A Tale of Two Families: Societal Selection Mechanism, Marital Formation, and Parental Human Capital Investment

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February 12, 2023

Abstract

The paper examines how family structure and the societal selection mechanism for college education affect parental investment in their children's human capital, and how parental investment and the selection mechanism, in turn, shape the educational and marital structure of the next generation. We construct an overlapping generation model of endogenous marriage formation to characterize the joint determination of distributions of family structure and educational attainment in the economy. We conduct counterfactual experiments by adopting either a lottery admission system or a differential admission system that gives preferential treatment to children from disadvantaged family backgrounds. We find that reallocating college education opportunities may equalize college enrollment rates across households, but can lead to lower college completion rates, lower marital rates and lower welfare in the aggregate by distorting both parental human capital investment and marriage incentives. By contrast, social engineering experiments that increase the likelihood of marriages among non-college-educated individuals can increase both welfare and college completion rates. The study highlights the disparity in the family structure the children grow up in as the root cause of educational disparity.

[1] I thank Michael Bradley, Celso Brunetti, Oksana Leukhina, Youming Liu, Valerie Ramey, Roberto Samaniego, Bryan Stuart, Hector Tzavellas, Benjamin Williams, Anthony Yezer, and conference and workshop participants at Monash University, CEF 2021 and SEA 2021, Midwest Macro 2022 Annual meetings for comments and suggestions. I thank Gupta Tarush and Dinh Nguyen for capable research assistance. All remaining errors are mine.

1 Introduction

Public policies on human capital investment in children have been a topic of intense debate due to their impact on income distribution. Various proposals have been made, such as reforms in allocating college education opportunities among high school graduates, with the aim of addressing disadvantages based on social and economic backgrounds. However, human capital investment in children is primarily a private household decision, influenced by both family structure and parental characteristics. To fully understand the root cause of educational disparities and evaluate the effectiveness of public policies, it is important to answer three questions: First, what role does family structure play in parental human capital investment decisions? Second, what impact do public policies aimed at improving college education equity have on human capital investment across different households, and potentially on family formation? Third, given the role of family structure in human capital accumulation, how would social engineering of the marital formation process affect human capital investment decisions, and how do these changes compare to policies that reallocate college education opportunities in terms of social welfare?

To address those questions, we construct an overlapping generation model of endogenous marriage formation to capture the joint determination of marital and educational structures across households. In our model, an individual lives for two periods, as a child and an adult. We assume that each female has two children, one boy and one girl. Adults of heterogeneous abilities, education levels, and preferences for singlehood meet randomly on the marriage market, and decide whether to marry or not. After marital decisions are made, households decide on labor force participation, consumption, and parental human capital investment. Parental spending on market goods and services and maternal child care time are complementary inputs in the production of their children's human capital, which in turn determines the likelihood of the children obtaining a college education. We examine how different family structures, in terms of parental marital status and educational attainments, may affect parental human capital investment under a given societal system of allocating college education opportunities. In decision-making, parents consider the societal college selection system and the long-term effects of their choices on their children's well-being. Our study also examines how parental investment decisions and the college selection system can shape the educational attainment and family structures of the next generation.

Our model allows for four channels through which college education can affect an individual's lifetime utility: First, the college-educated enjoy a skill premium when working. Second, the college-educated have a higher probability of meeting others with the same education prior to their marital decisions. Third, non-college-educated individuals are subject to a higher variance of preference shocks for singlehood, which affects their marital propensity given the economic trade-offs. Fourth, college-educated mothers are more effective at parental human capital investment. The second channel depicts assortative matching by college education. The third channel serves as a mechanism to capture the variation in marriage rates among college-educated individuals and those without a college education. Modeling endogenous marital formation allows us to account for the full benefits of college education and ensure internal consistency between distributions of marital and educational structures across families.

The model generates distributions of households by marital status, educational attainment, and work arrangements that are consistent with data from the American Time Use Surveys (2003-2017). It shows that mothers with higher education spend more time on child care, and that married nonworking mothers spend the most time on child care, while single working mothers spend the least. Since marriage provides not only the benefits of income pooling, but also frees up time for women to care for their children due to labor sharing, married and college-educated households engage in more human capital investment in terms of market goods and services and maternal care time.

The model is able to generate heterogeneous college enrollment and completion rates across different households. We model the college completion as a two-step process. The first step is the probabilistic dependence of college enrollment on accumulated human capital, which can be altered by public policies. The second step is the probability of college completion conditional on enrollment, which is also dependent on human capital accumulated during childhood. We assume that the second step is not subject to public policy reforms. The model features heterogeneous distributions of human capital as a result of endogenous decisions of various households. As documented by Blandin and Herrington (2022), college completion rates of children from single-parent non-college-educated and married non-college-educated households are respectively 11 and 19 percent, while rates of those from households with at least one college-educated parent are about 59 percent around 2005. Our model generates similar college enrollment and completion rates for those three types of households, and shows that family structure is crucial for children's college readiness, captured by human capital accumulated during childhood. When the college selection mechanism depends upon college readiness, family structure is the most important factor in determining college completion rates of the next generation.

We use the model to conduct counterfactual experiments on various policies that reallocate education opportunities after the formation of human capital during childhood. We model such policies as altering the dependence of college enrollment upon human capital. Specifically, we consider two policy experiments: First, the extreme case of a lottery system of college enrollment, in which the probability of college enrollment is the same for all students regardless of their accumulated human capital. Second, a differential college selection mechanism that gives preferential treatment to children from disadvantaged social and economic backgrounds, as determined by factors such as marital status and educational attainments of their parents.

We find that policies that redistribute enrollment opportunities to previously disadvantaged students, such as lottery and the differential college selection mechanisms, may increase college enrollment rates of targeted students, but lack of readiness may still impede college completion as college completion conditional on enrollment remains dependent on human capital. More importantly, such interventions may distort parental incentives to invest in human capital and also individual marriage decisions, leading to lower college completion rates and overall welfare.

The distortion comes from three channels. First, a selection system that relies less on college readiness, or does not rely on college readiness as in the lottery system, discourages parents from making human capital investment in their children. Second, reallocation of college education opportunities to non-college-educated households may shrink the welfare gap between being college-educated versus not, further dampening the incentives for human capital investment. Third, because the college-educated are more likely to meet with each other and more likely to get married than those who are non-college-educated, declines in college completion rates lead to lower marriage rates overall. As the composition of family structure shifts to single and non-college-educated households who make relatively less human capital investment, college completion rates decline further till reaching a stationary equilibrium where educational attainment and family structure are both endogenously determined and mutually consistent.

Welfare of college-educated individuals decreases, especially for those with high abilities, as their children may experience substantial decreases in college completion rates due to the first two channels. Paradoxically, although non-college-educated mothers seem to stand to gain from this policy change, they also see a decrease in lifetime utilities. First, increases in their children's college completion rates are limited by lack of college readiness; and even if one becomes college-educated, lifetime utilities of the college-educated are lower than before. Second, since men get married primarily to share the utilities from having children, declines in children's well-being make marriage less attractive, especially for non-college-educated males who have a higher variance for marital preferences. As non-college-educated mothers are more likely to meet with males of the same educational attainment, the marriage rates of non-college-educated mothers decline in equilibrium, thus contributing to their lower welfare.

Given the importance of family structure, we manipulate the marital formation process by eliminating two major differences in the marital market between individuals with or without a college degree. The goal is to see the effect of different marital opportunities while keeping the college selection mechanism constant. We do this by first removing assortative matching between college-educated individuals, thus increasing the chances of meetings between individuals with different educational levels. Then while keeping assortative matching in place, we assume the same variance of preferences for singlehood for both college and non-college-educated, increasing the chances of the non-college-educated to form a family.

We find that elimination of assortative matching results in a large welfare loss for the college-educated but a welfare gain for the rest, due to the change in their marital prospects. However, the second experiment, which raises the marriage rates of the non-college-educated but keeps the assortative matching in place, results in a much higher marriage rate for the entire population. Although the shrinkage of the welfare gap between being college-educated versus not reduces incentives for human capital investment for individual households, the large shift of family composition away from single-parent households, a group that makes much lower human capital investment, leads to a higher college completion rate among the younger generation. The increase in both college completion and marriage rates leads to a large increase in overall welfare, with a slightly larger increase for non-college-educated individuals.

Our findings emphasizes the crucial role of family structure in parental human capital investment decisions. Our results show that altering the college selection system may distort human capital incentives and marriage decisions. Policy measures such as lottery or differential admission systems may lower welfare for both college and non-college-educated due to decreased marriage rates and college completion rates. By contrast, social changes that boost the willingness of the non-college-educated to marry may not only provide care and resources for children to thrive, but also reduce the welfare gap and raise aggregate welfare. Our results show that tackling the root cause of educational disparity, the disparity in family formation and stability across individuals of different college attainments, can be more important than reallocation of college education opportunities across households.

Our work builds upon the findings of Aiyagari, Greenwood and Guner (2000) and Greenwood, Guner and Knowles (2003) by considering the interplay between family structure and intergenerational mobility in a model of endogenous marriage formation. Our work differs in that parents internalize both the societal selection mechanism and their children's well-being when making decisions, while in their frameworks parents internalize neither.

Our paper shares the emphasis of Blandin and Herrington (2022) on the impact of family structure on college education. Blandin and Herrington (2022) consider family structure as exogenously given when modeling parental investment decisions. We model marital formation endogenously, considering the impact of college education on marital prospects. Our model is able to achieve internal consistency between marital and educational distributions across families. Blanden, Doepke and Stuhler (2022) stress the importance of family background in educational inequality across countries. They do not explicitly consider or endogenize marital decisions. Gayle, Golan and Soytas (2015) analyze sources of the racial gap in time allocation and inter-generational transmission of human capital. While their main focus is on racial gap, the impact of family structure on human capital investment is robust across demographic groups including races. Kearney (2022) attributes widening college gap in household income partly to the college gap in family structure, a feature we capture in our model.

Abbott, Gallipoli, Meghir and Violante (2019) model endogenous college attendance decisions to examine the effect of liquidity constraints and financial aid policies on college attendance. However, they treat marital decisions as exogenously given and do not allow single-parent households. We take a different approach by modeling endogenous marriage decisions, and treating college enrollments and completions as stochastic processes depending upon human capital accumulated during childhood. We take this approach to focus on the joint determination of marital structure and human capital investment decisions.

We emphasize college readiness as a serious barrier to college attainment, as stressed by Carneiro and Heckman (2002), Hendricks and Leukhina (2018), and Athreya and Eberly(2021). Bound, Lovenheim and Turner (2010) also demonstrate the severity of such barriers in depressing the completion rates in less selective public universities and community colleges in the U.S. Molina and Rivadeneyra (2021) show that a policy of eliminating public university tuitions in Ecuador disproportionately benefits families of higher socioeconomic status, as high school completion rates are very low among the disadvantaged groups. We emphasize the role of family structure on college readiness, and argue that any policies that solely emphasize reallocating college enrollment opportunities without addressing inequity in college preparedness may come at a social cost by distorting household marital and human capital investment decisions.

Our work focuses on policy measures at the college attendance stage, after the formation of human capital. It is complementary to Garcia, Bennhoff, Leaf and Heckman (2021) on the importance of early childhood interventions. Chetty et al (2022) show that social connections with individuals of higher social economic status strongly predict upward economic mobility for those of lower status, which echoes our findings on the importance of marital opportunities. Our results show that the most fundamental early interventions may be social policies that contribute to a stable and resourceful family environment.

The paper proceeds as follows. Section 2 describe the model and optimal decisions. Section 3 presents baseline calibrations and model simulations. Section 4 conducts counterfactual experiments of college selection systems. Section 5 presents results of social-engineering experiments on marital formations. Section 6 concludes.

2 The Model

Consider an economy populated by equal numbers of men and women. Each individual lives for two periods, the first period as a child, and the second period an adult. Each adult woman has two children attached to her.[2] We assume that one of the children is male, and the other female. Each adult is indexed by an ability level, a_f for females and a_m for males, which is distributed across the population based on a given distribution. Each adult can be either college-educated or non-college-educated, with the probability depending upon the amount of human capital he or she accumulates as a child. At the beginning of their adulthood, all agents participate in a marriage market. Each agent can take a draw from the marriage market, and decide whether to accept or reject a mate. When both individuals accept the marital proposal, a couple is formed. Our model accommodates unions of all genders. However, since there are few data observations available for homosexual couples during the sample period we study, from now on we present unions as between males and females to generate results comparable with data.

