocated between spouses. That is, α', a wife's proportion of childcare when governed by the social norm, is replaced by α^*, the optimal proportion based on the wife's relative wage in each household, holding other parameters at their estimated values.

Based on our model estimates, the average cost of the social norm ($C(\alpha') - C(\alpha^*)$) is 0.0043, which amounts to 4.34% of the average cost of raising a child (Appendix G).[23] The optimal division of childcare removes the cost of social norm, thus increasing total fertility from 2.033 to 2.261—an increase of 11.2%. In the absence of the social norm, South Korea's total fertility would well exceed the population replacement rate, leading to population growth. This increase in total fertility can be decomposed into endogenous changes in all three components of total fertility: marriage rates, childlessness rates, and completed fertility. The marriage rate increases from 0.955 in the benchmark simulation to 0.968 in the counterfactual simulation; the childlessness rate for married women decreases from 2.9% to 1.3%; and completed fertility of married mothers increases from 2.192 to 2.366.

Figure 2 (a) compares the model predictions for childlessness rates with and without the social norm by education levels. The solid line with triangles denotes the childlessness rate of married women in the benchmark simulation (in the presence of the social norm), and the dashed line denotes the rate in the counterfactual simulation (in the absence of the social norm). Removing the

education levels. In Figure 1 (d), the gap between the data and the model prediction for the marriage rates of low-educated men can be attributed to our assumption of random marriage matching.

[23] We interpret the deviation from optimal sharing of childcare as a norm. There could be other reasons, such as noncooperation between spouses (Gobbi, 2018). We believe that non-cooperation is unlikely to explain the deviation from optimality in South Korea. If the deviation from optimality were driven by noncooperation between spouses, the proportion of childcare provided by wives should vary by their education levels. Wives with higher education levels tend to have better options outside of marriage and consequently greater intrahousehold bargaining power. Table 3 shows no significant education gradients in the proportion of childcare borne by wives, which sharply contrasts with patterns observed in the U.S. (Gobbi, 2018).

social norm lowers childlessness rates across all education levels. The decrease in childlessness rates is greater for highly-educated women; the childlessness rate for married women with no schooling falls marginally from 3.9% to 3.8%, whereas the rate for those with at least a master's degree falls substantially from 4.0% to 1.0%.

Figure 2 (b) shows that removing the social norm also has differential effects on completed fertility of married mothers across education levels. For those with no schooling, completed fertility decreases slightly from 3.562 to 3.446. The reason is as follows. For married women with no schooling, the optimal sharing rule for childcare (α^*) is not very different from the sharing rule governed by the social norm (α') because of the large gender wage gap. Hence among married women with no schooling, the number of children does not change very much when the social norm is removed. On the other hand, the removal of the social norm slightly increases the marriage rate for those with no schooling due to the increased efficiency of marriage (Figure 3 (c)). However, the "newly" married (those who would have been single in the presence of the social norm but get married when the norm is removed) tend to have fewer children than those who would have gotten married even in the presence of the social norm. Most of the "newly" married have a very low level of non-labor income; prior to the removal of the norm, their marriage offers were rejected by men who were concerned about poverty-driven childlessness. The removal of the social norm enlarges the "newly" married mothers' budget set somewhat, but because they are still relatively poor, their completed fertility is low. Taking these facts together, the removal of the social norm slightly lowers completed fertility of married mothers with no schooling.

In contrast, completed fertility increases for those with primary education or above when the social norm is removed. Moreover, the increase is greater for highly-educated women. Completed fertility for those with at least a master's degree increases by 43% from 1.50 to 2.13.

The differential effects of the social norm on childlessness rates and completed fertility are consistent with the property of the cost of the social norm in Section 3.3: The cost, on average, increases with women's education level. Appendix Table G2 presents the estimated cost of the social norm ($C(\alpha') - C(\alpha^*)$) by the education levels of a married couple. The cost of the social norm

increases from 0.095 for women with no schooling to 0.231 for women with at least a master's degree.

Figures 2 (c) and (d) compare the model predictions for the marriage rates of men and women with and without the social norm. The average marriage rate would increase by an average of 1.3% in the absence of the social norm, but the effects on marriage rates vary by gender and education. Among women, those with higher levels of education are faced with a higher cost of the social norm; consequently highly-educated women experience a greater increase in the marriage rate when the social norm is removed. In contrast, among men, the increase in the marriage rate following the removal of the social norm is greater for those who are less educated. The reason is as follows. For low-educated men, women who are likely accept their marriage offers are those with low income. Their potential wife's consumption may not exceed the minimum amount that is required for procreation ($\hat{c}$), thus making marriage with them not very attractive for these men; one of the main reasons for marriage for men is to have children. Removing the social norm leads to efficient spousal time allocation between work and childcare such that both the husband and the wife can now consume more with an expanded budget set. This increase in consumption reduces poverty-driven childlessness for these households, thus making marriage more attractive to these low-educated men when the social norm is removed.

5.2 The Social Stigma Attached to Out-of-wedlock Births and the Decomposition of Childlessness for Single Women

We investigate the effects of the social stigma attached to out-of-wedlock births on marriage and fertility. We conduct a counterfactual experiment where the marginal utility of having a child is assumed to be the same for the married woemn and single women, i.e., we set $\varepsilon^S = \varepsilon^M = 1$.

The childlessness rates of married women, completed fertility of married mothers, and the marriage rates for men and women in the counterfactual experiment are almost identical to those in the benchmark simulation. The only patterns that change when the stigma is removed are the childlessness rate of single women and completed fertility of single mothers. Figure 2 (e) shows

the removal of the stigma leads to a fall in the childlessness rates for single women across all education levels, with women with six years of schooling experiencing the greatest impact. On average, the childlessness rate of single women would decrease from 0.982 to 0.957 in the absence of the stigma. Figure 2 (f) depicts completed fertility of single mothers. In the absence of the social stigma, completed fertility of single mothers increases across all education levels except those with nine years of schooling, for whom it decreases slightly from 1.22 to 1.15.[24] In sum, total fertility of single women increases by 0.03 (i.e., $(1-c^s)n^s$ in equation (1)) when the stigma is removed.

The social stigma has negative effects on fertility of single women, but theses effects appear to be quantitatively modest. The modest effects of the social stigma on the marriage and childlessness rates of single women are not very consistent with the conjecture proposed by the sociology and demography literature that the unusually high childlessness rates of single women and the high marriage rates in East Asian societies might be related to the social stigma attached to out-of-wedlock births. This conjecture was discussed in Section 2.2.

To understand why this conjecture is incorrect, we use our structural model to conduct a decomposition of the sources of childlessness among single women. The decomposition analysis is presented in Appendix B. The childlessness rate among single women in South Korea is 98.2%, of which 2.19% is attributed to social stigma, 32.70% is attributed to poverty, and 62.87% is attributed to the high opportunity cost of raising a child. This decomposition corresponds with the hump-shaped relationship between marriage rates and education for South Korean women; they are single either because they are too poor to procreate or because having children is too costly for them due to the high opportunity cost. 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.

