What Explains Growing Gender and Racial Education Gaps?

by

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Abstract: In the 1960 cohort, American men and women graduated from college at similar rates, and this was true for Whites, Blacks and Hispanics. But in more recent cohorts, women graduate at much higher rates than men. Gaps between race/ethnic groups have also widened. To understand these patterns, we develop a model of individual and family decision-making where education, labor supply, marriage and fertility are all endogenous. Assuming stable preferences, our model explains changes in education for the '60-'80 cohorts based on three exogenous factors: family background, labor market and marriage market constraints. We find changes in parental background account for 1/4 of the growth in women's college graduation from the '60 to '80 cohort. The marriage market accounts for 1/5 and the labor market explains the rest. Thus, parent education plays an important role in generating social mobility, enabling us to predict future evolution of college graduation rates due to this factor. We predict White women's graduation rate will plateau, while that of Hispanic and Black women will grow rapidly. But the aggregate graduation rate will grow very slowly due to the increasing Hispanic share of the population.

Keywords: Returns to college, parental background, college graduation, education, gender wage gap, assortative mating, labor supply, marriage, fertility

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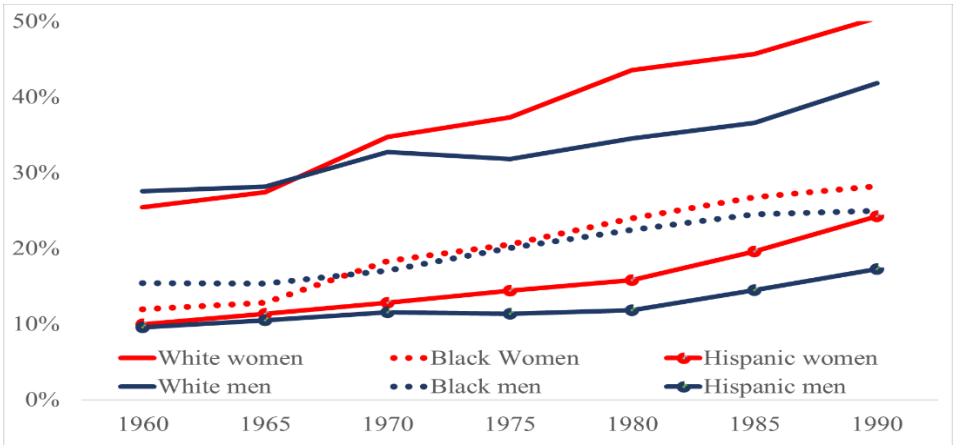
I. Introduction

American men and women in the 1960 birth cohort graduated from college at roughly the same rate, and this was true for White, Black and Hispanic Americans.[1] But in more recent cohorts, women graduate from college at much higher rates than men. The graduation rate of Whites has also increased relative to those of Blacks and Hispanics.

Figure 1 plots graduation rates of men and women, separately for Whites, Blacks and Hispanics, using CPS data on 5-year birth cohorts from 1960 to 1990. Graduation rates have grown substantially *in general*, but they have grown much faster for women. By the 1980 birth cohort, women in all three race/ethnic groups graduated from college at substantially higher rates than men, reversing a gender gap in favor of men that had existed for generations.[2]

Differences across race/ethnic groups are also notable: White Americans graduate at a much higher rate than Black Americans, who in turn graduate at a higher rate than Hispanic Americans. These gaps have expanded: Between the '60 and '80 birth cohorts, the graduation rate of White, Black and Hispanic women grew by 19, 11 and 6 percentage points, respectively, expanding pre-existing gaps between groups. For men, the figures are 9, 8 and 1, respectively, so the gap between White/Black men and Hispanic men grew substantially.

Figure 1: The Growth in the Gender Education Gap



Note: We plot the college graduation rate for 5-year birth cohorts from 1960 to 90.

In this paper, we develop and estimate a structural life-cycle model of education, marriage, fertility and labor supply decisions of men and women and couples that succeeds in capturing all the key patterns in Figure 1, as well as fitting a broad range of other demographic and labor market outcomes. We fit the model to the behavior of the 1960-1980 birth cohorts.

[1] For brevity we henceforth refer to White, Black and Hispanic Americans in the cohorts we study as simply Whites, Blacks and Hispanics. Small samples preclude studying finer categories within these diverse groups.
[2] In the '40 to '50 birth cohorts white men graduated college at an 8 percentage point higher rate than women. This gap closed suddenly in the '55 and '60 cohorts (who started college in about 1973 to 1978). Mechanically, this was driven by a substantial drop in college attendance of men, and a very slight increase for women.

We assume Whites, Blacks and Hispanics have *common preferences* for school, work, marriage and fertility. We let preferences differ by gender, but we hold them *fixed over cohorts*. Thus, we do not use changing tastes for school to explain the growing gender education gap. Nor do we use race/ethnic differences in preferences to explain any patterns in Figure 1.

Our model allows three factors to differ by gender/race and to change across cohorts: First, parental background, which consists of mothers' education, parent's marital status and parent's immigration status. These shift tastes for school, tastes for marriage, and skill in the labor market. The second factor is labor market conditions (job and wage offers). The third factor is marriage market conditions (frequency and quality of marriage offers).

Thus, in our model, the only things that cause *changes across cohorts* in educational attainment like we see in Figure 1 are *changes* in these three factors. Similarly, *differences* in education across race/ethnic groups are solely due to *differences* in parental background, labor market opportunities and marriage market opportunities.

Our model is very successful in explaining the differences in all endogenous variables (education, work, marriage, fertility) by gender/race for cohorts from 1960-80 using only these three exogenous factors, with fixed preferences.[3] Hence, we can use our model to decompose differences in college graduation rates by gender/race/cohort into parts due to each factor.[4]

A brief summary of our results is as follows: Our first main result is that changes in parental background are a key factor driving the growing gender education gap: Children with college educated mothers have greater tastes for (or ability at) college, and this effect is stronger for daughters than sons. Thus, the increase in women's education over time has the knock-on effect of increasing daughter's education relative to sons in the next generation.

The marriage market also contributed: Women's chance of getting marriage offers at older ages has improved, making it easier to defer marriage until after college. In contrast, we find that assortative mating did *not* increase much across the cohorts we study, so this is not an important factor driving the increase in women's college graduation rate.

Labor market returns to college increased in the '60 to '80 cohorts, but they increased twice as fast for women as for men. This factor accounts for about 50% of the increase in their graduation rate.[5] Parental background accounts for about 1/4 and marriage offers 1/5.

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[3] Importantly, the 3 factors cannot adjust freely to explain differences in education, as the model must also match wage, employment and marriage rates. For example, Hispanic men have very low rates of college attendance. The model cannot explain this simply by assuming they have low returns to education, as that explanation is only tenable if it is consistent with the patterns of wages by education level actually observed in the wage data.

[4] We must assume *fixed* preferences across cohorts and race/ethnic groups to do this. If we allowed tastes to vary, we could not attribute the different behaviors across groups and cohorts *solely* to the 3 exogenous factors.

[5] We treat wages as exogenous. Lee and Wolpin (2006) and Johnson and Keane (2013) model changes in the equilibrium wage structure over time that generated increases in women's wages.

As we saw in Figure 1, college graduation rates grew from the ’60 to ’80 cohorts for all race/gender groups. We find the *relative* impact of the three factors is similar across groups. However, absolute impacts are greatest for White women. In particular, labor market returns grew faster for White women than for White men, and they grew more slowly for minorities than for Whites. That is why both gender and races gaps widened from the ‘60 to ’80 cohorts.