Each adult is endowed with one unit of time. Females must allocate their time between work, child care and leisure, while men split their time between work and leisure for simplicity.[3] We assume complementary inputs of maternal child care time and market goods and services in producing human capital obtained by children. We further assume that college-educated females are more effective at producing human capital in children. Higher amount of human capital leads to higher probability of being college educated. In addition to consumption and leisure, single females and married couples take utility not only in the warm glow from their children's human capital accumulation per se, but also the children's lifetime utility as an adult. Parents treat their children equally. Single males only care about their own consumption and leisure, with no consideration for children. Each period the older adult males and females are replaced by young adults.

[2]We abstract from single-father households for simplicity. In the United States, single-mothers make up majority (between around 83 percent in 2005 to 90 percent in 1970) of single-parent households based on data from the U.S Census bureau.

[3]Based on the American Time Use Survey, fathers do spend time on child care, but the fraction of males engaging in child care on survey days and their average amount of child care time is much less than those of mothers (Song and Wei, 2018). We assume that women take the sole responsiblity of child care for simplicity. The intra-household allocation of child care time is a topic in and of itself for future research.

2.1 The Contemporary Utility

Below we set up the problem for singles and couples.

2.1.1 Single Females

We assume that a single female with two children maximizes the following utility function:

$$U^{f,s}\left(C^{f,s}, Q^{f,s}, L^{f,s}\right) = \frac{1}{1-\gamma}\left(\frac{C^{f,s}-C_b}{\varsigma_{f,s}}\right)^{1-\gamma} + \varphi\frac{\left(Q^{f,s}\right)^{1-\eta}}{1-\eta} + \theta\frac{\left(L^{f,s}\right)^{1-\psi}}{1-\psi}, \tag{1}$$

where $C^{f,s}$ represents consumption of the single mother, C_b represents subsistence consumption or habit, $Q^{f,s}$ represents the amount of human capital accumulated in children, and $L^{f,s}$ represents leisure. Here $\varsigma_{f,s} > 1$ represents the equivalence scale for a single-mom household, and γ, η, and ψ represent curvature parameters for utilities in consumption, their children's human capital and leisure.

We assume that human capital accumulated during childhood is produced by both parental spending on market goods and services and maternal time on child care. We assume that a minimum amount of maternal child care time, L_b, is required for their children, and only a fraction δ of the basic care time, L_b, can be substituted by market-purchased child care services if the mother is at work. The two types of inputs are complementary. Specifically,

$$Q^{f,s} = \left\{\alpha\left(D_b + D^{f,s}\right)^{\kappa} + (1-\alpha)\left[L_b + \nu\left(e_f\right)L_m^{f,s}\right]^{\kappa}\right\}^{\frac{1}{\kappa}}, \tag{2}$$

where D_b represents basic child care expenditures on market goods and services, $D^{f,s}$ and $L_m^{f,s}$ denote extra child care expenses on market goods and services and extra maternal care time for human capital investment purposes. Here $v\left(e_f\right)$ represents the efficiency of the maternal care, which positively depends upon maternal education.

The resource constraint facing the household is

$$\begin{array}{ll} C^{f,s} + P_D\left(D_b + D^{f,s}\right) = a_f W_{e_f}\overline{h} - W_{cc}\delta L_b, & \text{if } \mathbf{I}_w^{f,s} = 1, \\ C^{f,s} = B^{f,s}, D^{f,s} = 0, & \text{if } \mathbf{I}_w^{f,s} = 0. \end{array} \tag{3}$$

where P_D represents the price of purchasing market goods and services for child care. We use $\mathbf{I}_w^{f,s}$ to represent the indicator variable for working and assume that the work time is indivisible at $\overline{h}$. A female worker earns $a_f W_{e_f}$ per unit of work time, where a_f represents her inherent ability and W_{e_f} represents the female's wage rate at the given education level, e. When working, the household has to pay for basic child care services at W_{cc} per unit of time, where W_{cc} represents the wage for child care workers. If choosing not to work, a female qualifies for nonwork benefits, $B^{f,s}$, to be used for consumption, in addition to receiving the basic market goods and services, D_b, to be used for human capital investment in children.

Accordingly, the time constraint is

$$\mathbf{I}_w^{f,s}\overline{h} + L_m^{f,s} + \left(1 - \mathbf{I}_w^{f,s}\delta\right) L_b + L^{f,s} = 1, \tag{4}$$

which means that the female needs to spend her own time on the full amount of basic child care, L_b, if she is not working.

2.1.2 Couples

A couple with two children maximizes the following utility function:

$$U\left(C^c, Q^c, L^c, L_H^c\right) = \frac{1}{1-\gamma}\left(\frac{C^c - C_b}{\varsigma_c}\right)^{1-\gamma} + \varphi\frac{\left(Q^c\right)^{1-\eta}}{1-\eta} + \frac{1}{2}\theta\left(\frac{\left(L^c\right)^{1-\psi} + \left(L_H^c\right)^{1-\psi}}{1-\psi}\right), \tag{5}$$

where ς_c represents the equivalence measure for couples. We assume that consumption C^c and children's human capital Q^c are public goods, and the utility in leisure of the husband L_H^c and the wife L^c are additive for the entire household.

The production function for human capital is the same as in the case of single females,

$$Q^c = \left\{\alpha\left(D_b + D^c\right)^{\kappa} + (1-\alpha)\left[L_b + \nu\left(e_f\right) L_m^c\right]^{\kappa}\right\}^{\frac{1}{\kappa}}. \tag{6}$$

Here we distinguish the wife and husband's education by e_f and e_m. The couple's budget constraint depends upon work statuses of both husband and wife as follows,

$$\begin{array}{rl} C^c + P_D\left(D_b + D^c\right) = \left(\mu a_f W_{e_f}\overline{h} - W_{cc}\delta L_b\right) + \varrho a_m W_{e_m}\overline{h}, & \text{if } \mathbf{I}_{w,f} = 1, \mathbf{I}_{w,m} = 1 \\ C^c = B, D^c = 0 & \text{if } \mathbf{I}_{w,f} = 0, \varrho a_m W_{e_m}\overline{h}\mathbf{I}_{w,m} \leq B + P_D D_b \\ C^c + P_D\left(D_b + D^c\right) = \varrho a_m W_{e_m}\overline{h}, & \text{if } \mathbf{I}_{w,f} = 0, \varrho a_m W_{e_m}\overline{h}\mathbf{I}_{w,m} > B + P_D D_b \end{array} \tag{7}$$

where $\mathbf{I}_{w,f}$ and $\mathbf{I}_{w,m}$ equal 1 when the female or the male works. We implicitly assume that only women are engaged in child care. The parameter $\mu < 1$ captures the notion that females are either subject to marriage taxes, or have to incur a given fixed cost in terms of time when going to work. The parameter $\varrho > 1$ represents the gender gap in males' wages premium over those of females. The parameter a_m represents the husband's ability, which follows a given distribution. There are four possible combinations of work statuses in the household: both working, wife working but husband not, husband working but wife not, and neither working. When wife does not work, and the household income falls below a threshold, the household receives consumption B and basic market goods and services for child care, D_b.

The married female's time constraint is

$$\mathbf{I}_w^{f,c}\overline{h} + L_m^c + \left(1 - \mathbf{I}_w^{f,c}\delta\right) L_b + \left(1 - \mathbf{I}_w^{f,c}\right) L_b^{hc} + L^{f,s} = 1, \tag{8}$$

where L_b^{hc} represents the extra time spent on household chores by a nonworking married female, in addition to child care. The male in the household does not spend time on child care. As a result, L_H^c equals $1 - \overline{h}$ when he works, and 1 when he does not.

2.1.3 Single Males

The decision problem for single males are trivial. He maximizes the utility function,

$$U^{m,s}\left(C^{m,s}, L^{m,s}\right) = \frac{1}{1-\gamma}\left(C^{m,s} - C_b\right)^{1-\gamma} + \theta\frac{\left(L^{m,s}\right)^{1-\psi}}{1-\psi}, \tag{9}$$

where

$$C^{m,s} = \varrho a_m W_{e_m}\overline{h}\mathbf{I}_{w,m}, \tag{10}$$

$$L^{m,s} = 1 - \overline{h}\mathbf{I}_{w,m}. \tag{11}$$

We essentially assume that all single men work for simplicity.

2.2 Value Functions

In the model, parents not only take utility from the amount of human capital accumulated in children per se, they also care about their children's lifetime utility. They take into account that a higher amount of human capital investment leads to a higher probability of their children being college educated, and that their children's education plays a role in their lifetime utility.

We denote χ_f and χ_m as realizations of a female and male's random utility gain from staying single. The distribution of the utility gains differ by gender and education. We denote $V^f\left(a_f', e_f', \chi_f'\right)$ and $V^m\left(a_m', e_m', \chi_m'\right)$ as representing respectively value functions of females and males prior to their marital decisions. The value function of a single female, $V^{f,s}\left(a_f, e_f, \chi_f\right)$, is

$$\begin{aligned} V^{f,s}\left(a_f, e_f, \chi_f\right) &= \max_{\left\{\mathbf{I}_{w,f}^{f,s}, L_m^{f,s}, D^{f,s}\right\}} \Big\{U\left(C^{f,s}, Q^{f,s}, L^{f,s}\right) + \chi_f \\ &+\frac{\beta}{2}\sum_{e'=0}^{1}\left[E_{\left\{a_f', \chi_f' | e'\right\}} V^f\left(a_f', e', \chi_f'\right) pr\left(e' | Q^{f,s}\right)\right] \\ &+\frac{\beta}{2}\sum_{e'=0}^{1}\left[E_{\left\{a_m', \chi_m' | e'\right\}} V^m\left(a_m', e', \chi_m'\right) pr\left(e' | Q^{f,s}\right)\right]\Big\}. \end{aligned} \tag{12}$$

subject to equations (1) to (3). Here $pr\left(e' = 1 | Q\right)$ represents the probability of being college educated conditional on the human capital accumulated during childhood. We assume that parents' human capital investment is public goods. As a result, the male and female children share the same Q, and we assume the same probability of becoming college-educated given the same Q for boys and girls.

The value function of a couple is

$$\begin{aligned} V^{c}\left(a_f, a_m, e_f, e_m\right) &= \max_{\left\{\mathbf{I}_{w,f}, \mathbf{I}_{w,m}, L_m^{c}, D^{c}\right\}} \Big\{U\left(C^{c}, Q^{c}, L^{c}\right) \\ &+\frac{\beta}{2}\sum_{e'=0}^{1}\left[E_{\left\{a_f', \chi_f' | e'\right\}} V^f\left(a_f', e', \chi_f'\right) pr\left(e' | Q^{c}\right)\right] \\ &+\frac{\beta}{2}\sum_{e'=0}^{1}\left[E_{\left\{a_m', \chi_m' | e'\right\}} V^m\left(a_m', e', \chi_m'\right) pr\left(e' | Q^{c}\right)\right]\Big\}, \end{aligned} \tag{13}$$

subject to equations (5) to (7).

Since single males do not have offsprings, their value function, $V^{m,s}(a_m, e_m, \chi_m)$, is the same as the contemporary utility function (9), plus a realized utility gain (loss), χ_m, from staying single.

At the beginning of the period, all new adults enter a random match with an opposite sex. A female characterized by $\{a_f, e_f, \chi_f\}$ is matched with a male characterized by $\{a_m, e_m, \chi_m\}$, with the probability of $F(a_m, e_m, \chi_m | a_f, e_f, \chi_f)$. The opposite case is vice versa. We assume assortative meetings on the marriage market by education. Essentially, the conditional probability of a college-educated individual meeting with someone with the same education is higher than the unconditional probability of one being college educated. Such an assumption can be motivated by preferences, shared working environments, etc. We assume that the probabilities of meeting with someone with a given ability and taste for singlehood are independent from an individual's own corresponding characteristics.

Marriage occurs when both the male and the female in the match prefer getting married to staying single. We use the indicator variables $\mathbf{I}_M^j(\Theta) = 1$ to denote the case a female ($j = f$) or a male ($j = m$) prefers to get married, given the random match characterized by $\Theta = \{a_f, e_f, \chi_f, a_m, e_m, \chi_m\}$.