[24] Single women with nine years of schooling experience a large decrease in the childlessness rate (Figure 2 (e)); some of these women would not have had any children in the presence of the social stigma. When the stigma is removed, these "new" single mothers would most likely have only one child. Because of the influx of "new" single mothers on the margin, completed fertility for single mothers in this group decreases.

5.3 Quantitative Analyses Using Data from Taiwan

We estimate our model using data from Taiwan's censuses and household surveys to confirm that the quantitative results based on South Korean data hold for other East Asian societies. Our model also well matches the marriage and fertility rates in Taiwan. Appendix C presents the data, estimation results, and model fit.

As with South Korea, we conduct a counterfactual experiment by removing the social norm of unequal gender division of childcare (Figures 3 (a)-(d)). The removal of the norm in Taiwan increases total fertility by 17.2% from 2.13 to 2.50. The marriage rate increases from 0.928 to 0.952; the childlessness rate for married women decreases from 2.1% to 1.1%; and completed fertility for married mothers increases from 2.34 to 2.66. As with the counterfactual analysis results for South Korea, we identify the differential effects of the norm on both margins of fertility for Taiwanese women. Removing the norm has positive effects on both margins of fertility, and theses effects are greater for highly-educated women. The effects of removing the norm on marriage rates vary by gender and education; the increase in the marriage rate is largest for highly-educated women and less-educated men.

The parameter that measures the degree of the social stigma attached to out-of-wedlock births, ε^S, is estimated to be 0.879, suggesting the existence of a certain degree of the social stigma for single mothers in Taiwan. Figure 3 (e) shows that removing the social stigma leads to a fall in childlessness rates of single women across all education levels. In contrast, the effect of removing the social stigma on completed fertility of single mothers is modest (Figure 3 (f)). Consistent with the counterfactual analysis for South Korea, the childlessness rates of married women, completed fertility of married mothers, and the marriage rates for men and women in the counterfactual experiment without the social stigma are almost identical to those in the benchmark simulation.

5.4 Counterfactual Analyses Using U.S. Parameter Estimates

Marriage and fertility patterns in East Asian societies are very different from those in western societies (Table 1). Besides the two social norms that we have discussed, are there other factors that

drive these differences? We conduct a counterfactual analysis where we replace the South Korea parameter estimates with the U.S. parameter estimates from Baudin et al. (2015). We continue using our model and the empirical distribution of education levels for men and women in South Korea. Although the structure of our model and the empirical distribution of education levels are different from those used in Baudin et al. (2015), the moments simulated with the U.S. parameter estimates are very close to those reported in Baudin et al. (2015) (Appendix H).[25]

5.5 Explaining the Three Facts on Marriage and Fertility

Our model estimation and counterfactual analyses enable us to explain the three incongruous facts on marriage and fertility in East Asian societies as described in Table 1 of Section 2.1.

High Marriage Rates: Marriage is attractive for both men and women in South Korea as they derive high utility from having children inside marriage (small ν and $\varepsilon_s < 1$). However, men benefit more than women because marriage is the only way for men to have children. Hence men are sometimes willing to take marriage offers from low-educated women, even if doing so implies sharing income with a poorer spouse. Since men have high bargaining power in consumption sharing within a household (small $\underline{\theta}$), a husband does not have to share much of his income with his spouse. On the other hand, low-educated women find marriage attractive as marriage may be the only way for most of them to have children given that their labor income alone is not high enough for their consumption to reach the minimum consumption level that is required for procreation ($\hat{c}$). Overall, these characteristics lead to high marriage rates in South Korea.

Low Total Fertility for Married Mothers: As shown in the counterfactual analysis in Section 5.1, the social norm of unequal gender division of childcare significantly raises the cost of childcare, thus leading to low fertility for married mothers.

Low Childlessness Rates for Married Women: The estimate of ν, the utility of remaining child-

[25] We conducted two more sets of counterfactual analyses using the U.S. parameter estimates. First, we replaced α' with α^{US}, i.e., we assume that the gender division of childcare between South Korean spouses imitates that of American spouses. Second, we replaced only one of our parameter estimates with its U.S. counterpart counterpart in each analysis. The results of the two analyses are presented in Appendix H.

less, is much smaller in South Korea than in other countries including the U.S. This low value of ν implies a high utility gain from having children in South Korea—consistent with the Confucian value that producing offspring is a social responsibility—which explains why the childlessness rates for married couples in East Asia are low.

High Childlessness Rate for Single Women: In South Korea, women who choose to remain single are either those who are highly educated or those with very little education. Highly-educated women find marriage costly because of their high wage rates and the social norm of unequal gender roles; the opportunity cost of having children is too high for them, so they choose to remain childless when they are single. On the other hand, low-educated women remain single because their marriage offers are rejected by men; men find them unattractive, because they are so poor that they are likely subject to poverty-driven childlessness. The rejected women cannot afford to have children when they are single.

We conclude that the tension between persistent Confucianism and socioeconomic development results in three notable facts on marriage and fertility in East Asian societies. The Confucian norms prioritize family and the continuation of the family name, endow women with low intra-household bargaining power, and promote unequal gender division of childcare. With huge gains in women's educational attainment and a decreasing gender wage gap, the optimal marriage and fertility decisions are increasingly deviating from the decisions dictated by Confucian norms.

5.6 Historical Simulations

We now use our model to explain the demographic transition in South Korea over the past few decades. Specifically, we answer the following two questions by conducting historical simulations: First, what are the main factors driving the rapid decline in fertility in South Korea over the past few decades? Second, what is the role of the social norm of unequal gender division of childcare in the rapid decline in fertility? Appendix D3 describes the data for the historical simulation.

5.6.1 Education Boom, Economic Growth, and Change in Wage Structure

We examine four major factors that influence demographic transition, as documented in the literature: (i) an increase in educational attainment; (ii) economic growth proxied by changes in total factor productivity (TFP); (iii) a decrease in the gender wage gap; and (iv) a change in the return to schooling. These four factors are represented by e, z, γ, and ρ, respectively, in equation (38).

In the benchmark historical simulation, we combine changes in all four main factors—education, TFP, gender wage gap, and the return to schooling—in a single simulation. We obtain the empirical distribution of education levels (e), the estimated gender wage gap (γ), the return to schooling (ρ), and TFP levels (z) for each cohort using the following data sets: The education distribution of each cohort comes from the 1985–2010 census data. The gender wage gap and return to schooling are estimated from the 1980–2015 SLCTE data using equation (38). The data source for the TFP 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).[26] Finally, the level of TFP for the 1920 cohort is adjusted such that completed fertility of married mothers from the 1920 cohort in each simulation matches that in the data.

Figure 4 (a) plots completed fertility of married mothers based on the data (solid line) and the simulation (solid line with circles) for the 1920–1970 cohorts. These two lines are close to each other, and document a rapidly decreasing trend in fertility. Specifically, fertility drops from 5.443 to 1.927 according to the data, and from 5.443 to 1.776 according to the simulation.