Importantly, while women’s labor market returns to college increased faster than men’s over these cohorts, we find that they still lag behind men’s. Thus, the reason women in recent cohorts go to college more than men is not that their labor market return is greater: It is rather that their *overall* rate of return is greater after factoring in both their greater utility from college – arising because they like school more and/or they are better at it – and their greater marriage market returns – arising because finding a college spouse is more valuable for women.

Due to the intergenerational linkage created by parent education, we can use our model to forecast behavior of future cohorts, if labor and marriage market conditions remain stable. In this exercise, we predict the graduation rate of White women peaked with the ’90 to ’00 cohorts, and will plateau at about 53% going forward. That of White men will continue to grow (very) slowly, causing the gap between White men and women to narrow (very) gradually.

In contrast to Whites, we predict college graduation rates of Black and Hispanic women will continue to grow rapidly. For Black women we predict an increase from 28% in the 1990 cohort to 33% in the 2010 cohort, roughly the rate of White women in the 1970 birth cohort. For Hispanic women we predict a large increase from 22% to 29%, which is encouraging. We predict gender education gaps will continue to grow within the Black and Hispanic groups.

Our model implies education gaps between Whites and minorities will persist unless their offer wage functions converge. Conditional on observed education and work experience, offer wages are still higher for Whites. As one way to reduce racial gaps, we use our model to evaluate the impact of providing Blacks and Hispanics with college tuition subsidies. Large subsidies would be required to equalize their educational outcomes with Whites.

We also quantify how subsidies impact the next generation, as mother’s education affects skills/tastes of their children. E.g., We predict a tuition subsidy of $12.9k per year would increase the graduation rate of Hispanic women by 5.1 pp, and cause that of their daughters to increase by 3.5 pp, and their sons by 2.1 pp. So there is substantial passthrough to children.

Because we model all major US demographic groups, we can also predict how the aggregate graduation rate will evolve in the future. We predict from the ‘90 to ‘10 cohorts college graduation rates will increase for all groups, ranging from 7 pp for Hispanic women to 2 pp for Black men. But the *aggregate* rate will increase very little, due to the increasing share of Hispanics – who have lower graduation rates than other groups – in recent birth cohorts.

Our model is similar to Eckstein, Keane and Lifshitz (2019), henceforth EKL. But we extend EKL to explain behavior of Black and Hispanic men and women – which differs tremendously from Whites, not just in education choices but in many other dimensions as well. Our challenge is to find a *parsimonious* generalization of EKL that can explain these behavioral differences, both *across* race/ethnic/gender groups and *within* these groups *over time*.

We extend EKL in three other important ways: First, we let the distribution of labor market skill endowments depend not only on parents' education but also on their marital status and immigration status. This accommodates in a simple way the possibility that investments in child development may be greater in couples than in single parent families, and that the impact of parent education may differ depending on whether education was obtained in the US.

Second, we introduce inter-generational persistence in tastes for marriage by letting taste for marriage depend on parents' marital status. Marriage rates differ substantially across Whites, Blacks and Hispanics, which in turn generates differences in both skill endowments and tastes for marriage among their children. This is important for our model to explain the persistent behavioral differences across the three groups.

Third, we include welfare participation as an additional choice. The welfare reform of 1996 made welfare receipt more difficult by imposing work requirements and time limits on recipients. We model the reform as introducing a 5-year time limit on benefit receipt. And we model work requirements parsimoniously as increasing the fixed cost of welfare participation.[6] The impact of welfare programs on behavior depends on both skill endowments and marriage market opportunities. As these differ across Whites, Blacks and Hispanics, the impact of welfare on the behavior of the three race/ethnic groups may differ as well.

The outline of the paper is as follows: In Section II we review the literature. Section III presents our model. Section IV describes solution, estimate and model fit. The model provides an excellent fit to behavior of the '60, '70 and '80 cohorts, and the '90 cohort in an out-of-sample validation. Section V discusses parameter estimates. Section VI presents calculations of the option value of college. Section VII presents decompositions of education differences across gender/cohort and race/ethnic groups into parts due to the three exogenous factors. Section VIII presents our forecasts of future education levels. Section IX presents education subsidy experiments aimed at equalizing opportunity across groups, and Section X concludes.

[6] In related work, Blundell, Costas Dias, Meghir and Shaw (2016) model how welfare reform in the UK affected education choices of women, and their subsequent labor supply, but they do not model marriage and fertility choices (which are treated as exogenous processes). Low, Meghir, Pistaferri and Voena (2018) model effects of the 1996 US welfare reform on labor supply in a model with endogenous marriage, but they do not model effects on education or fertility.

II. Background and Literature Review

Several papers explore reasons for the increase in women's education relative to men: Becker, Hubbard, Murphy (2010a,b), Sanchez-Marcos (2008), Leukhina and Smaldone (2022), and Cervantes and Cooper (2023) emphasize increasing labor market returns to education for women. Goldin, Katz and Kuziemko (2006) emphasize contraception, delayed fertility and marriage, and changing ambitions of women. Ge and Yang (2013) argue higher divorce rates made college relatively more valuable for women. Greenwood, Guner, Kocharkov and Santos (2016) emphasize better home production technology. Eckstein, Keane and Lifschitz (2019), or EKL, argue that increasing returns to education in both marriage market and labor markets, as well as family background, were all important factors.

Our innovation is to analyze the changes in education by cohort/gender/ethnicity shown in Figure 1 in a unified framework where education, marriage, fertility and labor supply are all endogenous. Parental background plays a key role in our model: It affects skill endowments at age 16, tastes for school, and tastes for marriage. This is consistent with a large literature in economics that emphasizes the important impact of family background on investments in both cognitive and non-cognitive skills of children – see, e.g., Heckman and Masterov (2004), Cunha, Heckman, Lochner and Masterov (2006), Todd and Wolpin (2007), Cunha and Heckman (2008), Fiorini and Keane (2013), Attanasio et al (2022).

Our emphasis on mother's education as a driver of child skills is consistent with work by Sayer et al (2004), Guryan, Hurst and Kearney (2008), Kalil, Ryan and Corey (2012) and Potter and Roska (2013) showing college educated mothers spend more time in educational activities with children, and by Carneiro, Meghir and Parey (2013) who find causality from mother education to child skills. Prior work modeling the impact of parental education on children's college attendance includes Cameron and Heckman (2001), Keane and Wolpin (2001), Abbott, Gallipoli, Meghir and Violante (2019) and EKL. These papers emphasize that parents' education matters for several reasons: 1) higher ability parents tend to have higher ability children (both via genetics and larger investments in child development), 2) college education parents make larger transfers to finance college, and 3) better educated parents may influence children's taste for school, either directly, or via investments that enhance non-cognitive skills like self-discipline and persistence.

Table 1 shows that differences in parental background across cohorts and ethnic groups are substantial, so they may be an important factor driving differences in education. The table shows the fraction of children whose mothers were college graduates is much greater for Whites than for Blacks or Hispanics, and it has increased substantially over time for all three

groups. For example, for Whites, it increased from 14% in the 1960 birth cohort to 38% in the 1990 cohort. Of special importance for Hispanics is that the percent with U.S. born parents increased substantially over cohorts – See Table 1, last column. This may have improved education prior to age 14, leading to better initial skill endowments. It may also imply changing tastes for education on the part of both parents and children.