The value functions $V^f(a_f, e_f, \chi_f)$ and $V^m(a_m, e_m, \chi_m)$ are given by

$$V^f(a_f, e_f, \chi_f) = \int_{a_m} \sum_{e_m \in \{0,1\}} E_{\chi_m | e_m} \Big\{ \mathbf{I}_M^m(\Theta) \mathbf{I}_M^f(\Theta) V_f^c(a_f, a_m, e_f, e_m) + \left[1 - \mathbf{I}_M^m(\Theta) \mathbf{I}_M^f(\Theta)\right] V^{f,s}(a_f, e_f, \chi_f) \Big\} dF(a_m, e_m, \chi_m | a_f, e_f, \chi_f). \tag{14}$$

$$V^m(a_m, e_m, \chi_m) = \int_{a_f} \sum_{e_f \in \{0,1\}} E_{\chi_f | e_f} \Big\{ \mathbf{I}_M^m(\Theta) \mathbf{I}_M^f(\Theta) V_m^c(a_f, a_m, e_f, e_m) + \left[1 - \mathbf{I}_M^m(\Theta) \mathbf{I}_M^f(\Theta)\right] V^{m,s}(a_m, e_m, \chi_m) \Big\} d\Upsilon(a_f, e_f, \chi_f | a_m, e_m, \chi_m). \tag{15}$$

$$\mathbf{I}_M^f(\Theta) = \begin{cases} 1 & \text{if } V_f^c(a_f, a_m, e_f, e_m) \geq V^{f,s}(a_f, e_f, \chi_f), \\ 0 & \text{otherwise} \end{cases} \tag{16}$$

$$\mathbf{I}_M^m(\Theta) = \begin{cases} 1 & \text{if } V_m^c(a_f, a_m, e_f, e_m) \geq V^{m,s}(a_m, e_m, \chi_m), \\ 0 & \text{otherwise} \end{cases} \tag{17}$$

Here $V_f^c(a_f, a_m, e_f, e_m)$ and $V_m^c(a_f, a_m, e_f, e_m)$ represent the value of the female and the male when staying married. They are respectively given by

$$
\begin{aligned}
V_f^c(a_f, a_m, e_f, e_m) &= \frac{1}{1-\gamma}\left(\frac{C^{c^*}-C_b}{\varsigma_c}\right)^{1-\gamma} + \varphi\frac{(Q^{c*})^{1-\eta}}{1-\eta} + \theta\frac{(L^{c*})^{1-\psi}}{1-\psi} \\
&+\frac{\beta}{2}\sum_{e=0}^{1} E_{\left\{a_f',\chi_f'|e'\right\}} V^f\left(a_f', e', \chi_f'\right) pr\left(e'|Q^{c*}\right) \\
&+\frac{\beta}{2}\sum_{e=0}^{1} E_{\left\{a_m',\chi_m'|e'\right\}} V^m\left(a_m', e', \chi_m'\right) pr\left(e'|Q^{c*}\right), \quad (18) \\
V_m^c(a_f, a_m, e_f, e_m) &= \frac{1}{1-\gamma}\left(\frac{C^{c*}-C_b}{\varsigma_c}\right)^{1-\gamma} + \varphi\frac{(Q^{c*})^{1-\eta}}{1-\eta} + \theta\frac{(L_H^{c*})^{1-\psi}}{1-\psi} \\
&+\frac{\beta}{2}\sum_{e=0}^{1} E_{\left\{a_f',\chi_f'|e'\right\}} V^f\left(a_f', e', \chi_f'\right) pr\left(e'|Q^{c*}\right) \\
&+\frac{\beta}{2}\sum_{e=0}^{1} E_{\left\{a_m',\chi_m'|e'\right\}} V^m\left(a_m', e', \chi_m'\right) pr\left(e'|Q^{c*}\right). \quad (19)
\end{aligned}
$$

where $C^{c^*}, Q^{c^*}, L^{c^*}$, and $L_H^{c^*}$ represent the optimal decisions of the maximization problem (13).

2.3 College Selection Mechanism

The selection mechanism takes the form of $pr(e'=1|Q)$, a probabilistic dependence of being college-educated as a function of human capital accumulated during childhood. An individual's probability of being college-educated is the product of two terms: $pr(A=1|Q)$, the probability of college enrollment conditional on human capital accumulated; and $pr(e=1|A=1,Q)$, the probability of completing college education conditional on enrollment and human capital accumulation during childhood. That is,

$$pr(e'=1|Q) = pr(A=1|Q)\, pr(e'=1|A=1,Q). \quad (20)$$

The probability of completing college education is zero if not enrolling.

We assume that the two terms take the following functional forms:

$$pr\,(A=1|Q) = \frac{\exp\left(z_0^A + z_1^A Q\right)}{1+\exp\left(z_0^A + z_1^A Q\right)},\ z_1^A \geq 0, \tag{21}$$

$$pr\,(e'=1|A=1,Q) = \frac{\exp\left(z_0^e + z_1^e Q\right)}{1+\exp\left(z_0^e + z_1^e Q\right)},\ z_1^e \geq 0. \tag{22}$$

Here $\left\{z_0^A, z_0^e\right\}$ anchors the probability at the lowest amount of human capital, and $\left\{z_1^A, z_1^e\right\}$ indexes the selectivity of the selection mechanism. The lower z_1^A or z_1^e is, the lower the probability of college enrollment and completion for the same amount of Q.

Given the functional form, the derivative of the probability with respect to Q is given by

$$\begin{aligned}&\frac{\partial pr\,(e'=1|Q)}{\partial Q}\\ =\ & pr\,(e'=1|A=1,Q)\,\frac{\partial pr\,(A=1|Q)}{\partial Q} + pr\,(A=1|Q)\,\frac{\partial pr\,(e'=1|A=1,Q)}{\partial Q}.\end{aligned} \tag{23}$$

The first term represents the marginal effect of human capital on the probability of college enrollment, weighed by the probability of completing education upon admission. The second term represents the marginal effect of human capital on the probability of completing college education upon enrollment, weighed by the probability of college enrollment.

We assume that public policies can alter $pr\,(A=1|Q)$, but not $pr\,(e'=1|A=1,Q)$. In the case of a lottery system where college enrollment does not depend upon human capital, we have $z_1^A = 0$, and only the second term above remains.

2.4 Optimal Decisions

This section describes how individuals make decisions on consumption, time allocation and human capital investment in children, conditional on their marital and work decisions.

2.4.1 Consumption and Time Allocation Decisions

Since we assume fixed work hours, the male time allocation problem is trivial. In our model, the main role of males in a household is to provide an extra source of income. As a result, the first-order conditions for consumption and time allocations are similar for single females and for couples. Instead of using superscripts $\{f, s\}$ and $\{c\}$ to denote single females and couples, we use $\{j\}$ that can be set to either status.

We obtain the optimum under the constraints $D^j \geq 0$ and $L_m^j \geq 0$. The first order condition with respect to D^j is,

$$\begin{aligned} & \frac{1}{\varsigma_j}\left(\frac{C^j - C_b}{\varsigma_j}\right)^{-\gamma} P_D \\ \geq \; & \frac{\partial Q^j}{\partial D^j}\left\{\varphi\left(Q^j\right)^{-\eta} + \frac{\beta}{2}\frac{\partial pr\left(e' = 1|Q^j\right)}{\partial Q^j}\left(S_1 - S_0\right)\right\}, \end{aligned} \tag{24}$$

where

$$S_1 = E_{\left\{a'_f, \chi'_f|e'=1\right\}} V^f\left(a'_f, 1, \chi'_f\right) + E_{\{a'_m, \chi'_m|e'=1\}} V^f\left(a'_m, 1, \chi'_m\right), \tag{25}$$

$$S_0 = E_{\left\{a'_f, \chi'_f|e'=0\right\}} V^f\left(a'_f, 0, \chi'_f\right) + E_{\{a'_m, \chi'_m|e'=0\}} V^f\left(a'_m, 0, \chi'_m\right). \tag{26}$$

The left hand side of equation (24) represents the marginal cost of purchasing an extra unit of goods for childhood human capital investment. The right hand side is the marginal benefit from an extra unit of market goods and services in human capital. The marginal benefit reflects two motives behind parents' allocation of resources to children: the warm glow motive, in terms of marginal increases in the contemporary utility flow; and the investment motive, in terms of higher lifetime utility of children due to higher odds of getting college educated. The latter motive depends upon the role of human capital in the college selection mechanism, captured by $\frac{\partial pr\left(e'=1|Q^j\right)}{\partial Q^j}$, and the difference in the lifetime value between a college-educated and non-college-educated individual.

The agent is at a corner solution, $D^j = 0$, when inequality prevails. The corner solution means that the individual would like to reduce D^j to negative as the marginal benefit is smaller than the marginal cost, but she cannot.

The first order condition with respect to L_m^j is,

$$\left(\frac{1}{2}\right)^{I^c} \theta\left(L^j\right)^{-\psi} \geq \frac{\partial Q^j}{\partial L_m^j}\left\{\varphi\left(Q^j\right)^{-\eta} + \frac{\beta}{2}\frac{\partial pr\left(e' = 1|Q^j\right)}{\partial Q^j}\left(S_1 - S_0\right)\right\}. \tag{27}$$

where I^c equals 1 when we consider a couple, and equals 0 otherwise. The left hand side represents the marginal cost of time spent on maternal care, and the right hand side represents the marginal benefit from maternal care in terms of extra contemporary utility and higher lifetime utility of children from marginally higher odds of them getting a college education. When inequality prevails at the corner of $L^j = 0$, the marginal cost exceeds the marginal benefit of an extra unit of maternal care. However, the female cannot reduce her maternal care time or its close substitute below $(1-\delta) L_b$. In the case of couples, the marginal utility of leisure is different from the case of single mothers because the wife's utility from leisure is only part of couple's utility from leisure, so the increase in maternal care time affects marginal utility of leisure for the couple to a lesser degree.

The Case of Unconstrained Optimum In the unconstrained optimum, we have

$$\frac{(1-\alpha)}{\alpha}\left(\frac{D_b + D^j}{L_b + \nu(e_f) L_m^j}\right)^{1-\kappa} = \frac{U_L/U_c}{\nu(e_f) P_D}, \tag{28}$$

where the ratios of total child care spending and child care time depends positively on the ratio of shadow wage $\frac{U_L/U_c}{\nu(e)}$ over the price of physical child care goods, P_D. Here

$$U_L/U_c = \frac{\left(\frac{1}{2}\right)^{I^c} \theta \left(L^j\right)^{-\psi}}{\frac{1}{\varsigma_j}\left(\frac{C^j - C_b}{\varsigma_j}\right)^{-\gamma}}. \tag{29}$$

The Corner Solution at $D^j = 0$ If the decision is binding at $D^j = 0$, define $\widehat{Q}^j = Q^j|_{D^j=0}$, we have

$$C_t \quad < \quad \overline{C} = C_b + \varsigma_j^{1-\frac{1}{\gamma}} \left[\frac{\alpha}{P_D}\left(\frac{\widehat{Q}^j}{D_b}\right)^{1-\kappa} \widehat{\Phi}^j\right]^{-\frac{1}{\gamma}}, \tag{30}$$

$$\widehat{\Phi}^j \quad = \quad \varphi\left(\widehat{Q}^j\right)^{-\eta} + \frac{\beta}{2}\frac{\partial pr\left(e' = 1|\widehat{Q}^j\right)}{\partial \widehat{Q}^j}(S_1 - S_0). \tag{31}$$

Here $\widehat{\Phi}^j$ is part of the right hand side of equations (24) and (27), which represents the marginal benefit related to extra gain in human capital.

The equation shows that the agent would like to choose negative D^j to increase consumption, but is constrained from doing so due to non-negative constraint on child care spending. As a result, the household must have consumption above the minimum $\overline{C}$ to choose positive spending on children. Equation (30) shows that the higher marginal product of D^j and the higher marginal impact of D^j on Q^j at the corner, the lower the threshold of $\overline{C}$ to cross into the positive zone of D^j. On the other hand, higher prices of human capital investment goods, P_D, and higher C_b and D_b, raise the threshold of minimum consumption.

When D^j is at a corner, but the optimal decision on L_m^j is interior, the optimal amount of leisure, $\widehat{L}$, if it is interior, is determined by the implicit function,

$$\widehat{L}^j = \left[\frac{(1-\alpha)\,\nu\,(e)}{\left(\frac{1}{2}\right)^{I^c}\theta} \left(\frac{\widehat{Q}^j}{L_b + \nu\,(e)\,\widehat{L}_m^j} \right)^{1-\kappa} \widehat{\Phi}^j \right]^{-\frac{1}{\psi}}. \tag{32}$$

The Corner Solution at $L_m^j = 0$ If the decision is binding at $L_m^j = 0$, define $\widetilde{Q} = Q|_{L_m^j=0}$, we have

$$L < \overline{L} = \left[\frac{(1-\alpha)\,\nu\,(e)}{\left(\frac{1}{2}\right)^{I^c}\theta} \left(\frac{\widetilde{Q}^j}{L_b} \right)^{1-\kappa} \widetilde{\Phi}^j \right]^{-\frac{1}{\psi}}, \tag{33}$$

where $\widetilde{\Phi}^j$ is defined as in equation (31), except that $\widehat{Q}$ is substituted by $\widetilde{Q}$.