Next, we investigate the magnitude of each individual factor's contribution to the fertility decline in South Korea (Figure 4 (b)). To quantify the effect of the change in education alone, we simulate the model using the empirical distribution of education levels for each cohort while holding the TFP level, gender wage gap, and return to schooling at the estimated values for the 1920 cohort. The solid line with triangles in Figure 4 (b) shows simulated fertility when only education is changed. We observe that the increase in educational attainment leads to a decrease in fertility

[26] For example, for the 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 forecasts of future TFP under the assumption that the growth rate in the past decade continues in future decades, following Baudin et al. (2015).

across cohorts; education alone accounts for 33.6% of the fertility decline from 5.443 to 1.776. We also simulate the model using the empirical distribution of education levels and the TFP level for each cohort while holding the gender wage gap and return to schooling at the estimated values for the 1920 cohorts. The dotted line shows that completed fertility decreases from 5.443 to 2.109, accounting for 91.4% of the fertility decline. Collectively, these results imply that the growth in TFP accounts for 57.8% of the fertility decline across the 1920–1970 cohorts. Finally, similar exercises show that the decrease in the gender wage gap explains 8.3% of the fertility decline, and the change in the return to schooling explains only 0.8% of the fertility decline.

5.6.2 The Social Norm of Unequal Gender Roles and Demographic Transition in South Korea

We now investigate the effects of the social norm of unequal gender roles on the decrease in completed fertility across the 1920–1970 cohorts. Specifically, what would have happened to fertility across the five cohorts if couples had allocated childcare in an optimal manner? To answer this question, we conduct a historical simulation in which we replace α' with α^*, holding other parameter estimates constant in the benchmark historical simulation. We compute w_f and w_m in each household for each cohort (equation (38)), and then calculate the optimal proportion of the wife's provision of childcare, α^* (equation (10)), in each household.

Figure 4 (c) plots completed fertility of married mothers for the 1920–1970 cohorts in the benchmark historical simulation (solid line with circles) and that in the counterfactual simulation, where α' is replaced by α^* (dashed line). The dashed line is consistently above the solid line, indicating that fertility would have been higher across all five cohorts if married spouses in South Korea had optimally divided childcare. This result is consistent with our counterfactual experiment conducted on the cross-section of households in Section 5.1—the social norm has significantly negative effects on fertility. Furthermore, in the absence of the social norm, fertility would have increased more for younger cohorts, with the fertility differential between the historical simulation and the counterfactual simulation peaking at 0.339. That is, if each couple had optimally divided

childcare, completed fertility for married mothers in the 1970 birth cohort would have been 19% higher at 2.115, which is above the replacement rate.

The increase in the fertility differential in Figure 4 (c) mainly stems from the rapid increase in educational attainment among South Korean women in recent decades. As women get more educated relative to men, α^* decreases. Consequently, the cost of the social norm has increased for later cohorts. Figure 5 (a) plots the average number of schooling years of men and women. The difference in the average number of schooling years decreases from 2.9 years for the 1920 cohort to 0.5 year for the 1970 cohort. Accordingly, the female wage rate, w_f, has quickly caught up with the male wage rate, w_m, over time. Figure 5 (b) plots the ratio of w_f to w_m across cohorts. The ratio almost doubles from 0.447 for the 1920 cohort to 0.819 for the 1970 cohort, implying a significant deviation of α^* from α' across the cohorts as shown in Figure 5 (c). Figure 5 (d) shows that the cost of the social norm in raising children increases across cohorts, indicating that the boom in women's education has heightened the tension between Confucian culture and socioeconomic development.

5.7 Policy Analyses

We have shown that the social norm of unequal gender roles significantly contributes to low fertility, and the effect varies across education levels. We now investigate two pro-natal policies that could potentially mitigate the negative fertility effects of this social norm.

The first policy is for the government to share a proportion τ of childcare cost—for example, by building public childcare centers. The cost of childcare required to raise n children for a family then becomes

$$F(n) = (1-\tau)\phi n, \tag{42}$$

where $F(n)$, ϕ, and n are the same as in equation (6). We find that if the government were to provide 3.9% of total childcare ($\tau = 0.039$), total fertility would be at a level that would have prevailed in the absence of the social norm. However, the effects of this policy at different education levels

differ from the effects of removing the social norm. Figure 6 plots the marriage rates of women and completed fertility of married mothers in the benchmark simulation (solid line with triangles), the counterfactual experiment without the social norm (solid line), and the policy experiment (dashed line). Figures 6 (a) and (b) show that although the policy increases the marriage rates and completed fertility of married mothers at all education levels, it cannot completely mitigate the role of the norm. Specifically, the magnitude of the effects among highly-educated women is smaller in the policy experiment than in the counterfactual experiment without the social norm.

The second policy is to provide households with a cash subsidy for each child, a_{sub}. We find that if $a_{sub} = 0.0038$, total fertility would be at a level that would prevailed in the absence of the social norm. In our model, the childcare cost for each child in an average married household is the equivalent of 0.0994 units of the consumption good. Thus, $a_{sub} = 0.0038$ translates to 3.82% of the childcare cost for each child, which amounts to USD 2,300 per year for each child.[27] As with the first policy experiment, the effects of this subsidy policy on the marriage rates and fertility are not identical to the effects of removing the social norm at every education level. Figures 6 (c) and (d) show that although the subsidy policy increases the average marriage rate and fertility, it does not effective mitigate the role of this norm for highly-educated women.

6 Discussion

Thus far, we have studied the social norm of unequal gender roles in childcare and the social stigma attached to out-of-wedlock births. We also consider other potential norms in Confucian societies such as: (i) the norm of passing on the family name; (ii) low female intrahousehold bargaining power; (iii) gender inequality and motherhood penalties in the workplace; and (iv) the emphasis on child quality. Appendix A describes these additional social norms and presents quantitative analyses on these norms and marriage and fertility in South Korea.

[27] Based on the authors' calculations, the direct childcare cost per child is USD 310,555 (in 2015 USD) and the opportunity cost based on Adda et al. (2017) is USD 292,809. The total cost per child over the life cycle is USD 603,364. Thus, the childcare subsidy is USD 23,050 ($= 603,364 \times 3.82\%$). If each child is subsidized for ten years, the total cost is approximately USD 2,300 per year for each child.

Our model have three limitations. First, we assume that individuals are randomly matched with possible partners for marriage. Appendix Table F.1 show that our quantitative analysis results remain robust when we relax this assumption. Second, we assume that married couples always agree on fertility. Third, we simplify labor supply decisions in the model; specifically, an individual's labor supply is treated as the time endowment minus time spent on childcare. Appendix I discusses on the implications of spousal disagreement on fertility and endogenous labor supply for our model.