Table 1: Mother's Education, Marital Status and Immigration Status by Cohort

	White		Black		Hispanic		
Cohort	% of CG+PC mothers	% of single mothers	% of CG+PC mothers	% of single mothers	% of CG+PC mothers	% of single mothers	% of US born mothers
1960	14.0%	6.4%	6.0%	37.0%	7.0%	12.7%	42.0%
1970	24.0%	11.8%	12.0%	48.9%	8.0%	18.6%	44.0%
1980	26.0%	18.7%	13.0%	61.5%	11.0%	25.9%	52.0%
1990	38.0%	26.6%	19.0%	67.6%	14.0%	31.1%	75.0%
2000	45.0%	21.7%	25.0%	69.8%	17.0%	33.2%	
2010	51.0%	21.9%	28.0%	74.5%	23.0%	40.0%	

Note: The table reports the % of college graduate mothers (two decades earlier at age 30), and the % of single mothers (two decades earlier at ages 23-30), both taken from CPS data. The % of US born Hispanics is taken from the American Community Survey.

The fraction of children born into single mother households also differs substantially across ethnic groups and cohorts. For Whites, it increased from 6% in the 1960 cohort to 27% in the 1990 cohort. The rate for Hispanics is about 5 points higher. For Blacks the prevalence of single mother households is much higher: it increased from 37% in the 1960 cohort to 68% in the 1990 cohort. Table 2 shows that having a college graduate mother increases probability of college attendance while having a single mother reduces it, but the association is stronger for Whites and Hispanics than for Blacks.

Table 2: Association of College Graduation with Mother Education and Marital Status

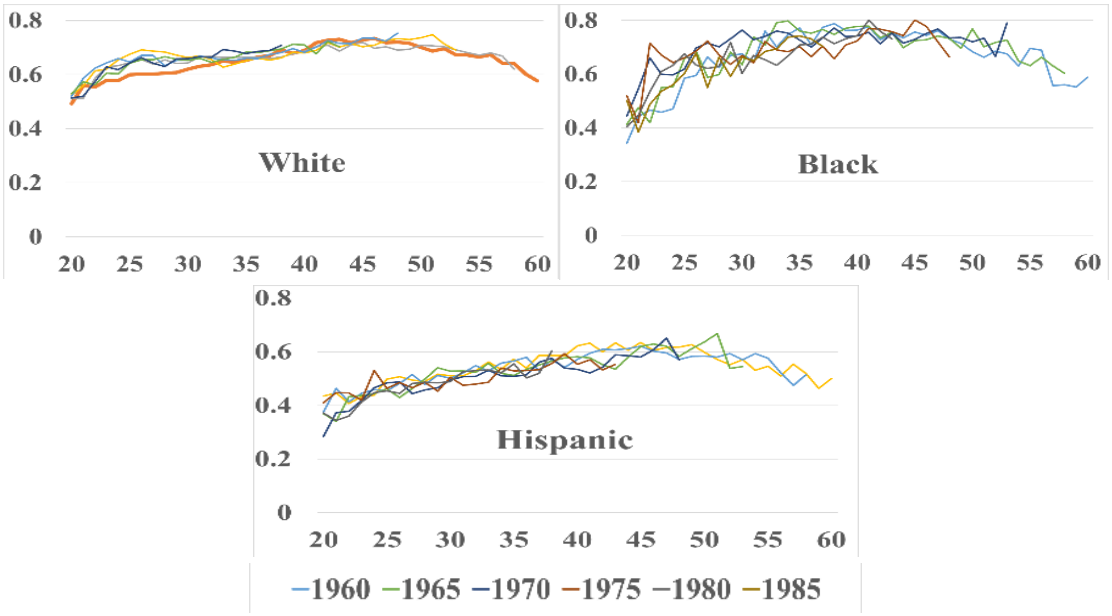
	White		Black		Hispanic	
	Men	Women	Men	Women	Men	Women
Single mom	-0.565***	-0.656***	-0.160	-0.366	-0.648**	-0.492*
	(0.17)	(0.16)	(0.26)	(0.22)	(0.24)	(0.23)
College mom	1.141***	0.922***	0.340	0.423*	0.925**	1.539***
	(0.18)	(0.19)	(0.25)	(0.20)	(0.30)	(0.32)

Note: NLSY97 data. Dependent variable: college graduation by age 30. We control for income in childhood, age of mother, year of birth, geographical variables.

Aside from changes in parent background, a second factor may drive the increase in women's education is improved labor market opportunities. One potential explanation is that women are investing more in human capital because they are forward-looking and expect to work more. But this is inconsistent with the data. Figure 2 shows employment rates of married women have been remarkably stable since the 1960 cohort. As we showed in EKL, Figure C1,

employment of married women increased dramatically from the '25 to '60 birth cohorts, but then stabilized. So increased employment plays a key role in explaining growth in women's education prior to the '60 cohort, but not since. A key challenge is to explain substantial *increases* in women's education in more recent cohorts while holding their employment *fixed*, using *fixed* preferences for leisure across cohorts.

Figure 2: Married Women's Employment over the Life-Cycle, by Birth Cohort



Note: CPS data on 5-year birth cohorts from 1960 to 1985.

Despite the fact that women's employment did not increase, we find evidence that their offer wage functions improved, both in terms of starting wages and returns to education and experience. This is an obvious potential factor increasing women's college attendance, as noted by Cervantes and Cooper (2023). But a key challenge for our model is to reconcile the higher wages and education of women with the stability in women's employment.

The third factor we consider is changing marriage market opportunities. Our work is somewhat related to papers by Chiappori, Salanie and Weiss (2017), and Chiappori, Costa-Dias and Meghir (2018) that study how returns to education in the marriage market have increased for women over time. However, the former takes education as given, while the latter considers a three-period model with education chosen first, followed by marriage, and then labor supply. The timing structure of these models does not allow them to assess how changes in marriage offer probabilities by age affects education choices, a factor that we find to be important (see below). Our work is more closely related to sequential choice models of education, marriage and labor supply in Ge (2011) and Keane and Wolpin (2010). The marriage may also incentivize higher education if assortative matching on education increased. But to preview our results we find this is not very important.

III. A Life-Cycle Model of Education, Labor Supply, Marriage/Divorce and Fertility

Our model is similar to EKL in many respects. So we focus on the new features we add, especially those most relevant to explain differences between Whites, Blacks and Hispanics. We expand the definition of parental background, *PB*, to include not just parent education, *PE*, but also parent marital status, *PM*, and immigration status, *PI*. We emphasize how school and marriage decisions are affected by parental background, and how labor/marriage market opportunities vary by gender, cohort and race/ethnicity. We add welfare participation as a choice, and let welfare rules to vary over time. We present the complete model in Appendix A.

III.A. School Decisions – Role of Parental Background

All people start out single and in school at age 16, at education level E_t = <HS, less than a high school degree. The first decision period is age 17, when they decide whether to stay in school (s_t = 1) or enter the labor market. If a they stay in school for 2 years they become a high school graduate (HSG). If they stay for 6 years they become a college graduate (CG), while 3 to 5 years leaves them at the some college (SC) level. If they stay in school for 7 or more years they attain the "post-college" (PC) level.

Let U_{ijt}^{S} denote the payoff to school attendance for person *i* of gender *j*=*m*,*f* at age *t*:

$$(1) \qquad U_{ijt}^{S} = \alpha_{0j} + \alpha_{1j} I(PE_i \geq CG) + \alpha_{2j} \mu_i^W(PB_i) + \alpha_{3j} \cdot I(E_{it} > HSG)$$

We let the intercept α_{0j} differ by gender, so men and women may get different utility from school. This is consistent with large literatures in both economics and sociology arguing girls like school better than boys, or find school less difficult, perhaps because they have more self-control. See for example, Becker, Hubbard and Murphy (2010a, b), Autor et al (2016), Heckman and Masterov (2004), Jacob (2002) and Voyer and Voyer (2014).[7]

A key aspect of our model is that mother's education *PE* shifts tastes for school. This is captured by parameter α_{1j} that multiplies the indicator $I(PE_i \geq CG)$ for mother having a college degree. Parental education may affect tastes for school directly, or it may affect ability at school, and hence the effort required for success. The important role of parental background in developing non-cognitive skills that increase school performance and the chances of college graduation is in line with findings of Heckman, Stixrud and Urzua (2006). More educated parents also make larger financial transfers to support students in school – see Keane and Wolpin (2001) and Abbott et al (2019). And the sociology literature suggests that more

[7] Interestingly, Becker et al (2010a, b) argue that women find school less difficult than men, which causes them to have a higher elasticity of supply to college. Hence, they respond more than men to a given increase in the return to college. They propose this as a reason for the increase in the gender education gap.

educated parents are more involved with children's schooling and impart higher educational expectations – see, Coleman (1988), Lareau (2003), Davis-Kean (2005). All these factors are also subsumed in α_{1j}, which we call a "taste shift" for simplicity.