The inequality represents the case that the agent would like to choose negative L_m^j to increase leisure, but is constrained from doing so due to non-negative constraint on L_m^j. As a result, the household must have leisure above the minimum $\overline{L}$ to choose extra time with children beyond basic child care. If leisure falls below $\overline{L}$, the marginal cost of spending an extra unit of time on maternal care would be above the marginal benefit. When the constraint on L_m^j is binding, the optimal amount of spending on child care, $\widetilde{D}^j$, if it is interior, is determined by the implicit function,

$$\widetilde{C} = C_b + \varsigma_j^{1-\frac{1}{\gamma}} \left[\frac{\alpha}{P_D} \left(\frac{\widetilde{Q}^j}{D_b} \right)^{1-\kappa} \widetilde{\Phi}^j \right]^{-\frac{1}{\gamma}}, \tag{34}$$

where $\widetilde{C}$ is the amount of consumption corresponding to the optimal $\widetilde{D}^j$.

The households who are constrained in their optimal decisions are most likely those with low abilities, who may be constrained by income, and also expect low returns on human capital investment due to the complementarity of the productive inputs.

2.4.2 Work and Marital Decisions

Individuals and households make consumption and time allocation decisions conditional on their work decisions, while their work decisions are made conditional on their marital decisions. The singles decide on working or not, while couples decide on the intra-household work arrangements, taking into account possible welfare payments and additional free time when not at work.

In the model, marital gains come from several sources. First, marriage means economies of scale for both males and females. Second, marriage means additional sources of income and a possibility to free up time for maternal child care, both primary benefits for women. Men are able to enjoy utility from warm glow and welfare of the children through marriage. Third, we assume nonpecuniary gain from marriage in the form of negative utility associated with being single, that is, $\left\{x_m, \chi_f\right\}$ We assume that non-college educated individuals have higher variance of those utility gains. We use this assumption as a short-cut to capture higher divorce rates and shorter duration of marriages among non-college-educated individuals in our one-period model for adults.

2.5 Stationary Equilibrium

The economy-wide distribution of education levels can be characterized as follows,

$$\Psi' = \Pi\left(\Psi, \mathbf{Q}^{f,s}, \mathbf{Q}^{c}, \mathbf{I}^{f}_{M}, \mathbf{I}^{m}_{M}\right), \tag{35}$$

where Ψ' and Ψ respectively represent the education distribution of the younger and the older generation. The above transition rule shows that the education distribution of the young generation depends upon the education distribution of the older generation, the marriage decisions of individuals with given ability levels, education attainments, utility gains of getting married, and human capital investment decisions given the ability and education of parent(s).

A stationary equilibrium is a set of allocation rules, $L^{f,s}_{m}(a_f, e_f)$, $D^{f,s}(a_f, e_f)$, $L^{c}_{m}(a_f, e_f, a_m, e_m)$, $D^{c}(a_f, e_f, a_m, e_m)$, $\mathbf{I}^{f,s}_{w,f}(a_f, e_f)$, $\mathbf{I}^{m,s}_{w,m}(a_m, e_m)$, $\mathbf{I}^{c}_{w,f}(a_f, e_f, a_m, e_m)$, $\mathbf{I}^{c}_{w,m}(a_f, e_f, a_m, e_m)$, $\mathbf{I}^{f}_{M}(\Theta)$, and $\mathbf{I}^{m}_{M}(\Theta)$, and distribution of education Ψ, such that the following conditions hold:

1. The functions $\mathbf{I}^{f,s}_{w,f}(a_f, e_f)$, $L^{f,s}_{m}(a_f, e_f)$ and $D^{f,s}(a_f, e_f)$ solve single females' maximization problem as described in equation (12).

2. The functions $\mathbf{I}_{w,f}^{c}(a_f, e_f, a_m, e_m)$, $\mathbf{I}_{w,m}^{c}(a_f, e_f, a_m, e_m)$, $L_m^c(a_f, e_f, a_m, e_m)$ and $D^c(a_f, e_f, a_m, e_m)$ solve couples' maximization problem as described in equation (13).

3. The function $\mathbf{I}_{w,m}^{m,s}(a_m, e_m)$ solves single males' maximization problem as described in equation (9).

4. The functions $\mathbf{I}_{M}^{f}(\Theta)$ and $\mathbf{I}_{M}^{m}(\Theta)$ solve the females' and males' optimal marital decision problems, as described in equations (14) to (17).

5. The distribution of education is governed by the stationary distribution described in (35) when $\Psi' = \Psi$.

3 Calibration and Model Simulations

This section describes model parameters and benchmark simulation results.

3.1 Categories of Model Parameters

In the model an individual lives for two periods, one period as a child, and another period as an adult. we set β to 0.45, so that each period corresponds to approximately 25 years. We set $\overline{h}$ to 0.36 to represent a full-time work week out of total nonsleeping hours. For the equivalence scales, we adopt the ECB equivalence scale by having the first adult counted as 1 unit, the second adult 0.5 units, and each child 0.3 units. As a result, equivalence scales for a single female household with two children and a married household with two children, $\{\vartheta_f, \vartheta_c\}$, are respectively 1.6 and 2.1 We normalize P_D, the price of market goods and services for child care, to 1.

There are six categories of parameters.

The first category relates to preferences: $\{\gamma, \eta, \psi, \varphi, \theta, C_b\}$. Here γ, η and ψ represent the curvatures of the utility in consumption, human capital of children and leisure. Their relative magnitudes matter for the allocation of time and resources in response to variations in shadow prices of goods and time. The parameters φ and θ matter for the importance of human capital and leisure relative to consumption goods in terms of utility. The parameter C_b denotes the subsistence consumption.

The second category relates to the production function of human capital and parameters that affect the time constraints of different groups. Those parameters are: $\left\{\alpha, \kappa, D_b, L_b, \upsilon_1, \upsilon_0, \delta, L_b^{hp}\right\}$. Together with preference parameters, those production parameters affect the household's allocation decisions on investment in terms of market goods and services and maternal time. They not only affect the substitution elasticity of market goods and services and maternal care time in conducting human capital investment, but also affect the threshold values of minimum consumption and leisure to allocate positive amounts of market goods and services and maternal care time. Since households with the lowest income tend to be constrained at D_b and L_b in terms of human capital investment, those two parameters serve to anchor the minimum amount of human capital investment in the society. The parameters, $\{\upsilon_1, \upsilon_0\}$, affect primarily the maternal child care time for college-educated versus non-college-educated mothers. Since single working moms can at most outsource δL_b amount of child care time to market purchased services, and single nonworking moms may spend no extra maternal care time beyond L_b, parameters δ and L_b are especially important in capturing the child care time of single moms. The parameter, L_b^{hp}, captures the required minimum amount of time on household chores for nonworking married women, thus avoiding excessively large amount of maternal care time.

The third category involves distribution parameters for ability and for marital preference shocks. The parameter, σ_a, represents the standard deviation of the ability a, with its mean normalized to 1. The parameters $\{x_m, x_f\}$ affect marriage decisions of males and females. We assume equal probabilities of x_m and x_f taking values from a high and a low value respectively However, we assume that the pairs of low and high values are different by gender and educational attainment. In particular, we assume that marital preference shocks for the non-college-educated have the same mean but a higher variance as compared to those for the college-educated to capture lower marital rates among the former group. The differences in variances for males and females are respectively $\{\sigma_M^2, \sigma_F^2\}$.[4] We also use one single parameter, p_{ss}, to capture the conditional probability of a college-educated female meeting with a college-educated male on the marriage market, and vice versa.[5] A

[4]Given the binominal distribution, if the taste shock for the colledge-educated males, χ_m^e takes one of the two values, $\left\{\chi_{m,\min}^e, \chi_{m,\max}^e\right\}$, the taste shock for the non-college-educated males takes one of the following two values, $\left\{\chi_{m,\min}^e - \sigma_M, \chi_{m,\max}^e + \sigma_M\right\}$. The same is true for females.

[5]Given that the fraction of the college educated among males is very close to the fraction of the college educated among females over our sample period, the conditional probability of a college-educated male meeting with a college-educated female on the marriage market

large p_{ss} indicates a high degree of assortative matching by education.

The fourth category relates to how human capital transits into the probability of becoming college educated. The parameters $\left\{z_0^A, z_1^A\right\}$ affect the probabilities of college enrollments, while $\{z_0^e, z_1^e\}$ characterize the conditional probabilities of college completion upon enrollment.

The fifth category relates to wages for child care workers,[6] and wages for non-college-educated and college-educated workers, $\{w_{cc}, w_0, w_1\}$, the degree of gender wage disparity ϱ, and the proportional work penalty for married females, μ. Based on the data, we calibrate w_{cc} to be 48% of average income[7]. Once $\{w_0, w_1\}$ are determined, we would know w_{cc} based on model-simulated average income. We normalize w_0 to 1 and calibrate parameters w_1 and ϱ to match the skill premium and the gender wage gap. The parameter μ affects the labor force participation decisions of married women.

The sixth category relates to policy parameters, B, the amount of benefits available for eligible households. Those parameters are calibrated to help match the probability of working. Certainly, the availability of welfare payments affect the outside option of marriage as well.

In addition to above-mentioned pre-specified parameters and the parameter γ being set to 3, we calibrate a total of 30 parameters to minimize the weighted sum of the percentage difference between 32 model-implied and observed moment statistics.[8] Table 2 reports the parameter values for the benchmark simulation. Although we use unconditional moments for the calibration, we use conditional moments to describe the fit of the model when they give clearer economic implications. Since the parameters are estimated matching unconditional moments, the matches of conditional moments may show a slightly larger difference from the data, but the matches are still reasonably close.

is the same as the conditional probability vice versa.

[6]Although we do not specifically model child care workers, their wages can be approximated by weighted sums of wages by workers of different abilities.

[7]Based on BLS, in May 2003 hourly wage for child care workers was $8.47, and that for averalge workers was $17.56, with the former being 48% of the latter. A similar ratio holds in May 2019.

[8]In addition to moments reported in Table 2 to Table 5, we also target the model implied and observed maternal care time of households with only wife working.

3.2 Model Simulations

In this section we examine summary statistics and decision patterns based on model simulations, and compare them with the data. We focus on three sets of statistics. The first set characterizes the distribution of mothers by education, marital status and working status, the second set features the average amount of maternal child care time for mothers in those categories, and the third set characterizes college enrollment and completion rates across different households. We focus on mothers as children only live with mothers in our model.

3.2.1 Distribution of Education and Marital Status

Panel A of Table 2 shows the distribution of households by marital status and educational attainment. The model shows that about 28 percent of mothers are educated, and 64 percent of children grow up with married mothers, consistent with the corresponding 30 and 65 percent observed in the pooled ATUS sample of mothers from 2003 to 2017.

The model generates marital patterns broadly consistent with the data. First, the model shows that college-educated females are more likely to be married: About 84 percent of college-educated mothers are married, while only 56 percent of non-college-educated mothers are, both of the same magnitudes as in the data. The college-educated women are more likely to be married because they have higher income, and more effective with time spent on child care, thus more desirable on the marriage market. In addition, they have smaller probabilities of meeting with non-college-educated males on the marital market, who are more likely to opt out of marriage due to high variances of their preference shocks toward singlehood. Second, the model generates assortative marital patterns. Greenwood, Guner and Knowles (2003) document that among married couples, 55 percent are both non-college-educated, 24 percent are both college-educated. Our model generate 49 percent of marriages among non-college-educated, and 27 percent among college-educated.

Panel A(B) of Figure 1 shows marital decisions of two non-college-educated (college-educated) individuals when both are endowed with favorable marital shocks (that is, lower values of x_m and x_f). Non-college-educated and lower-ability individuals are less likely to get married. This is understandable as additional sources of income and opportunities to free up time for maternal child care are two primary incentives for women to get married in the model. Men with higher ability and educational attainments are more likely to get married not only because they can provide extra resources of income, they may also have reached the relatively flat segment of their marginal utility of consumption, and would prefer to divert into utility from warm glow and investment in children.

Panel C of Figure 1 shows marital decisions of a non-college-educated female and a non-college-educated male, with the female endowed with unfavorable marital shocks. We examine unfavorable marital shocks to study who are at the margin of marital decisions. In this case, high ability women opt to stay single unless matched with males of reasonably high ability. Low ability males stay single. Panel D shows the case of matches between college-educated males and females when both are endowed with unfavorable marital shocks. More lower ability individuals are single as compared to Panel B. Given the high variance of marital shocks, when non-college-educated males and females are both endowed with unfavorable marital shocks, their chances of marriages are slim.