7 Conclusion

Our study shows that the tension between the persistent gender ideology and rapid socioeconomic development is the main driving force behind the unique marriage and fertility patterns in East Asian societies. Our results have major policy implications for East Asian societies. First, our two policy experiments show that a government's pro-natal policies can be insufficient in boosting fertility for highly-educated women. For this group, the government may need to promote a social-norm revolution by advocating equal gender roles within a household. This proposal is challenging, because Confucian norms have persisted for thousands of years in East Asia. Second, as long as the social norm of unequal gender roles persists, pro-natal policies based on government subsidies would become less effective over time. The results of our historical simulation show that the negative effect of the social norm on fertility is more significant for younger cohorts. As the gender wage gap shrinks in tandem with the increase in women's educational attainment, the optimal proportion of a wife's provision of childcare decreases. Consequently, the cost of the social norm increases, which would significantly offset the effect of existing pro-natal policies in these societies.

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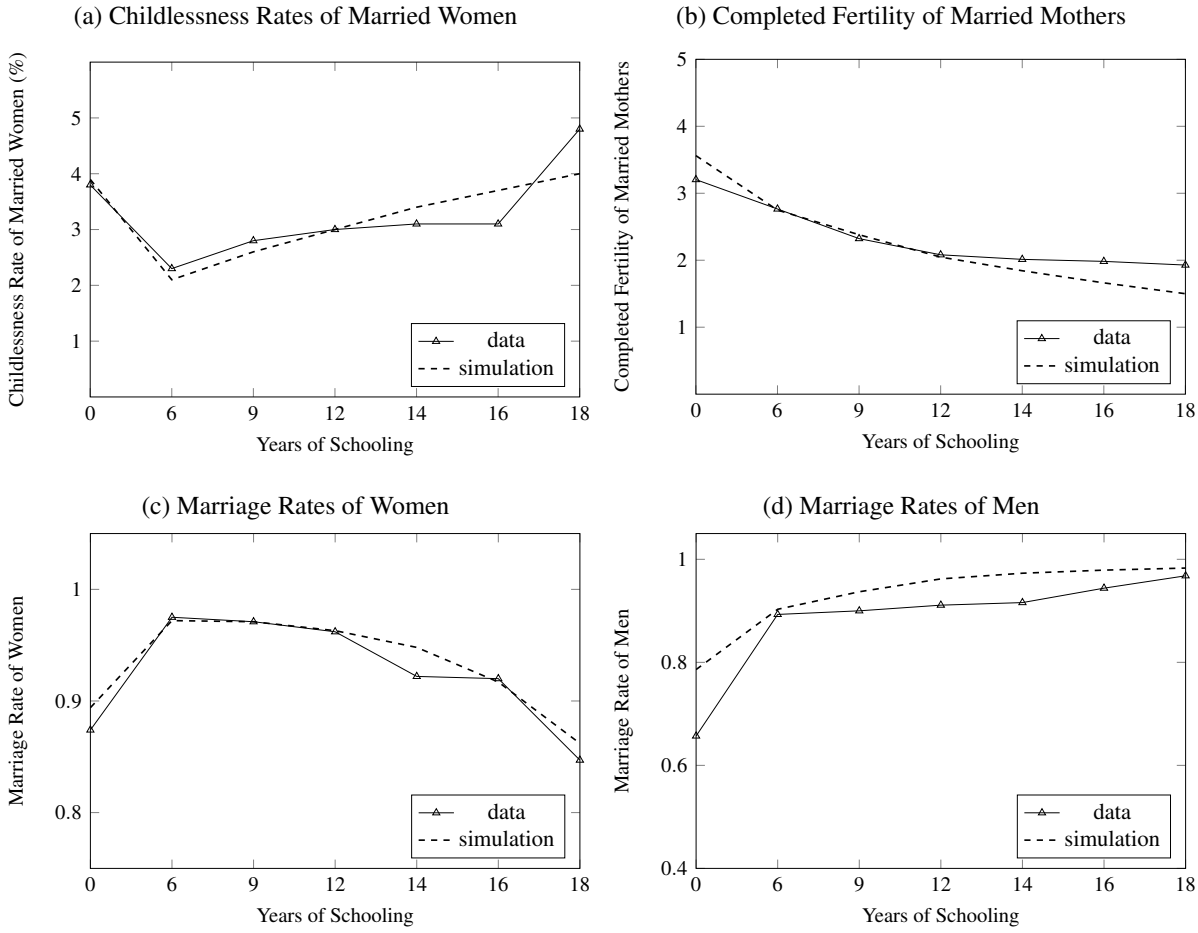
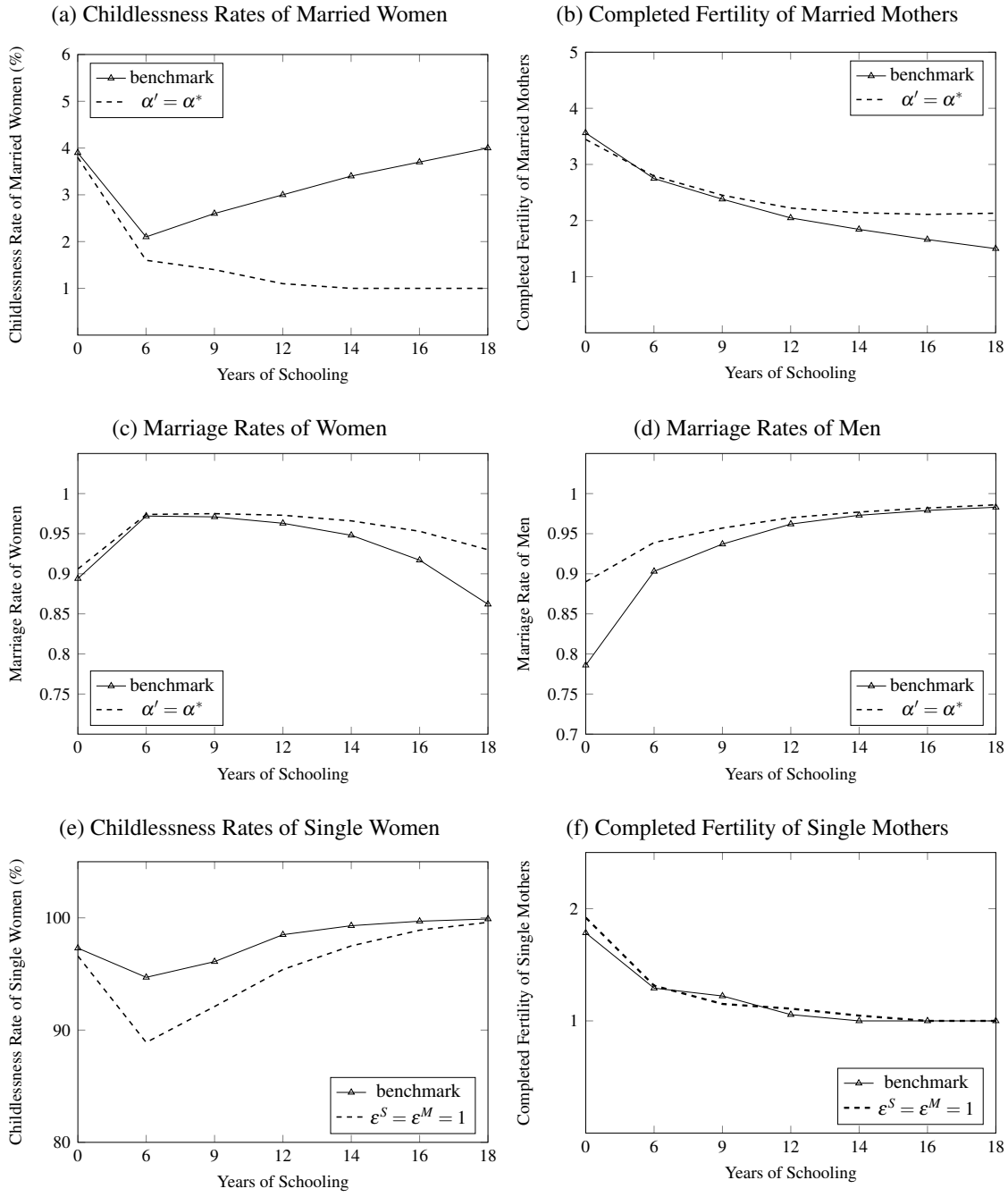
Figure 1: Model Fit: Childlessness Rates of Married Women, Completed Fertility of Married Mothers, and Marriage Rates of Women and Men, by Years of Schooling