As in Keane and Wolpin (1997), a key aspect of the model is the unobserved skill endowment at age 16, denoted $\mu_i^W(PB_i)$. This is identical to the labor market skill endowment that enters the offer wage function in equation (2) below. By entering the skill endowment in (1) we capture that taste for school (or ability at school) may be correlated with labor market skill. We allow the distribution of the skill endowment to depend on parental background, *PB*, as we explain in detail in Section II.C below. We are not aware of prior structural work that models the impact of parents' marital status (i.e., coming from a dual parent family), or parents' immigration status, on labor market skill and ability at school. We find this feature is very important for explaining differences between Whites, Blacks and Hispanics.

Finally, the parameter α_{3j} captures utility of college relative to high school, net of college tuition. We cannot identify a separate tuition cost parameter, as we do not use data on actual tuition. Also, we do not attempt to model details of the financial aid system in this paper.

III.B. Decisions that lead to Exit from School (Work, Marriage, Pregnancy)

In our model a decision to work, get married, or become pregnant all require exit from school. Once a person has left school he/she cannot return, and we rule out school after age 30.

Workers are endowed with a unit of time, split between market work (h), and leisure (l), so $h_t^j + l_t^j = 1$. They may work full-time, part-time, or not at all, $h_t^j \in \{1, 0.5, 0\}$. Single men and women may receive marriage offers, and make marriage decisions $M_t \in \{0,1\}$. In addition, women (single and married) make a decision about pregnancy, $p_t \in \{0,1\}$, and single women with children may decide to participate in a welfare program, $g_t \in \{0,1\}$.

III.C. The Labor Market

III.C.1. Wage Offer Function

The wage offer function has a standard Mincer (1974) form:

$$lnw_{itE}^{j,r,c} = \beta_{1E}^{j,r,c} + \beta_{2E}^{j,r,c} X_{it} - \beta_{3E}^{j,r,c} X_{it}^2 + \mu_i^W(PB_i) + \varepsilon_{it}^W \quad (2)$$

where X_t is work experience (years), $E \in \{< HS, HSG, SC, CG, PC\}$ is education level, μ_i^W is a latent skill endowment, and we have transitory wage shocks $\varepsilon_{it}^W \sim iidN(0, \sigma_\varepsilon^W)$.

Different labor market opportunities are a key factor driving different behavior by gender, race/ethnicity and cohort. Hence, we let the wage function parameters $\beta_{kE}^{j,r,c}$ vary freely by education, *E*, gender, *j*, race/ethnicity, *r*, and cohort, *c*. The intercepts capture how starting

wages differ across types, while the slopes capture how returns to experience differ. We allow returns to experience to differ by education, as several studies (e.g., Imai and Keane, 2004, Blundell et al., 2016) find greater experience returns for more educated workers.

At a given education level, (2) allows both starting wages and returns to experience to differ by gender and race/ethnicity, capturing two potential dimensions of discrimination. But discrimination is not the only explanation: Different intercepts or slopes by gender may capture that males and females of a given age/education are not perfect substitutes in production, so rental rates on male/female labor differ; see Johnson and Keane (2010). Differences in intercepts for different race/gender groups may capture different skill endowments at age 16, arising due to differential human capital investment at younger ages, as in Keane and Wolpin (1997, 2000), and different returns to experience may reflect different occupation choices.

We let parameters vary by cohort to allow for changes in the wage structure over time, particularly changes in returns to education/experience and relative wages between men and women and between race/ethnic groups. A key aspect of our paper is to understand how these changes in wage structure have led to changes in college graduation.

The time-invariant error component μ_i^W is the agent's skill endowment at age 16, as in Keane and Wolpin (1997). We allow for three skill levels (low, medium, high). A key aspect of our model is that the distribution of skill endowments differs by parental background $PB = \{PE, PM, PI\}$. *PE* is the mother's education level, *PM* is a 1/0 indicator for dual parent household, and *PI* is a 1/0 indicator for parents being native born. In our model immigration status is only relevant for Hispanics. We assume that *PI*=1 for all Whites and Blacks. But for Hispanics *PI*=1/0 with a probability that depends on the fraction of mothers born in the US for each cohort – see the last column of Table 1.

III.C.2. Distribution of Skill Types

The probability a person is each of the three skill types is determined by a multinomial logit (MNL) with the latent indices that depend on *PE, PI* and *PM*:

$$
\begin{aligned}
L_i^{High} &= \eta_0^H + \eta_1^H \cdot I(PE_i \geq CG) \cdot PI_i + \eta_2^H \cdot PM_i + \epsilon_i^H \\
L_i^{Medium} &= \eta_0^M + \eta_1^M \cdot I(PE_i \geq CG) \cdot PI_i + \eta_2^M \cdot PM_i + \epsilon_i^M
\end{aligned} \tag{3}
$$

where we normalize $v^{Low} = \epsilon^L$ for identification and where the ϵ vector is *iid* extreme value. We expect to find that $\eta_1^H > \eta_1^M > 0$, indicating that a person whose mother was a college graduate is more likely to be the high skill type. Notice that the indicator for having a college graduate mother is interacted with the indicator for having a native-born mother. In effect we are assuming that education obtained abroad is less valuable in the US labor market.

We also expect to find that $\eta_2^H > \eta_2^M > 0$, indicating that a person who comes from a dual parent household is more likely to be the high skill type. Thus, equation (3) accounts for intergeneration transition of ability, as well as different levels of child investment by parents of different education levels, or in dual vs. single parent households.

Crucially, we do not let parameters of (3) differ by gender, or by race/ethnicity, or by cohort. Thus, we impose the strong assumption that the mapping from *PB* to skill is <u>invariant</u> to cohort, race/ethnic group and gender. Given this assumption, we can identify effects of parental background on the skill endowment. Of course, given a single cohort and race/ethnic group, we could only estimate how *PE, PI* and *PM* are *correlated* with skill type, and we could not infer causality. But, given multiple cohorts/groups, and given the crucial assumption that (3) is invariant, we can identify how changes (differences) in *PB* lead to changes (differences) in the distribution of skill types across cohorts/groups. This is why we assume the distribution of latent ability *conditional* on *PB* is invariant to race/ethnicity, cohort and gender.

III.C.3. The Labor Market – Job Offers

The other important aspect of labor market opportunities are job offers probabilities. First, we assume an employed individual ($h_{t-1}>0$) has the option to keep his/her previous job, unless an exogenous separation occurs. Separation is determined by a logit with latent index:

$$S_{it} = \gamma_{0,jrc} + \gamma_{1,jrc} e_t + \gamma_{2,jrc} X_{it} + \gamma_{3,jrc} H_{it} + \epsilon_{it}^S \quad (4)$$

Here $e_t = 1, \ldots, 5$ corresponds to the five education levels in ascending order, X_t is work experience and H_t is health. A separation occurs if $S_{it} > 0$. We let the parameters of the separation function differ by gender, race/ethnicity and cohort.