In all, single mothers are more likely to be non-college-educated and low-ability females, while a small fraction of very high ability females may opt to stay single when matched with males of not sufficiently high abilities.

3.2.2 Distribution of Work Status

Panel B of Table 2 documents the work status of females by their households' education and marital status. In terms of unconditional distribution based on data observations, around 24 percent of mothers are single working moms who are non-college-educated, while around 4 percent are single working college-educated mothers. This is understandable as college-educated mothers are much more likely to be married. In terms of conditional distributions, the model shows that a much higher proportion of college-educated single mothers work, as compared to non-college-educated single mothers, an observation consistent with the data.

The model shows that 30 percent of mothers are married working moms who are non-college-educated, as compared to 16 percent who are married, working, and college-educated. The corresponding data observations are 25 and 17 percent.

Based on data observations, about 90 percent of married households choose one of two work arrangements, 60 percent of married couples have both spouses working, while 30 percent have a working husband and a stay-at-home wife. The model predicts 29 percent of married households adopt the latter working arrangement. Since nearly all men work full time in the model by construction, the model generates about 71 percent of households with both spouses working, as other work arrangements, such as both not working, or only female working, are barely adopted. Nevertheless, the model captures main features of work arrangements within couples.

Model simulations show that the arrangement of a working husband and a stay-at-home wife is more common when the female is of lower abilities and non-college-educated. For single mothers, the generosity of welfare payments matter for their work decisions. Figure 2 shows work decisions when the match is between non-college-educated males and females. Other matches have similar work patterns. The match may or may not end up in marriage. As shown in Figure 1, males and females of lowest abilities are likely to be single. Since single nonworking mothers qualify for welfare payments, those with lowest abilities choose not to work. When low ability women get married with reasonably high ability men, the woman would become a stay-at-home mom while the man works. Even some higher ability women choose to stay at home when their husbands' abilities are high enough. In most cases, both spouses choose to work.

3.2.3 Distribution of Maternal Care Time

Table 3 documents maternal child care time by marital and work status based on data observations and model simulations. Based on the American Time Use Survey, educated mothers spend more time on maternal child care, regardless of marital and work statuses. Nonworking moms spend more time on maternal child care than working moms.

Among single mothers, non-college-educated nonworking mothers spend 12 hours per week on maternal child care, while non-college-educated working mothers spend 9 hours based on the ATUS 2003. Model simulations yield similar patterns for non-college-educated single mothers. The model is able to capture the amount of maternal child care time by college-educated working mothers at about 10 hours per week, but underestimates the amount of maternal care time by college-educated single nonworking mothers, a group which accounts for only 0.3 percent of mothers, and thus assigned lower weight in matching moment statistics. In reality, college-educated single nonworking mothers may have more income support than welfare payments as assumed in the model. Such income support may make higher human capital investment in terms of maternal care worthwhile.

We focus on maternal care time in married households with two types of work arrangements: either with both spouses working, or with the husband working but the wife staying at home. Nearly 90 percent of married households adopt one of the two arrangements. Based on the ATUS, non-college-educated nonworking mothers with a working spouse spend 18 hours per week on child care, while non-college-educated working mothers with a working spouse spend 11 hours. The corresponding numbers generated by the model are 19 and 10 hours respectively. By contrast, college-educated nonworking mothers with a working spouse spend 23 hours per week on child care, while non-college-educated working mothers with a working spouse spend 15 hours. The corresponding numbers generated by the model are 21 and 12 hours respectively.

In terms of the absolute magnitude, college-educated nonworking mothers with a working spouse spend the highest amount of time on maternal care, while non-college-educated single working moms spend the least amount of time on child care. Our model generates the distribution of maternal care time across households that are broadly consistent with the data.

3.2.4 Distribution of Human Capital and College Completion Rates

Table 4 contains the statistics of college enrollment and completion rates by family structure in year 2005 as documented by Blandin and Herrington (2022).[9] As shown in the table, individuals from single-parent non-college-educated households (in our model, children living with non-college-educated single mothers) have 40 percent probability of enrolling in colleges, but 11 percent probability of eventual completion. For children in households with both parents non-college-educated, the corresponding rates are 54 percent and 19 percent, while for children with at least one parent being college-educated, the college enrollment and completion rates are respectively 88 and 59 percent. Our model generates enrollment and completion rates very close to data observations for the first two types of households, but underpredicts the enrollment and completion rates for those households with at least one parent being college-educated. This is similar to the difficulty of generating the upper end of wealth accumulation as marginal gains from both the warm

[9] We use the observation in the year 2005 as we target the maternal care time use patterns in 2003.

glow and investment incentives in human capital investment significantly weaken for income-rich households.

Panels A and B of Figure 3 show the amount of human capital accumulation during childhood when matches are between both non-college-educated or between both college-educated. Since market goods and services and maternal child care time are complementary in producing the human capital, the distribution of human capital follows similar patterns. If both the male and the female have low abilities, most of such matches result in a single-mother household, and the children accumulate minimum amount of human capital. As the ability levels of males and females increase, they are more likely to get married, and the children accumulate higher amount of human capital.

Panels C and D of Figure 3 shows the probabilities of college completion based on abilities and educational statuses of matched individuals. Since the societal selection mechanism depends positively on the amount of human capital accumulated, probabilities of college completion have similar patterns as accumulated human capital.

Table 5 contains all the price terms, including the skill premium, gender wage gap, and market wages for child care workers. Simulated model statistics are broadly consistent with data observations.

4 The Role of College Selection Mechanisms

In this section, we conduct counterfactual experiments to examine the impact of the college selection mechanism on educational disparity. In our model, the college selection mechanism takes the form of a logistic function that expresses the college enrollment rate as a function of human capital accumulated during childhood. Two parameters, $\left\{z_0^A, z_1^A\right\}$, characterize the selection mechanism. We conduct two counterfactual experiments: a lottery college admission system and a differential college admission system that gives preferential treatment to individuals from single or non-college-educated households. Table 6 summarizes alternative parameterization in all counterfactual experiments. The left panel of Table 7 reports the simulated outcomes of the two experiments, as compared to the benchmark economy.

4.1 A Lottery Admission System

We first consider a lottery admission system with a constant college enrollment rate regardless of the amount of human capital accumulated. In this case, z_1^A is 0 and z_0^A is set so that every child has a probability of 56 percent of going to college, the average rate of college enrollment in the benchmark economy.

Table 7 shows that the switch to the lottery system has strong impact on both college completion rates and family structures in the stationary equilibrium. Although the college completion becomes more equitable, the switch causes a 9 percent decline in the fraction of college educated population compared to the benchmark economy, and comes at differential costs to the three types of households categorized in Blandin and Herrington (2022). Specifically, the college completion rates for the single-mother non-college-educated households, married non-college-educated households and married households with at least one parent college-educated are respectively $13, 18$, and 30 percent, as compared to $11, 23$, and 51 percent in the benchmark case. About 60 percent of the younger generation experience an increase in their college completion rates. However, among those who experience increases, the average increase is about 4 percent, while among those who experience decreases, the average decline is about 24 percent. with the decrease highest among those households who make the highest amount of human capital investment in the benchmark economy.

Reduced human capital investment at the household level can explain part of the decline in college completion rates. Two factors discourage the household's investment motives. First, a reduction of z_1^A to 0 reduces the return to human capital accumulation by delinking the relation between human capital and college enrollment. Figure 4 shows the college completion rates corresponding to optimally selected amount of human capital in the benchmark economy and in the setting with the lottery admission system. In the latter setting the marginal contribution of human capital to college completion rates flattens at a lower level of human capital accumulation, and the same amount of human capital corresponds to a lower college completion rate due to the capped college enrollment rate, as compared to the benchmark case. Households respond to reduced investment incentives by reducing human capital investment in both market goods and services and maternal care time, while increasing their consumption and leisure time. Since the most affluent households, those who are college-educated and/or endowed with high abilities, are encountered with the largest reduction in enrollment rates under the reform, their investment declines the most.

The second factor behind the reduction in investment motives is the shrinkage of the gap between the lifetime utilities of the college-educated versus those who are not, that is, the term $S_1 - S_0$. Since warm glow incentives mostly dominate the incentives for human capital investment at lower values of Q, and investment motives feature strongly at higher levels of human capital, the shrinkage of welfare gap between being college-educated versus being not has larger adverse effect on those who make relatively large amount of human capital investment in the benchmark case.

The decline in college completion rates not only comes from reduced human capital investment motives at the household level, but also from a 5 percent decline in the marriage rate as the non-college-educated are less likely to be married. As a result, there are a higher fraction of households that conduct less human capital investment than those married and college-educated households. Panel A of Figure 5 plots the cumulative distribution of human capital accumulation, with the upper, middle and lower pair representing respectively the cumulative distributions for single-mother non-college-educated households, married non-college-educated households, and married households with at least one parent college-educated. The figure shows a compositional shift from the third type of the household, which invests the most in their children's human capital, to the first two types, which invest less. Specifically, as shown in Table 7, the fraction of single-mother non-college-educated households increases from 32 percent in the benchmark case to 38 percent, whereas the fraction of married households with at least one educated parent decreases from 33 percent to 23 percent. Such composition changes shift the density of human capital accumulation to the left, and lower the amount of aggregate human capital, as shown in Panel C.

Panel B of Figure 5 shows cumulative distributions of college completion rates of those three types of households. In the case of the lottery admission system, the college completion rates are capped between around 11 and 56 percent, in contrast to between 0 and close to 100 percent in the benchmark case. Panel D shows comparisons of cumulative distribution functions of college completion rates in the benchmark and lottery admission setting. The shift of density to lower college completion rates is a result of the capped uniform enrollment rate, reduced investment incentives, and the compositional shift of family structure. In equilibrium, lower college completion rates and lower marital rates are mutually consistent.

The change to the lottery admission system also has welfare implications. The households with at least one educated parent on average can afford more human capital investment in the benchmark economy. However, under the lottery system, their children may have lower college enrollment and completion rates, thus lower lifetime incomes and utilities. Since parents take utility in their children's well-being, college-educated males and females, who are likely to form families, would both experience declines in utilities.

Interestingly, although children of non-college-educated females may see their college completion rates go up, albeit slightly, the lifetime utility of non-college-educated females actually declines in their lifetime utilities. The reason is that although their children now have higher odds of college completion, lifetime utilities of college-educated males and females are lower than before. In addition, the magnitudes of increases in college completion rates are small anyway. All factors combined, the lifetime utilities from having children decline. Since one of the most important motives of men to get married is to share the utility from having children, such declines would discourage males, especially non-college-educated males from getting married. When non-college-educated males decline to get married, non-college-educated females, especially those with low abilities, would be left single on the marriage market. The declines in marriage rates drive down the lifetime utilities of non-college-educated females.

In our counterfactual experiment, non-college-educated females experience even larger declines in lifetime utilities than educated females. Non-college-educated males have a different story. A higher fraction of non-college-educated males are single, thus not affected by declines in utility from having children, while college-educated males who are most likely married and have children experience larger declines in welfare. As a result, when we consider both males and females, the aggregate welfare of non-college-educated population declines by 3.5 percent, as compared to 8.6 percent for the college-educated population.[10] The gap in lifetime utilities between being college-educated or not shrinks by 2.3 percent, thus further discouraging

[10]We choose not to express welfare changes in consumption or income units for two reasons: First, there are no analytical solutions to welfare changes in consumption units when the individual takes utility in multiple items beyond consumption, and the utility function in consumption is not logarithmic. Second, the welfare gap between being single (a single-period maximization problem for males) and being married (an infinite horizon problem) is too large at the individual level to be accounted for by increases in consumption or income, especially for those with the marginal utility of consumption in the flat region.

investment in human capital investment of the next generation. The aggregate welfare of the economy declines by around 9 percent under the lottery selection system.

4.2 Differential College Admission System

In this section we consider a differential college admission system, where children from either single-parent households or households with married non-college-educated parents enjoy a different selection system for college enrollment from others. Specifically, we assume a higher z_1^A for children from such households, which means that a lower amount of human capital accumulated is needed for a given probability of college enrollment for individuals from those two types of households. We adjust z_1^A to a lower value for individuals from households with at least one parent college-educated. The parameterization of heterogeneous z_1^A is chosen to yield the same college enrollment rate as in the benchmark case for all households and for the preferred group.