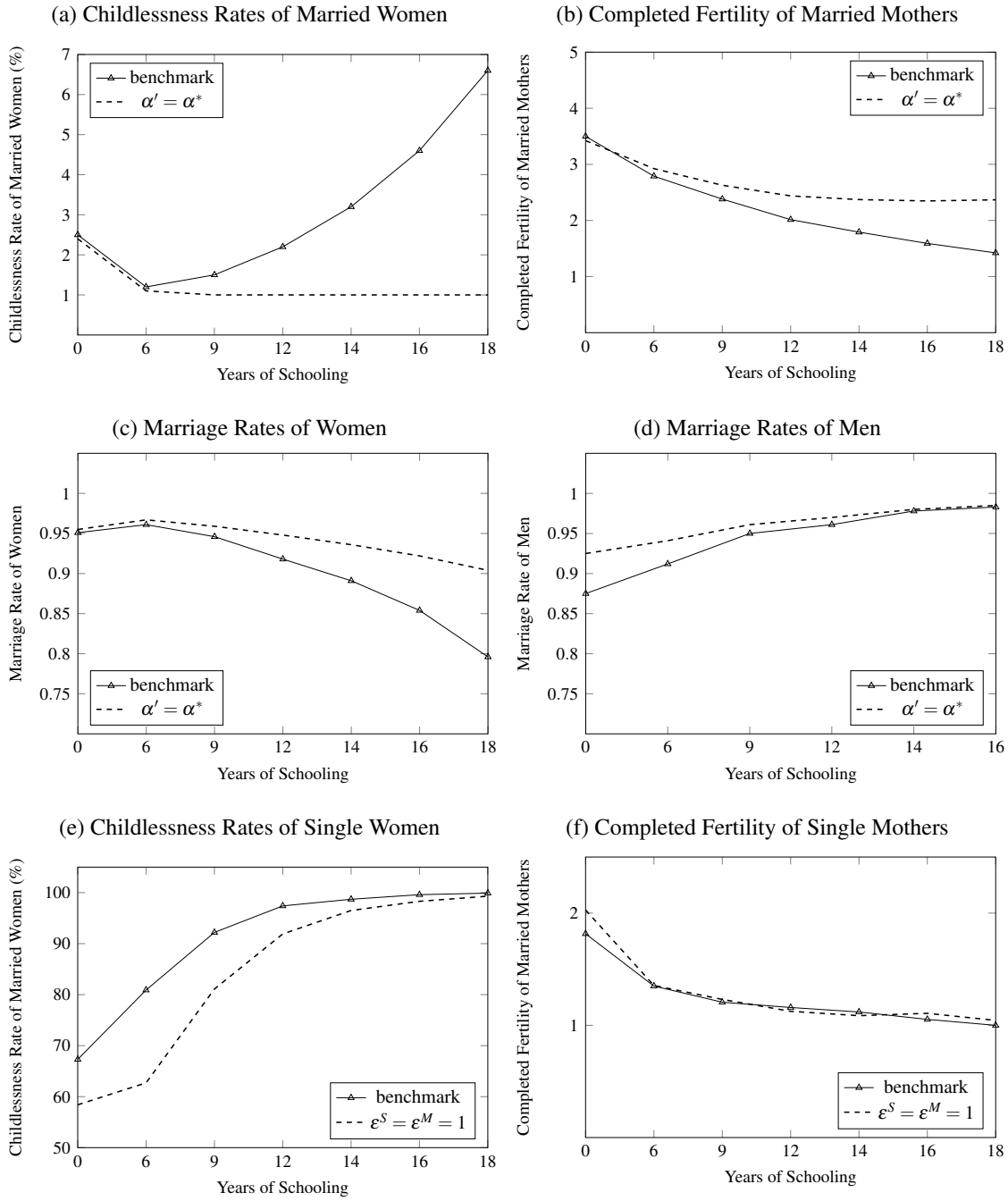
Note: Each figure plots fertility or marriage rates in the data (solid line with triangles) and in the benchmark simulation (dashed line).

Figure 2: Counterfactual Analysis in South Korea: Social Norm on Unequal Gender Division of Childcare and Social Stigma