In each period, people who were unemployed at the start of the period ($h_{t-1} = 0$) receive full- and/or part-time job offers probabilistically. Thus, their possible choice sets for hours are $D_t = \{0\}$, $\{0, 0.5\}$, $\{0,1\}$ or $\{0, 0.5, 1\}$. Probabilities of getting full-time and part-times offers are determined by (separate) logit models with latent indices of the form:

$$O_{it}^k = \phi_{0,jrc}^k + \phi_{1,jrc}^k e_t + \phi_{2,jrc}^k X_{it} + \phi_{3,jrc}^k H_{it} + \epsilon_{it}^O \quad \text{for} \quad k=PT, FT \quad (5)$$

where k=FT,PT denote full- and part-time, respectively. A full-time offer is received if $O_{it}^{FT} > 0$, and a part-time offer is received if $O_{it}^{PT} > 0$. We let the parameters of the offer function differ by gender, race/ethnicity and cohort.

By letting job offer probabilities depend on work experience and lagged employment (as workers employed last period are very likely to receive an offer to remain in the same job), we capture that agents who leave the labor force may find it difficult to obtain job offers later.

III.D. The Marriage Market

III.D.1. The Probability of Receiving Marriage Offers

The men and women in the model interact in a marriage market. They can choose to form (and later dissolve) couples. Once a couple is formed, decisions about labor supply and fertility are made jointly, as explained in Appendix A.3. We explain how we model the marriage market in detail in Appendix A.5. We let both the frequency and quality of marriage offers differ by gender, race/ethnicity and cohort. This is the third key factor – along with differences in parental background and labor market opportunities – that explains differences in behavior across demographic groups and over time in our model.

At the start of a period a single individual may receive a marriage offer. Denote the probability of receiving an offer as $p_j^H(\Omega_{jt})$ for $j = f, m$. It is determined by the logit model:

$$O_{it}^M = \delta_{0,jrc} + \delta_{1,jrc} \cdot t + \delta_{2,jrc} \cdot t^2 + \epsilon_{it}^M \tag{6}$$

where the probability of receiving an offer depends on age and age-squared. We let the coefficients differ by gender, race/ethnicity and cohort. Importantly, we find the age effects differ by gender, as offer probabilities decline with age more quickly for women. We allow for separate offer probabilities when a person is below 18 or still in school.

A particularly important difference between groups is that Black women are much less likely to receive marriage offers than White and Hispanic women. As we will see, this has an important impact on several aspects of their behavior, including education choices.

III.D.2. The Quality of Marriage Offers: Education of Potential Spouses

In our model, the most important aspect of a marriage offer is the education level of the potential spouse. The probabilities that different education levels are drawn are determined by a multinomial logit. To simplify this logit, we assume it generates only three possible levels of education: high-school and below (HS, *ed = 0*), some college (SC, *ed = 1*) or college and above (C, *ed = 2*). Thus, if a person gets a marriage offer, we draw the potential partner's education using a multinomial logit with the latent indices:

$$\begin{aligned} P_{jt}^C &= \psi_{0,jrc}^C + \psi_{1,jrc}^C \cdot I[ed^m - ed^f = 2] + \psi_{2,jrc}^C \cdot I[ed^m - ed^f = 1] + \epsilon_{it}^C \\ P_{jt}^{SC} &= \psi_{0,jrc}^{SC} + \psi_{1,jrc}^{SC} \cdot I[ed^m - ed^f = 1] + \epsilon_{jt}^{SC} \end{aligned} \tag{7}$$

High school is the base case with $v_{jt}^{HS} = 0$. In order to generate offers at all 5 education levels, we then then split the “HS” draws into >HS and HSG draws, and we split the "C" draws into CG and PC offers. This is based on the relative frequency of these education levels in the data.

The parameters ψ govern the probability that a person (of given education) receives offers from potential partners with particular education levels. We allow the ψ parameters to differ by gender, race/ethnicity and cohort. This captures how the education distribution of potential partners differs along these dimensions.

Notice that the variables that enter the logit are differences in education levels between the man and women. Thus, the parameters ψ determine the chance that a person receives an offer from a potential partner whose education is above, below or equal to his/her own. We let the parameters differ by gender so we can capture asymmetries, e.g., women may be more likely than men to get offers from potential partners whose education exceeds her own.

The ψ reflect both the supply of potential partners and tastes for partners of different types.[8] Rather than solve explicitly for marriage market equilibrium, we estimate parameters ψ that, when combined with the rest of our model, generate (to a good approximation) the observed distribution of match outcomes between types of partners.[9] Our method of moments estimation algorithm ensures that the assortative mating patterns predicted by the model are very close to those observed in the data.

Crucially, we let the η parameters differ by race/ethnicity and cohort. This captures different supplies of potential partners within each race/ethnic group and over time, as well as different and changing tastes for partners of different education levels.

III.D.3. The Decision to Accept/Reject Marriage Offers

We describe in detail how people decide whether to accept or reject marriage offers in Appendix A.5.2. As we explain there, the gain from accepting an offer must exceed a fixed cost of marriage. A key feature of the present model, not in EKL, is that we let the fixed cost of marriage depend on parents' marital status, *PM*. See Appendix A, equation A26.

We find that people from dual parent households have a lower fixed cost of marriage (or, equivalently, a greater taste for marriage). This introduces inter-generational persistence in marriage rates. This feature is important for explaining the lower marriage rates of Blacks relative to Whites and Hispanics. We view the fixed cost of marriage as a preference parameter, so like other preference parameters it is not allowed to vary by race/ethnicity or cohort. It only varies as a function of *PM*.

[8] For example, suppose men have a strong preference for partners with similar education. Then a HS woman may have little chance of receiving an offer from a college man, regardless of the supply of college men.

[9] Our ψ are reduced form parameters that implicitly combine (i) structural parameters of preferences for types of partners with (ii) endogenously determined supplies of partners. This approach has two key advantages: (1) It greatly simplifies estimation of the model relative to a case where we solve explicitly for the marriage market equilibrium, and (2) it allows us to avoid making detailed assumptions about how the marriage market works. The downside, is that we must assume the ψ are invariant to any policy experiments we may consider.

III.E. Welfare Benefits

A key distinction between our model and EKL is we add welfare as a choice and model time limits. These features are potentially important for explaining differences in labor supply behavior between White and minority women. Aside from parental background, labor market opportunities and marriage market opportunities, another feature of the environment that changes over time are the welfare benefit rules and tax rules – see Appendices B.3 and C.

We assume that a single mother with N_t children and income $w_t^f h_t^f$ is eligible for a welfare benefit $wb_t(\cdot)$ given by the function:

$$(8) \qquad wb_t\left(N_t, w_t^f h_t^f, G_t\right) = \begin{cases} \lambda_{0t} + \lambda_{1t} N_t + \lambda_{2t} w_t^f h_t^f & if \quad G_t < 5 \; or \; year < 1996 \\ 0 & if \quad G_t > 5 \; and \; year > 1996 \end{cases}$$

The $wb_t(\cdot)$ function is designed to capture the array of benefits targeted at single mothers in the US. These include AFDC/TANF, public housing, childcare subsidies, etc. Rather than model the detailed rules of these programs, we treat $wb_t(\cdot)$ as an exogenous stochastic process that we fit from data prior to estimation. The state variable G_t is number of years the woman has received benefits in the post-1996 period and prior to age t. We assume there is a 5-year time limit on welfare receipt beginning in 1996. See Appendix B.3 for more details.

Importantly, the benefit rule $wb_t(\cdot)$ provides a natural exclusion restriction in our model. It affects behavior of single women *directly* through the budget constraint, but it only affects behavior of married women, and all men, *indirectly* through the marriage market and household bargaining.