The switch to the differential admission system has strong impact on both college completion rates and family structures in the stationary equilibrium. Although the college completion becomes more equitable, the switch causes a 4 percent decline in the college completion rate, despite the same average enrollment rate of 56 percent as compared to the benchmark economy. The change comes at differential costs to heterogeneous households. Specifically, the enrollment rate is 46 percent for households with a single non-college-educated mother, and 68 percent for married households with both parents being non-college-educated. The college completion rates for the three types of households are respectively $13, 27$ and 34 percent, as compared to $11, 23$ and 51 percent in the benchmark case. Contrary to the lottery admission setting, which has no extra incentives for targeted groups, married non-college-educated households benefit most, as pooled income allows them to take advantage of the preferential treatment. About 67 percent of the younger generation experience an increase in their college completion rates. However, among those who experience increases, the average increase is about 3 percent, while among those who experience decreases, the average decline is about 16 percent. with the decrease highest among those households who make the highest amount of human capital investment in the benchmark economy.

The differential values of z_1^A for different types of families play an important role in changes in human capital accumulation and college completion rates. An increase in z_1^A affects incentives in human capital investment in two directions. On the one hand, a higher z_1^A raises the reward for a given amount of human capital investment; on the other hand, the marginal reward becomes flatter after a smaller amount of human capital is accumulated as compared to the benchmark case. A decrease in z_1^A has opposite effects. Figure 6 plots the optimally chosen amount of human capital accumulation, Q, and its corresponding college completion rates in the benchmark economy and in the setting with the differential college admission system. The figure shows that in the latter setting, a given amount of human capital accumulation leads to a higher college completion rate if the household belongs to the preferred group. However, we can see that the marginal increase in college completion rates reaches the flatter portion earlier for the preferred group. By contrast, for the non-preferred group with a lower z_1^A, the flatter region of the marginal contribution to the college completion rate happens after a higher amount of human capital accumulation. Such continued incentives, together with relatively higher income of the nonpreferred group, propel continued investment in human capital even at a higher level of investment not reached by the preferred group. Since changes in z_1^A have opposite effects on human capital investment, the impact on each household depends upon its characteristics, but the overall effect turns out negative.

In addition to differential changes in z_1^A, the preferential treatment for mostly non-college-educated households distort human capital investment incentives by reducing $S_1 - S_0$, the welfare gap between being college-educated and being not. Since being college-educated means less welfare gain than before, parents have less incentives to invest in their children's human capital, leading to lower college completion rates.

Similar to the lottery admission system, the differential college admission system also distorts marital incentives and causes a compositional shift of family structure toward those conducting less human capital investment. First, since single-parent households can enjoy the preferential college admission treatment, college-educated women of middle- and high-level abilities may choose to stay single instead of marrying men of lower abilities, as compared to the benchmark case; Second, lower college completion rates reduce welfare for everyone as there are now smaller probabilities of matching with college-educated individuals, who enjoy higher income and are more likely to get married. As the welfare of having children decline, as a result of declines in overall welfare, men are more likely to stay single, thus resulting in a decline in the marriage rate for the entire economy. Since children with married college-educated parents have higher college completion rates than others, the decline in the fraction of such families further contribute to the decline in the college admission rates in the economy.

Panel A of Figure 7 plots the cumulative distribution of human capital investment for the three types of households. The figure shows the composition shift from the third type of the household to the first two types, in particular, non-college-educated single-mother households. Such a composition shift contributes to lower amount of human capital in the aggregate.

Panel B of Figure 7 shows the cumulative distribution of college completion rates of those three types of households. It is interesting to notice the distributional shift of college completion rates within the second and third types of households. For the households with both parents non-college-educated, the cumulative distribution of college completion rates in the differential college admission setting stays below that of the benchmark case up to the middle range of the college completion rate. This indicates a rightward shift of the density distribution of college completion rates despite an increase in the share of the second type of households, as compared to the benchmark case. The shift is due to large gains in college completion rates for the range of human capital investment this group engages in under the preferential treatment. By contrast, the density of college completion rates shifts to the lower region for the third type of households as the cumulative distribution of college completion rates stays above that of the benchmark case except at the very high range of college completion rates. This says that not only there are fewer married households with at least one parent college-educated, but also among those types of households, more of them choose lower amount of human capital, which results in a shift of density to the left.

In all, the welfare of non-college-educated decline by 4.8 percent, but that of the college-educated individuals decreases by 19.4 percent. The welfare of the college-educated individuals declines more compared to the lottery admission case, as they have to allocate more resources to human capital investment for the same probability of college completion. The welfare gap shrinks by 12 percent, higher than in the setting with lottery admission system due to preferential treatment to one group versus another. Although the shrinkage of gap reduces investment incentives, the favorable change in z_1^A for certain households offsets some losses. The overall welfare declines by around 9 percent.

5 Social-Engineering Marital Formations

Given the critical role of the family structure in human capital investment decisions and the importance of compositional effects in the first two counterfactual experiments, it is a natural question to ask how a compositional change in family structure without altering the college selection system would affect human capital investment and college completion rates.

In our model we make two key assumptions on marital formations to capture assortative mating and higher marriage rates among the college-educated, both well documented data observations. The first assumption is assortative matching on dating markets where the college-educated have a higher probability of meeting with those with the same educational attainment prior to their marital decisions. The second assumption is on the variance of taste shocks for singlehood. We assume that the non-college-educated have a higher variance compared to the college-educated, a driver of their lower propensity for marriage.

We conduct two experiments in the following sections. In the first experiment, we social engineer the marital system to eliminate assortative matching prior to marital decisions. In the second experiment, we keep assortative matching in place, but remove the difference in the variances of the taste shock for singlehood, parameters that govern the marital propensity given the economic trade-offs of marital decisions. Panel B of Table 7 report the simulation results.

5.1 The Role of Assortative Matching

In this experiment we reduce the probability of a college-educated individual matching with one with the same education attainment of opposite gender from the benchmark value of 0.64 to $0,24$, which is approximately equal to the fraction of college-educated individuals in the new equilibrium. Essentially, there exists no assortative matching in the new environment. Since couples who are both non-college-educated are less likely to get married due to higher variances of taste shocks for singlehood, absence of assortative matching creates more opportunities to form families with at least one parent college-educated. Indeed, Table 7 shows that the fractions of single-mother non-college-educated households and married non-college-educated households decline by around 3 and 4 percent respectively, while the fraction of households with at least one college-educated parent increases by 3 percent.

Table 7 shows that the average college completion rate declines by 4 percent compared to the benchmark case. The decline is the result of several forces, some in opposite directions. First, the welfare gap between those who are college-educated versus those who are not shrinks by 28.2 percent, indicating that assortative matching is one of the major benefits of college education. The shrinkage of the welfare gap reduces the investment incentives for all, but especially for those parents who have relatively higher income, and invest in children's human capital not just for warm glow, but mostly for their future welfare. Second, since each individual has to decide whether to get married with the person he or she is matched with, with no second opportunities to match with a different person, absence of assortative matching among college-educated pairs leads to a large decrease in the fraction of couples who are both college educated. In the benchmark economy, 17 percent of families are couples who are both college-educated; now only 6 percent of them are. Instead, the fraction of couples with one of them college-educated increases by 14 percent. Since households with both college-educated parents are in general better off and conduct more human capital investment, such compositional change leads to lower college completion rates for children from the third type of household. Indeed, as shown in Table 7, although college enrollments decline for all three types of households, the third type of households experiences the largest declines. However, the declines in college enrollment and completion rates in all three types of households are smaller than when the college admission system is altered, especially for the third type of households, indicating that manipulation of college selection system has strong disincentives for human capital investment. While the first two forces reduce human capital investment incentives for each type of households, the compositional shift to the third type of households, which conduct much more human capital investment than the first two types, serves to improve the average college completion rates.

Figure 8 plots the cumulative distribution of human capital accumulation and college completion rates for the three types of households and for all in absence of assortative matching. The figure supports the reasoning above.

The change in assortative matching opportunities leads to a 5.9 percent increase in the welfare of non-college-educated individuals, but a 13.4 percent decrease in the welfare of college-educated individuals, as they lose the privilege of higher probabilities of matching with their peers.

The social engineering of the matching mechanism results in a more equitable society in terms of college completion rates and welfare distribution. The overall welfare increases by 1.2 percent.

5.2 The Role of Marriage Propensity

In the benchmark model, we assume that the non-college-educated individuals have a higher variance for their random tastes for singlehood. Since the non-college-educated have a higher variance for their taste for singlehood, they may choose to stay single when they sample a higher value for their taste shock for singlehood, given the same economic trade-offs. The shortcut assumption essentially means that the non-college educated are less likely to get (stay) married. Since we do not model divorces in the single-period model, the assumption also reflects higher divorce rates among the non-college-educated. Such difference is the main driver behind the difference in marriage rates among people with or without college education in our model. While the random matching mechanism allows people of different characteristics to meet, their preferences for singlehood determine whether they prefer to get married given the economic trade-off.

In the current experiment, we assume that individuals have the same variance of their randomly realized preferences for singlehood regardless of their educational attainment. The family structure of the economy changes dramatically as a result. The fraction of people who are married increase to around 96 percent. The fraction of married households with two non-college-educated parents increases from 32 percent to 55 percent relative to the benchmark case, and the fraction of married households with at least one college-educated parent increases from 33 to 40 percent.

Table 7 shows that the average college completion rate increases to 30 percent from 28 percent in the benchmark case, despite reduced human capital investment within each of the three types of households. In the current setting, the 4 percent single-mother households are most likely of the lowest abilities and income, even when compared to the same group in the benchmark case. It is not surprising that human capital accumulation of children from those households is lower. Higher propensity to marry among the non-college-educated also implies that there are more lower-ability, lower-income households among the married households with two non-college-educated parents. The decline in the average income may drive down human capital investment of this group. Besides that, the shrinkage in welfare gap between being college-educated versus being not reduces human capital investment incentives for all groups, especially the third type of households. There is an 8 percent decline in college completion rate for children from the third type of households, despite only a 4 percent decline in college enrollment rates, reflecting lower human capital accumulation overall for children from those households.

Despite reduced human capital investment and college completion rates within each type of households, the composition shift drives up the average college completion rates for the entire economy. There are now much fewer single-parent households who makes much lower human capital investment than others. The increase in the fraction of married families who pool resources for human capital investment shifts the density distribution of human capital and college completion rates to the right, as shown in Figure 9.

Welfare increases drastically by 31 percent for the non-college-educated as they are more likely to match with non-college-educated, and now such matches are more likely to result in marriages. The welfare of the college-educated increase by 27 percent as their matches with non-college-educated men are more likely to result in marriages, and their children would experience higher lifetime utilities even if they are non-college-educated. The average welfare increases by 31 percent for all households.

The experiment shows that any social policies that provides a resourceful and stable family for children would result in a welfare gain regardless of their parents' college attainment. By enhancing the family environment where children grow, such policies may reduce both educational and welfare disparity.

6 Conclusion

In this paper we find that family structure plays a crucial role in the amount of human capital accumulated in the childhood and college completion rates. Altering the college selection mechanism may achieve more equalized college education opportunities, but potentially at the cost of distorting both marriage and human capital investment decisions, and consequently resulting in a lower marriage rate, a lower college completion rate, and lower welfare overall.

We find that social engineering experiments that enhance marital prospect and stability among the non-college-educated may lead to a higher marriage rate, a higher college completion rate and higher welfare for individuals of different educational attainments. The findings call the attention to the root cause of the educational disparity: the disparity in the family structure the children grow up in.

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Table 1 Parameter Values

Parameters	Values	Interpretations
Preferences		
γ	3	curvature of utility in consumption
η	1.54	curvature of "warm glow"
ψ	9.04	curvature of utility in leisure
φ	0.46	coefficient for "warm glow"
θ	0.18	coefficient for leisure
C_b	0.01	subsistence consumption
Production of Human Capital		
α	0.92	coefficient for market goods and services
κ	-1.09	elasticity between two inputs
D_b	0.002	minimum human capital investment in market goods and services
L_b	0.09	minimum child care time
$[\upsilon_1, \upsilon_0]$	$[3.75, 0.29]$	efficiency unit of college-educated moms
δ	0.056	fraction of basic maternal care time substitutable for market services
Distribution Parameters		
σ_a	0.91	standard deviation of log-ability
χ_m^u	$[-269.6, -18.3]$	min and max of marital shocks for non-college-educated males
χ_m^e	$[-243.3, -44.6]$	min and max of marital shocks for college-educated males
χ_f^u	$[-5.52, 0.40]$	min and max of marital shocks for non-college-educated females
χ_f^e	$[-3.58, -1.55]$	min and max of marital shocks college-educated females
	0.64	prob of meeting college-educated conditional on being college-educated
Policy Parameters		
$\left[z_0^A, z_1^A\right]$	$[-0.68, 4.28]$	college enrollment selection mechanism
$[z_0^e, z_1^e]$	$[-1.40, 3.35]$	college completion rates conditional on enrollment
B	0.10	consumption subsidy for welfare recipients
Wages and Premiums		
$[w_0, w_1, w_{cc}]$	$[1, 2.25, 1.09]$	wages for non-college educated and college-educated and child care workers
$[\varrho, \mu]$	$[2.01, 0.89]$	gender gap and work penalty for married mothers
L_b^{hp}	0.19	minimum time on household chores by nonworking married moms

The table lists values of 30 calibrated parameters and one preset parameter γ used in baseline simulations. The min and max of marital shocks for non-college-educated individuals are derived based on the corresponding intervals for college-educated individuals and the differences in variances of marital shocks by gender and by education.