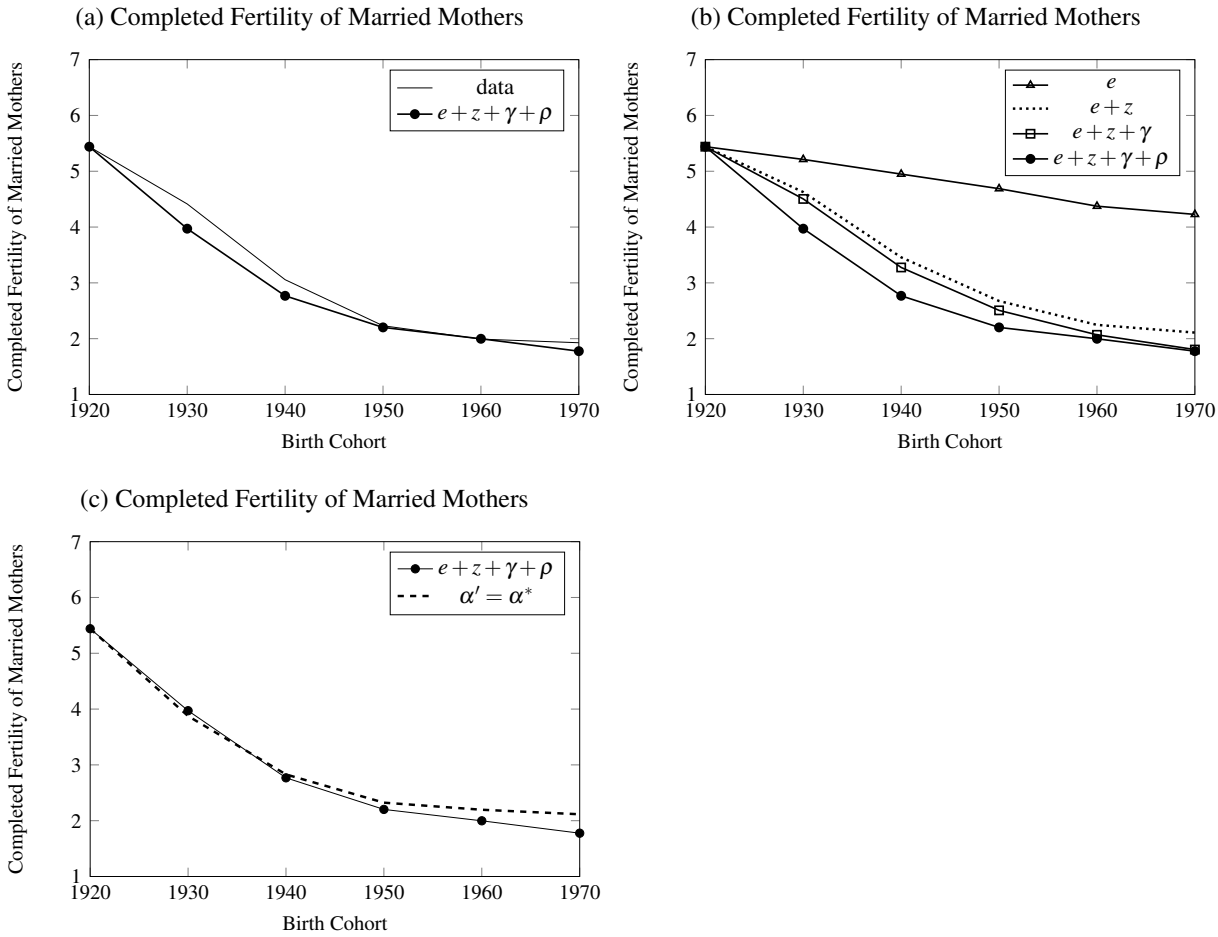
Note: Each figure in (a)-(d) plots fertility or marriage rates in the benchmark simulation (solid line with triangles) and in the counterfactual simulation (dashed line) in the absence of the social norm of unequal gender division of childcare ($\alpha' = \alpha^*$). Each figure in (e)-(f) plots fertility in the benchmark simulation (solid line with triangles) and in the counterfactual simulation (dashed line) in the absence of the social stigma attached to out-of-wedlock births ($\varepsilon^S = \varepsilon^M = 1$).

Figure 3: Counterfactual Analysis in Taiwan: Social Norm on Unequal Gender Division of Childcare and Social Stigma



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) in the absence of the social norm of unequal gender division of childcare ($\alpha' = \alpha^*$) for Taiwan. Each figure in (e)-(f) plots fertility in the benchmark simulation (solid line with triangles) and in the counterfactual simulation (dashed line) in the absence of the social stigma attached to out-of-wedlock births ($\varepsilon^S = \varepsilon^M = 1$) for Taiwan.

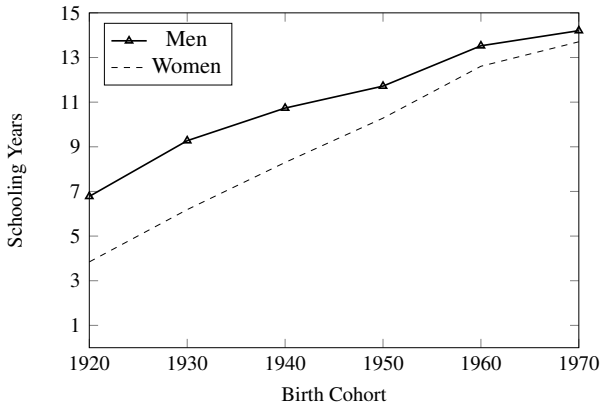
Figure 4: Historical Simulations



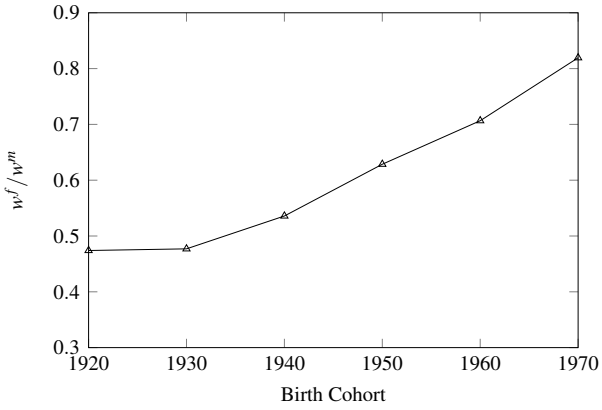
Note: Figure (a) plots completed fertility of married mothers based on the data (solid line) and the benchmark historical simulation (solid line with circles) when we simulate the model using the empirical distribution of education levels for each cohort (e), the TFP level for each cohort (z), the gender wage gap for each cohort (γ), and the return to schooling for each cohort (ρ). The solid line with triangles in Figure (b) plots completed fertility of married mothers in the counterfactual simulation when we use e for each cohort while holding the TFP level, gender wage gap, and return to schooling at the estimated values for the 1920 cohort. The dotted line in Figure (b) plots completed fertility of married mothers in the counterfactual simulation when we use e and z for each cohort while holding γ and ρ at the estimated values for the 1920 cohort. The solid line with squares in Figure (b) plots completed fertility of married mothers in the counterfactual simulation when we use e, z, and γ for each cohort while holding ρ at the estimated value for the 1920 cohort. The solid line with circles plots completed fertility of married mothers in the benchmark historical simulation. The solid line with circles in Figure (c) plots completed fertility of married mothers in the benchmark historical simulation. The dashed line in Figure (c) plots completed fertility of married mothers in the counterfactual simulation when we use e, z, γ, and ρ for each cohort in the absence of the social norm on unequal gender division of childcare ($\alpha' = \alpha^*$).