III.F. Value Functions of Single Men and Women

We can now write the choice-specific value function for single females. We let Ω_{ft} denote her current state. We assume for now the women chooses to stay single, and conditional on staying single she chooses school, labor supply, pregnancy and welfare participation:

The per-period utility function of a single female is given by:

$$(9) \; V_t^f\left(s_t, l_t, p_t, g_t | \Omega_{ft}\right) = \left(\frac{1}{\alpha}(C_t)^\alpha + L_j(l_t) - \Psi g_t + \pi_t p_t + A_f^s Q(l_t, 0, Y_t, N_t)\right)(1 - s_t) + U_{ijt}^S s_t + \delta E_{MAX} V(\Omega_{f,t+1})$$

Note that if she is in school (s_t = 1) she gets the utility from attending school U_{ijt}^S, while if she is out of school her utility depends on consumption, leisure, welfare participation and children via the term $\frac{1}{\alpha}(C_t)^\alpha + L_j(l_t) - \Psi g_t + A_f^s Q(\cdot)$. We now explain these terms in more detail:

The first term in (9) is a CRRA in consumption with curvature parameter α. Consumption is determined by the budget constraint that we explain in Appendix A2.1. The

second term, $L_j(l_t)$, captures the value of leisure and home production. The third term Ψ is a disutility of welfare participation. The fourth term captures the utility (or dis-utility) from a pregnancy ($p_t = 1$), and the fifth term captures utility from the quality and quantity of children $Q(\cdot)$. We explain all these terms in detail in Appendix A2.2.

The term δ is the discount factor and $E_{MAX}V(\Omega_{f,t+1})$ is the expected maximum of the t+1 value function, given the next period state $\Omega_{f,t+1}$ that is determined by the current state Ω_{ft} and the current choice $\{l_t, p_t, s_t, g_t\}$, as well as random factors.

One of these random factors is whether the woman receives a marriage offer at t+1, and whether that offer is good enough for her to decide to get married. The Emax function takes into account that the person may get married at t+1. It takes the form:

$$(10)\quad E_{MAX}V(\Omega_{f,t+1}) = E_{MAX}\left(M_{t+1}V_{t+1}^{fM}(\Omega_{m,t+1}, \Omega_{f,t+1}) + (1 - M_{t+1})V_t^f(\Omega_{f,t+1})\right)$$

Notice that if $M_{t+1} = 0$ the future value function is simply $V_t^f(\Omega_{f,t+1})$. But if $M_{t+1} = 1$ then the future value function is V_{t+1}^{fM} where the superscript *fM* denotes the value function of a married women. We explain the value functions for married men and women in Appendix A.3, and the marriage decision in detail in Appendix A.5.

The choice-specific value functions $V_t^m(l_t, s_t|\Omega_{mt})$ for single men are analogous, except they do not have the welfare participation (g_t) and pregnancy (p_t) options, so the $-\Psi g_t + \pi_t p_t$ term drops out. And utility from children is $Q(0, l_t, Y_t, N_t)$.

III.G. Summary

Given the large number of parameters in the wage/job offer/marriage offer functions, which we allow to differ by gender/race/cohort, we expect the model to fit wages, employment and marriage market matching very well. But it is important to emphasize that nothing in the school payoff (1) varies by race/cohort, and nothing in (1) changes differentially by gender over time. Hence, it is not at all obvious that our model can obtain a good fit to education by gender, race and cohort. We will only succeed if the model is able to explain different education choices by gender/race, and how these change over cohorts, solely as a function of changing economic incentives (coming from the labor/marriage market changes and the changes in tastes/skills induced by changing parental background) – while holding preferences fixed. What is impressive, as we will see below, is that we can fit education by gender/race/cohort very well without needing anything in (1) that varies by race or cohort, or that varies differential by gender over time.

IV. Solution, Estimation and Model Fit

IV.A. Solution

We back-solve the model from age 65 to 17, assuming a terminal value function at age 65, see Appendix F. We stress that we solve the dynamic programming (DP) problems of *individual* males and females. A person solves his/her problem knowing the probabilities of marriage and divorce, and how decisions are made by couples. The state space Ω_{jt} of our DP problem is discrete. The state variables are marital status, number of children, taste for leisure, education, experience, age, the lagged choice, latent skill type and parental background. The state of a married person also includes the state variables of the spouse, and the stochastically evolving match quality, which determines utility from marriage.

Starting at age 17, a single person makes choices knowing how these affect his/her marriage market opportunities. This requires predicting the distribution of potential spouses *conditional* on own age/education. We assume people know these distributions. This is imposed implicitly in estimation by: (i) using the same offer distribution that we fit within the estimation as the distribution that people use to forecast offers, and (ii) requiring that the model based on this assumed distribution provide a good fit to realized assortative mating patterns. This circumvents the need to solve for the spouse offer distribution as an endogenous object that emerges from the marriage market equilibrium, which would be infeasible in a dynamic model as complex as ours. For more details on solution of the model see Appendix D.

IV.B. Estimation

We estimate our model using annual repeated cross-section data from the March CPS from 1962 to 2021. We divide the sample into three groups: Whites, Blacks and Hispanics, and three cohorts born within two years of 1960, 1970 and 1980. We consider only civilian non-institutionalized adults aged 17-65. For out-of-sample validation and forecasting we also use data for cohorts born within two years of 1990, 2000 and 2010. See Appendix B for details.

We use the method of simulated moments (MSM) to estimate the model. As explained in Appendix E, we use simulated life-cycle histories from the model (5000 men and women for each cohort) to generate statistics that we match to the data. Statistics we match include completed schooling, employment rates, annual wages, marriage rates, welfare participation, assortative mating and fertility, for men and women of each ethnic group in the 1960, 70 and 80 cohorts. There are a total of 2736 moments that we detail in Appendix G. This includes 384 moments for each of the three ethnic groups in the 1960 cohort, 304 moments for each group in the 1970 cohort, and 224 moments for each group in the 1980 cohort. The identification of the model is discussed in detail in EKL. The main difference here is that changing welfare rules

over time provide an additional source of exogenous variation. And Section III.C.2 above provides additional discussion of how we identify effects of parental background.

We estimate the model *jointly* for the three cohorts and three ethnic groups, as we assume 89 model parameters are common across cohorts/groups. These common parameters are 48 preference parameters, 24 terminal value function parameters, 9 shock variances, 6 parameters for how ability depends on parent background, and 2 parameters for the distribution of alimony. The 48 preference parameters include tastes for leisure (12), school (7), kids (8), pregnancy (6), marriage (8), welfare (2), divorce (4) and the CRRA in consumption.

We observe cohorts for different age ranges; the last observation is age 61, 51 or 41 for the 1960, '70 and '80 birth cohorts. In simulating the model, we use the mother education and parental marital status rates reported in Table 1. For Hispanics we also use the immigration status: We assume Hispanic mothers not born in the US do not have a college degree.

The wage, job and marriage offer functions differ by race/cohort/gender, generating many parameters. For each of the (3*3*2=18) groups we have 15 wage offer and 12 job offer parameters,[10] giving 27 labor market parameters per group, and 27*18 = 486 labor market parameters in total. For each cohort/race group we have 15 marriage market parameters, giving 15*9 = 135 in total. So the model has 486+135+89 = 710 parameters in total for the 18 cohort/race/gender groups. This is an average of about 39 parameters per group. This is not very large considering the large number of statistics we fit per group.