Table 2 Distribution of Education Attainment and Marital and Work Status

	Data		Model	
Panel A				
Fraction of college-educated	0.30		0.28	
Fraction of married parents	0.65		0.64	
	Single	Married	Single	Married
Fraction of college-educated mothers	0.16	0.84	0.16	0.84
Fraction of non-college-educated mothers	0.44	0.56	0.44	0.56
Education assortative matching of Couples				
wife\husband	Uneducated	College Educated	Uneducated	College Educated
Non-College-Educated	0.55	0.11	0.49	0.15
College-Educated	0.11	0.24	0.09	0.27
Panel B				
Fraction of mothers who are working and	Uneducated	College Educated	Uneducated	College Educated
Single	0.21	0.04	0.24	0.04
Married	0.25	0.17	0.30	0.16
Fraction of Work Arrangements among Married				
Nonworking Mothers, husband working	0.30		0.29	
Both Working	0.60		0.71	

The date entries, except for educational compositions within couples, are calculated based on the American Time Use Surveys pooled sample (2003-2017). The data entries on educational compositions are based on Greenwood, Guner, Kocharkov and Santos (2016).

Table 3 Maternal Child Care Time by Marital and Work Status

	Data		Model	
Single Mothers				
	Uneducated	Educated	Uneducated	Educated
Working	9	10	9.7	10.1
Not Working	12	18	10.4	11.0
Married Mothers				
	Uneducated	Educated	Uneducated	Educated
Both Working	11	15	9.9	11.8
Spouse Working	18	23	19.4	20.7

The entries are hours per week spent on child care by mothers of different marital, educational and working status. They are calculated based on the American Time Use Survey 2003.

Table 4 College Enrollment and Completion Rates

	Single Parent	Couple	Couple
	(Uneducated)	(both uneducated)	(at least one educated)
College Enrollment Rates			
Data	0.40	0.54	0.88
Model	0.40	0.54	0.76
College Completion Rates			
Data	0.11	0.19	0.59
Model	0.11	0.23	0.51

The data entries are taken from Blandin and Herrington (2022).

Table 5 Wage Differentials

	Gender Gap	Skill Premium	Wages for Child Care Workers
Data	0.65	2.05	1.10
Model	0.57	2.25	1.07

Table 6 Alternative Parameterization in Counterfactual Experiments

$[z_0^A, z_1^A]$	$[0.25, 0]$	Lottery Admission System
$[z_0^A, z_1^A]$	$[-0.68, 9.42]$	Differential Admission System (preferred group)
$[z_0^A, z_1^A]$	$[-0.68, 1.50]$	Differential Admission System (non-preferred group)
p_{ss}	0.24	No Assortative Matching
χ_m^u, χ_m^e	$[-243.3, -44.6]$	Equal Variances of Taste Shocks for Singlehood (males)
χ_f^u, χ_f^e	$[-3.58, -1.55]$	Equal Variances of Taste Shocks for Singlehood (females)

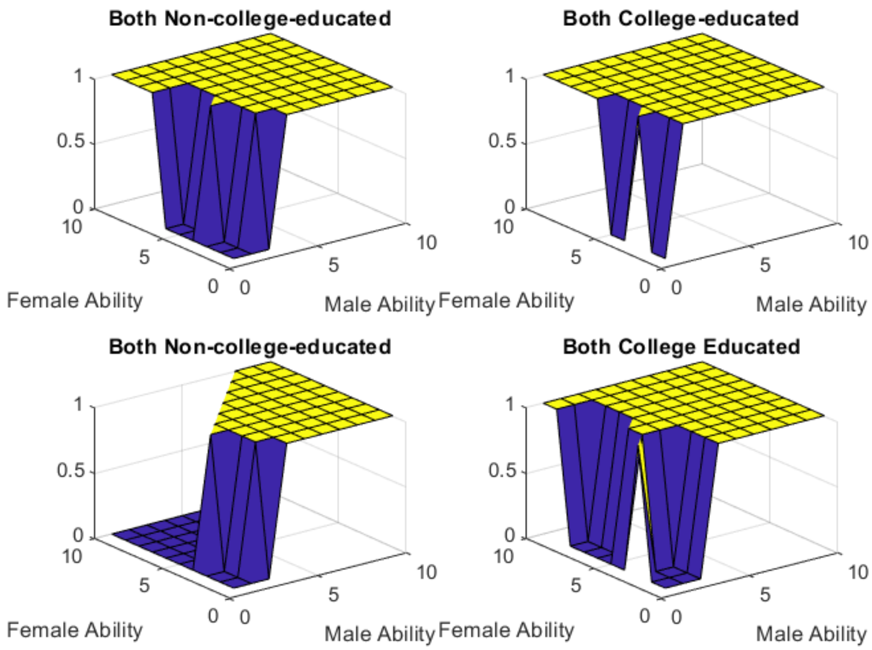
(36)

Table 7 Simulation Results of Counter-Factual Experiments

		Panel A: College Selection		Panel B: Social Engineering	
	Benchmark	Lottery	Differential	Non-assortative	Same Varia
Marriage Rate	0.64	0.59	0.59	0.63	0.96
College Completion Rate	0.28	0.19	0.24	0.24	0.30
College Enrollment Rate by Types					
Type 1	0.40	0.56	0.46	0.40	0.37
Type 2	0.54	0.56	0.68	0.52	0.53
Type 3	0.76	0.56	0.53	0.69	0.72
College Completion Rate by Types					
Type 1	0.11	0.13	0.13	0.10	0.08
Type 2	0.23	0.18	0.27	0.20	0.21
Type 3	0.51	0.30	0.34	0.41	0.45
Fraction of Households for Each Type					
Type 1	0.32	0.38	0.35	0.29	0.04
Type 2	0.32	0.36	0.32	0.28	0.55
Type 3	0.33	0.23	0.26	0.35	0.40
(Below in percentage terms)					
Change in Welfare Gap	0	−2.3	−12.0	−28.2	−35.4
Change in Welfare					
Non-college Educated	0	−3.5	−4.8	5.9	30.9
College-Educated	0	−8.6	−19.4	−13.4	27.1
Overall	0	−9.0	−9.0	1.2	31.1

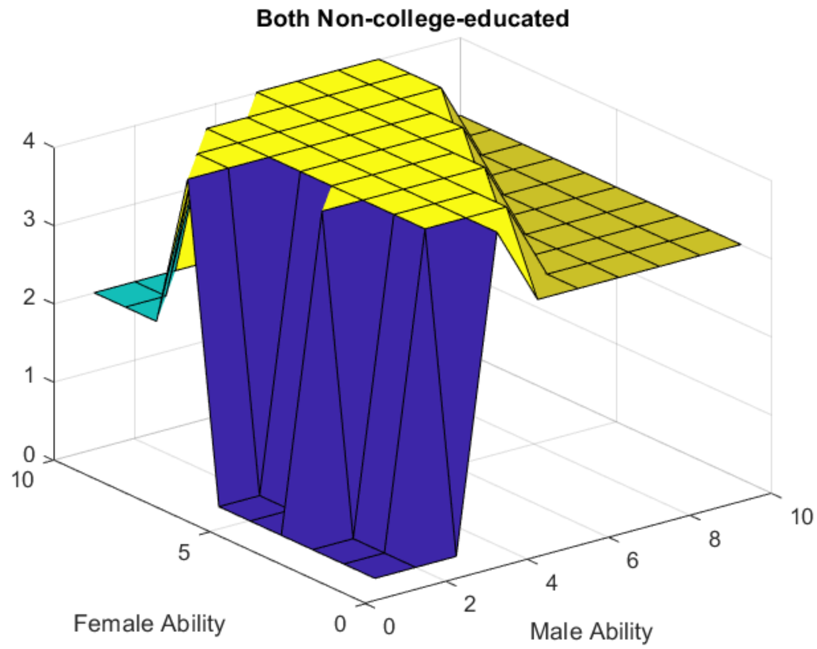
Type 1 represents single, non-college-educated households; Type 2 represents married couples who are both non-college-educated; Type 3 represents married households with at least one college-educated parent.

Figure 1: Marriage Decisions by Education and Ability Type



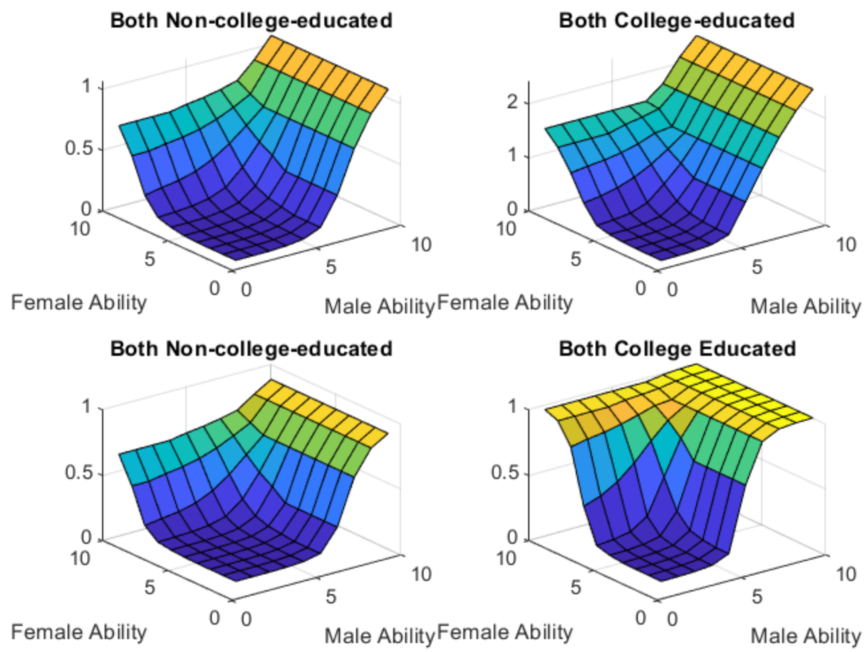
The first row represents Panels A and B from left to right, and the second row represents Panels C and D. Panel A(B) shows marital decisions of two non-college-educated (college-educated) individuals when both are endowed with favorable marital shocks. Panel C shows marital decisions of two non-college-educated individuals with the female endowed with unfavorable marital shocks. Panel D shows the decisions of two college-educated individuals, both with unfavorable marital shocks.

Figure 2: Work Decisions by Education and Ability Type



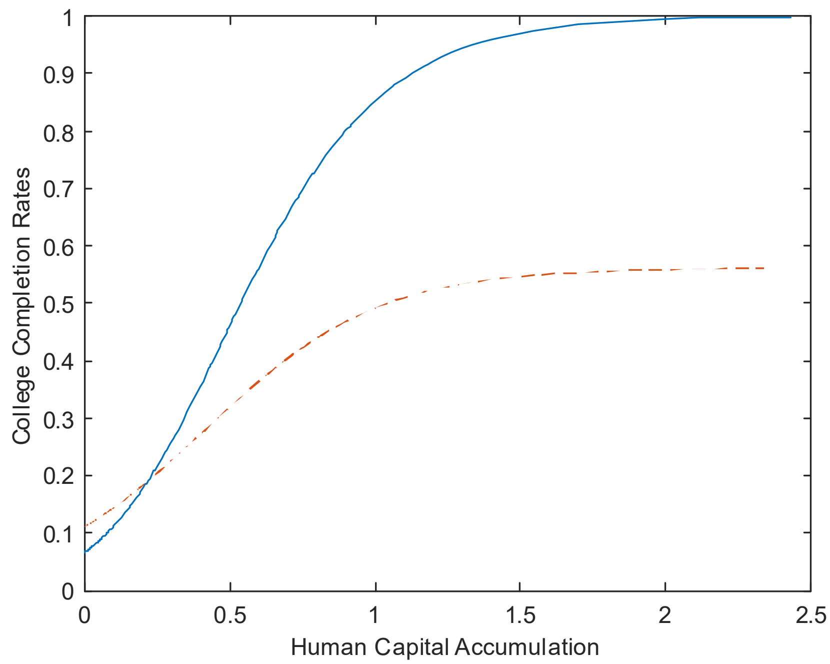
The Figure shows work decisions by two non-college-educated individuals, both with favorable marital shocks. Here work decisions are characterized by dummies. When work decision dummy is equal to 4,it indicates that both spouses work; when the dummy is equal to 3, the husband works but the wife does not; when the dummy is equal to 2, a rare case, the wife works but the husband does not. The spouses do not choose decision 1, which indicates that both spouses do not work. When work decisions are not assigned, it means that the corresponding matches do not result in marriages. For single-mother households, only those with abilities higher than a certain threshold work.