Figure 5: Gender Wage Gap, Optimal Division of Childcare (α^*), and Social Norm Costs: 1920–1970 Birth Cohorts

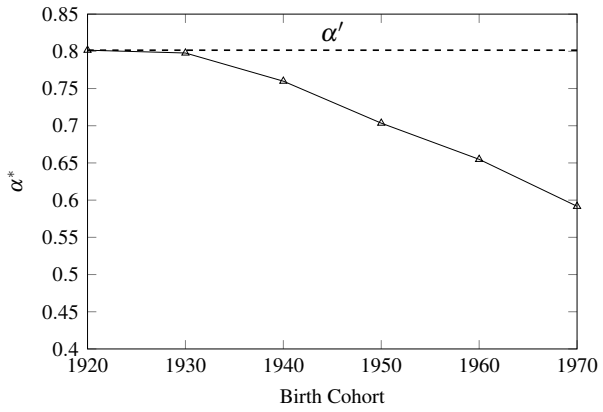
(a) Average Schooling Years of Men and Women



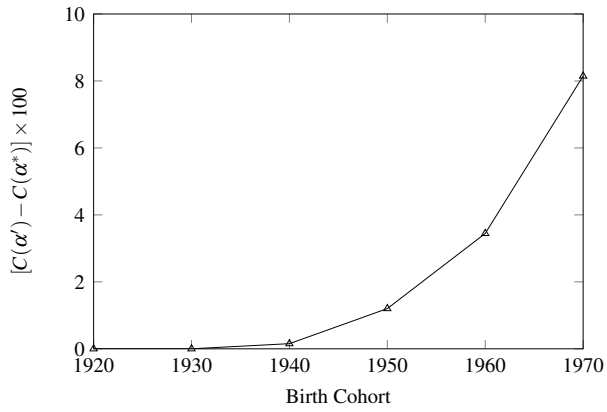
(b) Ratio of Female Wage to Male Wage (w^f/w^m)



(c) Optimal Proportion of Childcare Provided by Wives (α^*)



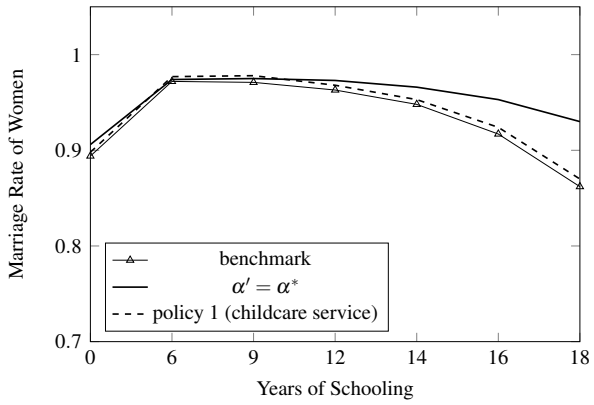
(d) Cost of the Social Norm



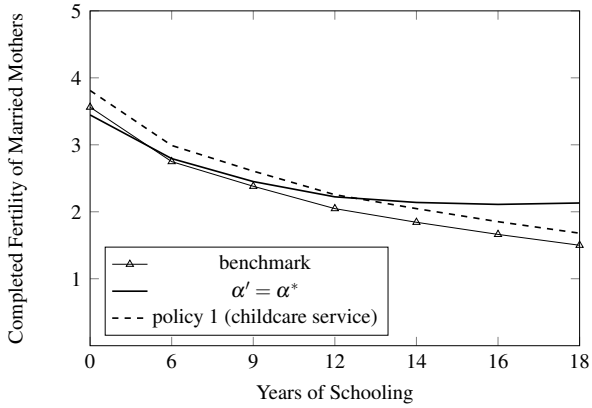
Note: Figure (a) plots average schooling years of men and women across birth cohorts. Figure (b) plots the ratio of the female wage rates to the male wage rates (w_f/w_m) across birth cohorts. Figure (c) plots optimal proportion of childcare provided by wives α^* (solid line with triangles) and the proportion regulated by the social norm (dashed line). Figure (d) plots the cost of the social norm in raising children.

Figure 6: Policy Experiments

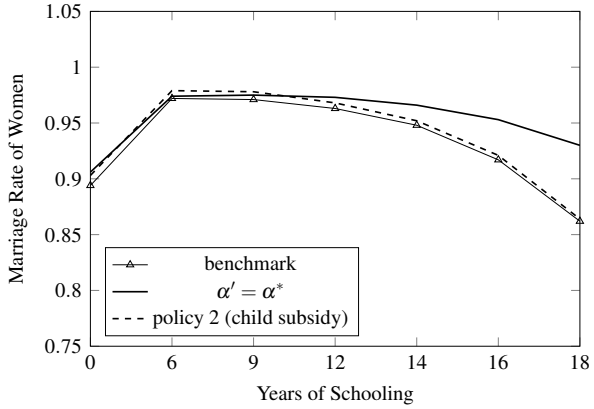
(a) Policy 1: Marriage Rates of Women



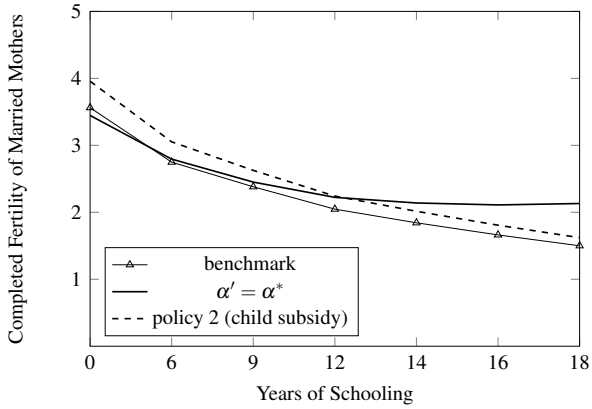
(b) Policy 1: Completed Fertility of Married Mothers



(c) Policy 2: Marriage Rates of Women



(d) Policy 2: Completed Fertility of Married Mothers



Note: Figure (a) plots the marriage rates of women and completed fertility of married mothers in the benchmark simulation (solid line with triangles), the counterfactual experiment without the social norm $\alpha' = \alpha^*$ (solid line), and the policy experiment when the government provides 3.9% of total childcare costs $\tau = 0.039$ (dashed line). Figure (b) plots completed fertility of married mothers in the benchmark simulation (solid line with triangles), the counterfactual experiment without the social norm $\alpha' = \alpha^*$ (solid line), and the policy experiment when the government provides 3.9% of total childcare costs $\tau = 0.039$ (dashed line). Figure (c) plots the marriage rates of women in the benchmark simulation (solid line with triangles), the counterfactual experiment without the social norm $\alpha' = \alpha^*$ (solid line), and the policy experiment when the government provides households with a cash subsidy $a_{sub} = 0.0038$ for each child (dashed line). Figure (d) plots plots completed fertility of married mothers in the benchmark simulation (solid line with triangles), the counterfactual experiment without the social norm $\alpha' = \alpha^*$ (solid line), and the policy experiment when the government provides households with a cash subsidy $a_{sub} = 0.0038$ for each child (dashed line).