Table 3: Model Fit to Education by Cohort for Whites, Blacks and Hispanics

	1960		1970		1980		1960		1970		1980		1960		1970		1980	
	White		White		White		Black		Black		Black		Hispanic		Hispanic		Hispanic	
	Actual	Fitted	Actual	Fitted	Actual	Fitted	Actual	Fitted	Actual	Fitted	Actual	Fitted	Actual	Fitted	Actual	Fitted	Actual	Fitted
Men's education distribution at 30																		
HSD	**0.11**	**0.10**	**0.07**	**0.07**	**0.06**	**0.04**	**0.16**	**0.20**	**0.10**	**0.12**	**0.12**	**0.08**	**0.42**	**0.44**	**0.39**	**0.40**	**0.36**	**0.33**
HSG	**0.39**	**0.38**	**0.31**	**0.32**	**0.29**	**0.34**	**0.48**	**0.42**	**0.41**	**0.41**	**0.38**	**0.41**	**0.30**	**0.25**	**0.29**	**0.27**	**0.34**	**0.39**
SC	**0.23**	**0.25**	**0.28**	**0.27**	**0.29**	**0.26**	**0.24**	**0.25**	**0.32**	**0.30**	**0.29**	**0.30**	**0.18**	**0.23**	**0.20**	**0.21**	**0.18**	**0.17**
CG	**0.20**	**0.21**	**0.27**	**0.24**	**0.26**	**0.25**	**0.11**	**0.10**	**0.14**	**0.14**	**0.16**	**0.17**	**0.07**	**0.08**	**0.09**	**0.09**	**0.09**	**0.10**
PC	**0.07**	**0.07**	**0.08**	**0.09**	**0.09**	**0.10**	**0.02**	**0.03**	**0.00**	**0.02**	**0.05**	**0.05**	**0.02**	**0.01**	**0.03**	**0.02**	**0.02**	**0.02**
Women's education distribution at 30																		
HSD	**0.09**	**0.08**	**0.06**	**0.04**	**0.04**	**0.04**	**0.19**	**0.20**	**0.13**	**0.13**	**0.09**	**0.10**	**0.37**	**0.33**	**0.33**	**0.36**	**0.33**	**0.31**
HSG	**0.38**	**0.40**	**0.27**	**0.29**	**0.22**	**0.23**	**0.41**	**0.39**	**0.36**	**0.40**	**0.32**	**0.34**	**0.35**	**0.36**	**0.30**	**0.28**	**0.27**	**0.33**
SC	**0.27**	**0.27**	**0.31**	**0.31**	**0.30**	**0.28**	**0.27**	**0.28**	**0.32**	**0.30**	**0.35**	**0.33**	**0.18**	**0.20**	**0.23**	**0.22**	**0.23**	**0.18**
CG	**0.20**	**0.21**	**0.27**	**0.26**	**0.30**	**0.32**	**0.11**	**0.12**	**0.14**	**0.14**	**0.17**	**0.16**	**0.09**	**0.10**	**0.11**	**0.12**	**0.13**	**0.14**
PC	**0.05**	**0.05**	**0.10**	**0.10**	**0.14**	**0.13**	**0.02**	**0.01**	**0.04**	**0.03**	**0.08**	**0.08**	**0.01**	**0.01**	**0.04**	**0.02**	**0.04**	**0.04**

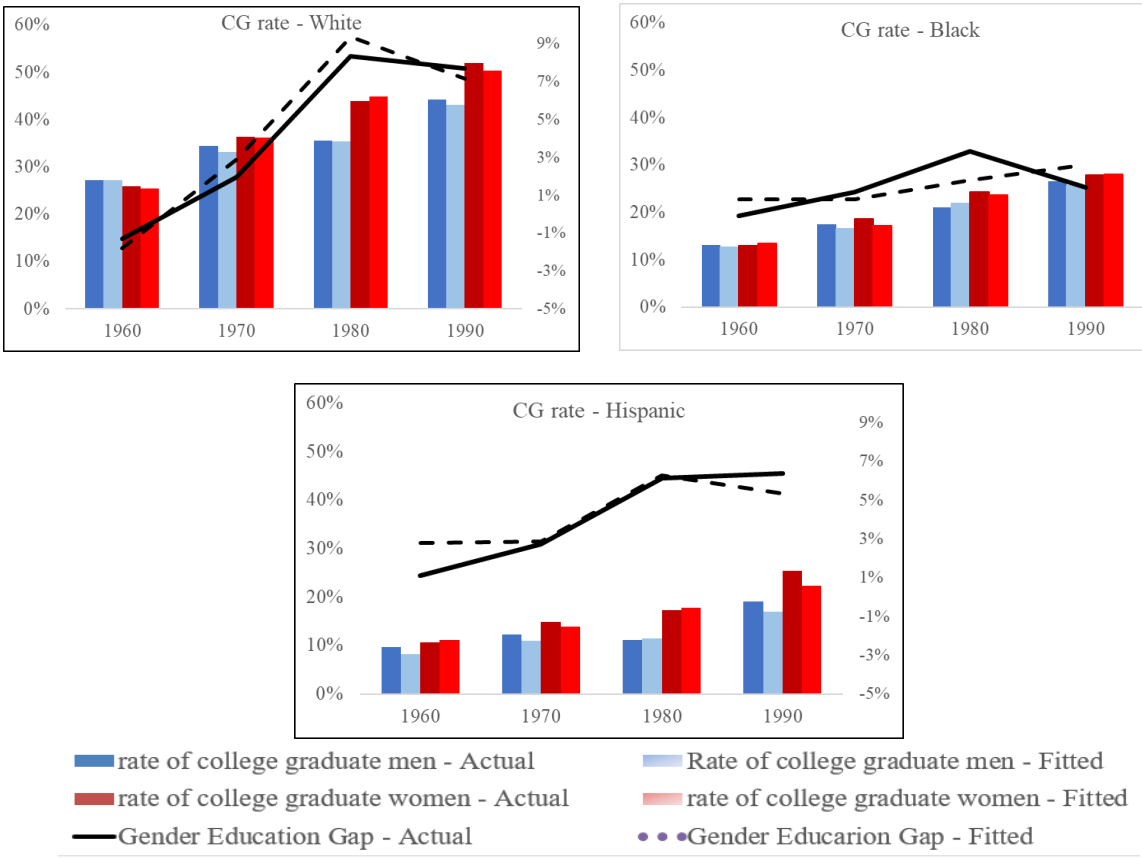
[10] We allow the three parameters of the offer wage function in equation (2) to differ by 5 levels of education, so we have 15 offer wage function parameters for each of the 18 gender/cohort/race groups. The job offer function in equation (4) has 8 parameters (4 each for part and full-time offers), while the job destruction equation (5) has 4 parameters, for a total of 12 job offer/destruction parameters.

IV.C. Model Fit

Tables 3 shows the fit to completed education. The fit is remarkably good for all groups and cohorts. For example, for White women the fraction with college as the highest degree is 20%, 26% and 30% in the ’60, ’70 and ’80 cohorts, and the model predicts 21%, 25% and 32%. The fraction of women who get post-graduate education increases even more quickly. It is 5%, 9% and 14% in the ’60, ’70 and ’80 cohorts, while the model predicts 5%, 9% and 13%.

Figure 3 shows the fit to college graduation rates. Our model provides an excellent fit for all gender/race/cohort groups. It succeeds in predicting graduation rate gaps between groups, the increasing graduation rates across cohorts, and the substantial increase in college attendance of women relative to men in 1970 and 1980 cohorts. Figure 3 also shows that our model gives accurate forecasts for the 1990 cohort – which we return to in Section VIII.