Figure 3: Human Capital Accumulation and College Completion Rates by Education and Ability Type



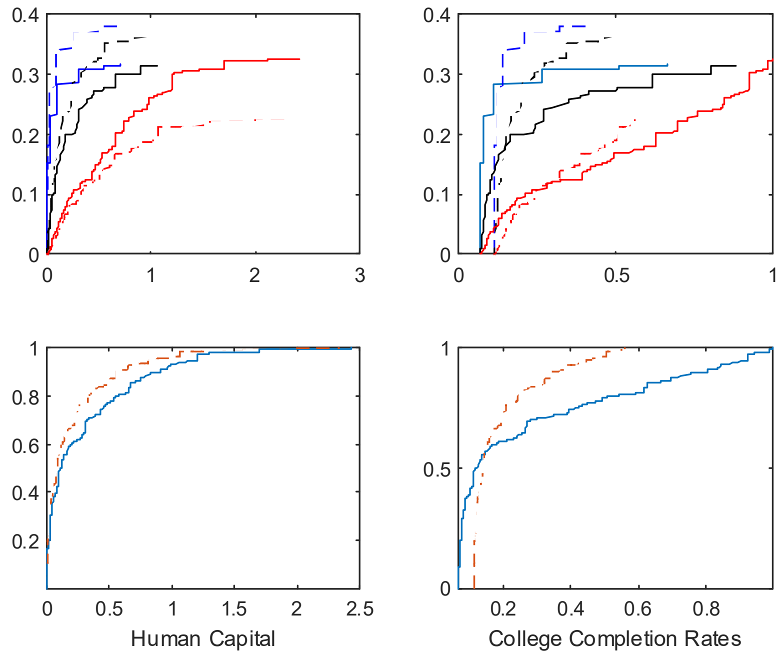
The first row represents Panels A and B from left to right, and the second row represents Panels C and D. Panel A (B) shows amount of human capital accumulation of children by non-college-educated (college-educated) females matching with non-college-educated (college-educated) males, both with favorable marital shocks. Panel C (D) shows college completion rates of children by non-college-educated (college-educated) females matching with non-college-educated (college-educated) males, both with favorable marital shocks.

Figure 4: Lottery Admission System: College Completion Rate versus Q



The figure shows the optimally chosen amounts of human capital accumulation for children and their corresponding college completion rates in the benchmark economy (blue solid) and the economy with a lottery selection mechanism (red dashed). The horizontal axis features human capital accumulated, and the vertical axis features college completion rates.

Figure 5: Lottery Admission System: Cumulative Distributions



The first row represents Panels A and B from left to right, and the second row represents Panels C and D. Panels A and B of the figure show cumulative distributions of human capital accumulated and college completion rates of children in the economy for the three types of households in an economy with a lottery college admission system (dashed) versus those in the benchmark economy (solid). The upper (blue), middle (black), and lower (red) pairs represent respectively the cumulative distributions for the three types of households: single-mother non-college-educated, married non-college-educated and married with at least one parent college-educated. Panels C and D plot cumulative distributions of human capital accumulation and college completion rates in the aggregate, with the solid and dashed lines representing respectively the benchmark economy and the lottery admission case.

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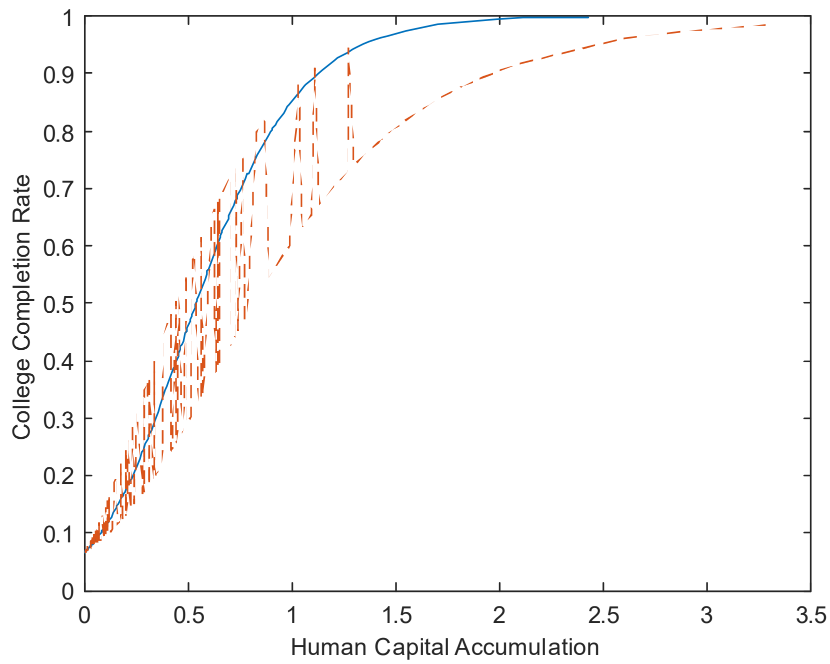
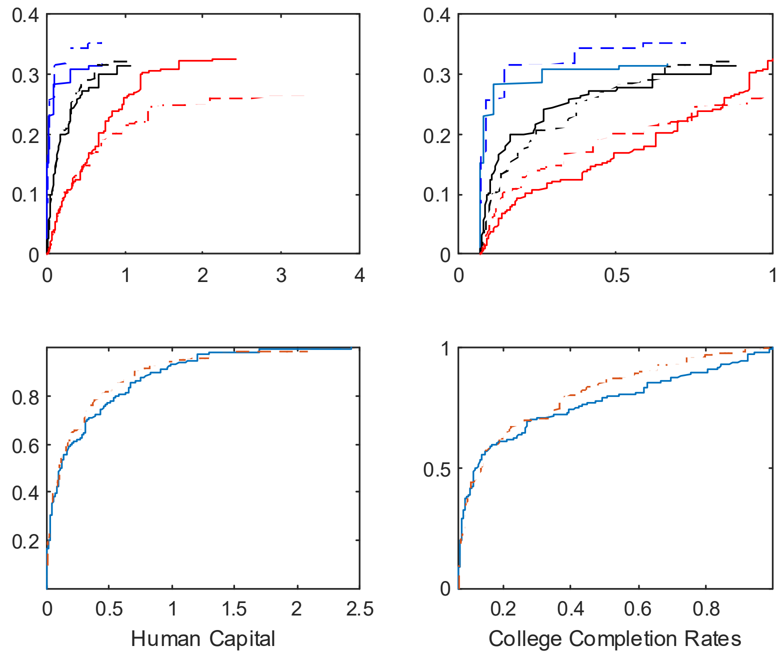
Figure 6: Differential Admission System: College Completion Rate versus Q



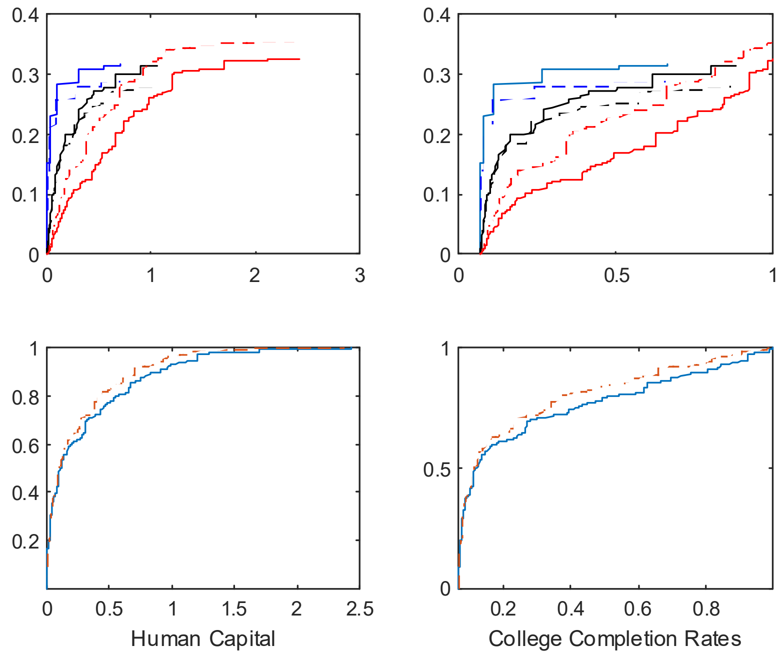
The figure shows cumulative distributions of human capital and college completion rates of children in the economy with a differential college selection mechanism (red dashed) versus those in the benchmark economy (blue solid). The horizontal axis features human capital, and the vertical axis features college completion rates.

Figure 7: Differential Admission System: Cumulative Distribution



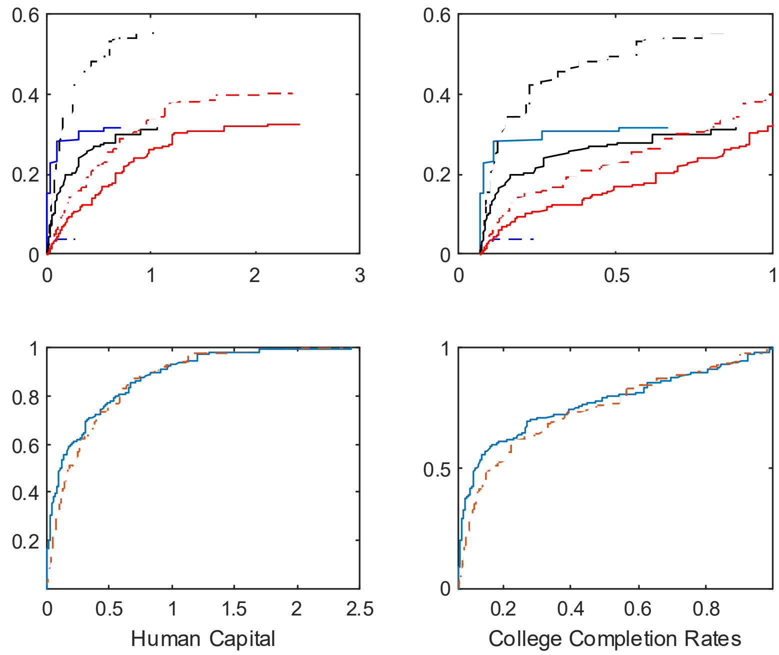
The first row represents Panels A and B from left to right, and the second row represents Panels C and D. Panels A and B of the figure show cumulative distributions of human capital accumulated and college completion rates of children in the economy for the three types of households in an economy with a differential college admission system (dashed) versus those in the benchmark economy (solid). The upper (blue), middle (black), and lower (red) pairs represent respectively the cumulative distributions for the three types of households: single-mother non-college-educated, married non-college-educated and married with at least one parent college-educated. Panels C and D plot cumulative distributions of human capital accumulation and college completion rates in the aggregate, with the solid and dashed lines representing respectively the benchmark economy and the differential admission case.

Figure 8: The Case without Assortative Matching: Cumulative Distributions



The first row represents Panels A and B from left to right, and the second row represents Panels C and D. Panels A and B of the figure show cumulative distributions of human capital accumulated and college completion rates of children in the economy for the three types of households in an economy without assortative matching (dashed) versus those in the benchmark economy (solid). The upper (blue), middle (black), and lower (red) pairs represent respectively the cumulative distributions for the three types of households: single-mother non-college-educated, married non-college-educated and married with at least one parent college-educated. Panels C and D plot cumulative distributions of human capital accumulation and college completion rates in the aggregate, with the solid and dashed lines representing respectively the benchmark economy and the case without assortative matching.

Figure 9: Experiment with Marital Propensity: Cumulative Distributions



The first row represents Panels A and B from left to right, and the second row represents Panels C and D. Panels A and B of the figure show cumulative distributions of human capital accumulated and college completion rates of children in the economy for the three types of households in an economy with equal variances of taste shocks for singlehood (dashed) versus those in the benchmark economy (solid). The upper (blue), middle (black), and lower (red) pairs represent respectively the cumulative distributions for the three types of households: single-mother non-college-educated, married non-college-educated and married with at least one parent college-educated. Panels C and D plot cumulative distributions of human capital accumulation and college completion rates in the aggregate, with the solid and dashed lines representing respectively the benchmark economy and the case with equal variances of taste shocks for singlehood.