Table 1: Marriage and Fertility Rates across Countries/Regions

Countries/regions	TFR	Rank /#224	Marriage Rate		Childlessness Rate	
			Men	Women	Married	Single
	(1)	(2)	(3)	(4)	(5)	(6)
East Asian						
China	1.60	182	0.945	0.949	0.011	0.978
Japan	1.41	209	0.680	0.727	0.064	0.977
South Korea	1.26	220	0.830	0.839	0.029	0.989
Hong Kong	1.19	221	0.813	0.748	0.036	0.920
Taiwan	1.13	222	0.834	0.907	0.034	0.932
Macau	0.95	223	0.907	0.808	N.A.	N.A.
Singapore	0.83	224	0.831	0.763	0.045	0.980
Average	1.20		0.834	0.820	0.039	0.962
Western						
UK	1.88	142	0.627	0.623	0.108	0.433
US	1.87	143	0.633	0.626	0.121	0.398
Canada	1.60	183	0.621	0.630	0.139	0.644
Finland	1.75	162	0.535	0.558	0.070	0.490
Spain	1.49	199	0.696	0.713	0.103	0.691
Italy	1.43	208	0.708	0.745	0.125	0.325
Average	1.67		0.635	0.651	0.111	0.497
Developing						
Average	3.07		0.802	0.681	0.054	0.423

Note. Columns (1) and (2) show the total fertility rate (TFR) and its rank among 224 countries and territories. 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. Columns (3) and (4) show marriage rates of men and women, respectively. 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. Columns (5) and (6) show the childlessness rate for married and single women, defined as the proportion of married (single) women aged 45 and above who do not have any children. Data sources and variable definitions are provided in appendix Table D1.

Table 2: Weekly Hours Spent on Housework by Gender

East Asian and	China		Japan		South Korea		Hong Kong		Taiwan		Developing	
Developing, Year	1991	2012	2006	2014	1999	2014	2002	2013	2004	2017	2000	2010
Female (a)	26.2	25.4	26.1	25.4	20.5	25.4	23.1	18.2	16.7	17.2	33.0	32.5
Male (b)	5.3	5.0	4.6	5.3	4.3	5.6	7.7	5.6	3.7	4.0	10.1	11.2
(a)/(a+b)	0.83	0.84	0.85	0.83	0.83	0.82	0.75	0.76	0.82	0.81	0.76	0.75
Western	UK		US		Canada		Finland		Spain		Italy	
Year	2001	2015	2003	2015	2005	2016	2000	2010	2003	2010	2003	2014
Female (a)	24.92	21.3	27.8	26.7	27.3	24.5	25.5	25.5	34.4	31.8	36.8	34.3
Male (b)	13.7	11.7	16.6	16.5	16.8	16.1	16.8	17.6	11.3	14.5	12.3	14.1
(a)/(a+b)	0.65	0.64	0.63	0.62	0.62	0.60	0.60	0.59	0.75	0.69	0.75	0.71

Note. Rows (a) and (b) show the number of weekly hours spent on housework by gender. Housework consists of unpaid domestic and care work. Due to data limitations, the table does not include Macau and Singapore. Developing countries include Costa Rica, Mexico, Uruguay, South Africa, and Tanzania because the data are not available for the other 31 developing countries in Table 1. Data sources and variable definitions are provided in appendix Table D1.

Table 3: Proportion of Childcare Borne by Wives by Couple's Education

	Husband				
Wife	6−	9	12	14	16+
0 and 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

Note. The table documents the proportion of childcare borne by wives by couple's education. 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. The sample consists of married households with a wife aged 20-40 from the pooled sample of 2004, 2009, and 2014 KTUS. If the number of observations is less than 10, we do not report the share (N.A.). The pattern remains robust for different types of households and different types of childcare activities (Appendix A.1).

Table 4: Model Parameters

Panel A: Parameters estimated directly from the data							
Description	Parameter	Value	SE/SD	Comparison to Literature			
				Baudin et al. (2015)	Baudin et al. (2020)		
					Mean	Min	Max
Return to schooling[a]	ρ	0.069	5.86e-05	0.092	0.05	0.05	0.05
Gender wage gap	γ	0.704	2.42e-04	0.869	0.786	0.67	0.88
Proportion of childcare provided by wives	α'	0.801	0.192	0.524	0.783	0.571	0.965
Elasticity parameter	ψ	0.465	-	1.0	1.0	1.0	1.0
Home production productivity (single)	A^S	2.035	-	1.0	1.0	1.0	1.0
Ratio of good costs: singles vs. married	μ^S/μ^M	0.662	-	1.0	1.0	1.0	1.0
Natural sterility parameter	$\chi_f = \chi_m$	0.005	-	0.012	0.010	0.010	0.010
Panel B: Parameters estimated by SMM							
Description	Parameter	Value	SE	Comparison to Literature			
				Baudin et al. (2015)	Baudin et al. (2020)		
					Mean	Min	Max
Mean of non-labor income[b]	m_a	0.296	7.49e-04	0.435	0.406	0.194	0.870
Standard deviation of non-labor income	σ_a	0.273	3.69e-03	0.497	0.648	0.581	0.893
Goods cost for married households	μ^M	0.680	2.96e-04	0.272	0.281	0.012	0.546
Minimum consumption to procreate	$\hat{c}$	0.190	9.34e-04	0.399	0.354	0.097	0.529
Preference parameter	ν	6.505	9.70e-04	9.362	9.367	8.097	11.099
Time cost of being single (men)	δ_m	0.003	8.19e-04	0.256	0.197	-0.023	0.367
Time cost of being single (women)	δ_f	-0.080	1.27e-03	0.077	0.077	-0.057	0.278
Bargaining parameter	$\underline{\theta}$	0.225	7.78e-04	0.864	0.442	0.035	0.972
Variable cost of raising a child	ϕ	0.399	4.26e-04	0.206	0.188	0.154	0.206
Social norm of stigma	ε^S	0.892	1.10e-03	1.0	1.0	1.0	1.0

Note. Panel A and B present parameters estimated directly from the data and those estimated from the simulated method of moments (SMM). We compare our estimates with those from the literature. The parameters in Baudin et al. (2015) are estimated from the 1990 US sample, whereas those in Baudin et al. (2020) are from the samples of 36 developing countries. Standard errors reported in Panel B are bootstrapped.

[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 .

Table 5: Marriage Rates and Fertility from the 2015 South Korean Census

			Childlessness rate	Completed fertility of mothers	Marriage rate	
Education level	e	Observations	Married	Married	Women	Men
1. No schooling	0	58,924	0.0379	3.204	0.874	0.657
2. Primary school	6	360,291	0.0229	2.765	0.975	0.893
3. Middle school	9	430,244	0.0281	2.323	0.971	0.900
4. High school	12	1,119,923	0.0303	2.081	0.962	0.911
5. 2-year college	14	214,148	0.0309	2.013	0.922	0.916
6. 4-year college	16	461,163	0.0314	1.983	0.920	0.944
7. Master's or doctoral	18	106,299	0.0484	1.928	0.847	0.968
All		2,750,992	0.0294	2.246	0.953	0.914

Note. Completed fertility is the number of children of mothers aged 45–70, and the childlessness rate is the proportion of women aged 45–70 who do not have children. The years of schooling that correspond to each education level are denoted as e. Data source is the 20% sample of the 2015 population and housing census of South Korea.