Figure 3: Fit to College Graduation Rate by Gender and Cohort and Ethnic Group

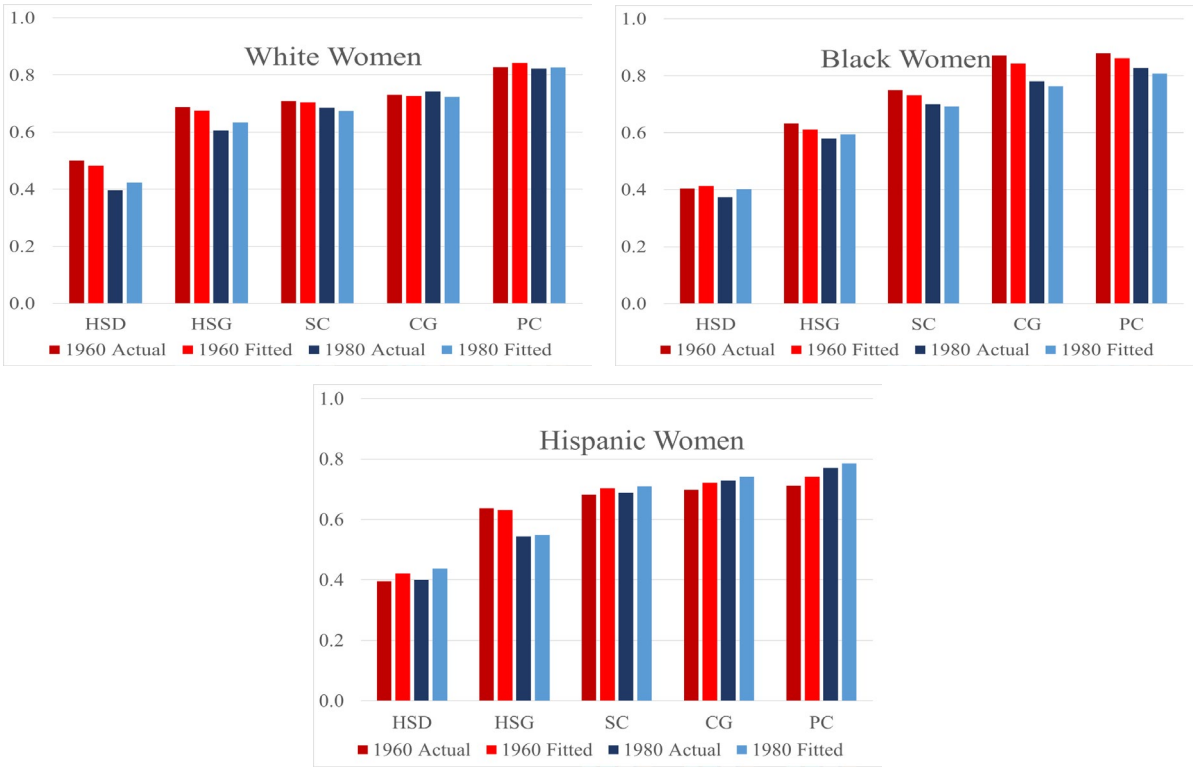


Our model also gives an excellent fit to many other statistics. Figure 4 highlights one that is particularly important, the employment rate of women at ages 32-36. As we see, employment rates of White women with at least some college education were very stable from the ’60 to ’80 cohorts, while those of women with high school of less education actually fell. The model captures these patterns well, even with fixed preferences across cohorts.

As we noted in the introduction, the employment rate of White women in the 32-36 age range grew rapidly from the ’25 to ’60 birth cohorts. But as we see in Figure 4, this growth has stopped in more recent cohorts. Thus, our model is able to explain why education of White women continued to grow rapidly, even after their employment rate stopped growing.

Figure 4 shows the patterns are different for Black and Hispanics, and we capture these differences. For Black women employment fell slightly in all education groups. For Hispanic women, it increased among the college educated, and dropped for high school graduates.

Figure 4: Fit to Employment Rates conditional on Education, Women, Age 32-36



Appendix Table J1 shows the fit to wages, employment and welfare participation. The fit is very good on all three dimensions. Appendix Table J2 shows the fit to marriage and divorce rates and assortative mating patterns, which we also capture very accurately.

Table 4 shows the fit to welfare participation. The rate of single mothers on welfare declined dramatically across the three cohorts, and our model captures this well. For Whites in the 1960, ’70 and ‘80 cohorts, the fraction of unemployed single mothers aged 27-31 on welfare fell from 60% to 33% to 13%, and our model predicts a decline from 56% to 35% to 10%. For Blacks and Hispanics participation rates are higher but also fell substantially. For instance, for Blacks in the ’60 cohort, 71% of unemployed single mothers aged 27-31 were on welfare, but in the 1980 cohort this dropped to only 24%. Our model predicts a decline from 75% to 20%.

Table 4: Model Fit to Welfare Participation

	1960 White		1970 White		1980 White		1960 Black		1970 Black		1980 Black		1960 Hispanic		1970 Hispanic		1980 Hispanic	
	Actual	Fitted	Actual	Fitted	Actual	Fitted	Actual	Fitted	Actual	Fitted	Actual	Fitted	Actual	Fitted	Actual	Fitted	Actual	Fitted
Unemployed - 27-31	0.60	0.53	0.33	0.30	0.13	0.10	0.71	0.65	0.46	0.40	0.24	0.21	0.77	0.69	0.45	0.42	0.16	0.12
Unemployed - 32-36	0.50	0.42	0.15	0.18	0.11	0.08	0.67	0.58	0.24	0.26	0.17	0.15	0.64	0.60	0.30	0.33	0.20	0.15
Unemployed - 37-41	0.21	0.09	0.08	0.07	0.09	0.06	0.37	0.32	0.16	0.09	0.09	0.04	0.40	0.32	0.18	0.10	0.09	0.05
Employed - 27-31	0.12	0.18	0.11	0.08	0.05	0.03	0.17	0.13	0.15	0.18	0.06	0.05	0.13	0.14	0.13	0.11	0.05	0.04
Employed - 32-36	0.07	0.11	0.03	0.02	0.02	0.02	0.13	0.11	0.06	0.08	0.04	0.02	0.10	0.10	0.06	0.04	0.04	0.02
Employed - 37-41	0.05	0.02	0.02	0.02	0.01	0.00	0.05	0.00	0.03	0.01	0.01	0.00	0.07	0.01	0.02	0.01	0.03	0.01

Finally, Table 5 shows the fit to total fertility at age 35. Unmarried White women have half as many children as married White women, and half of unmarried White women are childless. In contrast, less than a quarter of unmarried Black women were childless in the 1960 birth cohort, rising to over a third in later cohorts – a change driven in part by welfare reform. Nevertheless, unmarried Black women still have 60% more children than unmarried Whites. Unmarried Hispanics have as many children as unmarried Blacks, while married Hispanics have more children than Whites or Blacks. The model captures these general patterns well.

Table 5: Model Fit to Fertility

	1960 White		1970 White		1980 White		1960 Black		1970 Black		1980 Black		1960 Hispanic		1970 Hispanic		1980 Hispanic	
	Actual	Fitted	Actual	Fitted	Actual	Fitted	Actual	Fitted	Actual	Fitted	Actual	Fitted	Actual	Fitted	Actual	Fitted	Actual	Fitted
Married Women - Kids distribution at age 35																		
Childlessness rate	0.14	0.15	0.17	0.16	0.17	0.19	0.13	0.13	0.17	0.14	0.19	0.18	0.13	0.10	0.11	0.13	0.11	0.13
Number of Children	1.89	1.94	1.77	1.70	1.84	1.71	1.99	2.12	1.96	1.98	1.92	1.91	2.25	2.33	2.22	2.20	2.24	2.15
Un-Married Women - Kids distribution at age 35																		
Childlessness rate	0.50	0.52	0.53	0.53	0.51	0.53	0.23	0.23	0.32	0.31	0.35	0.34	0.31	0.27	0.30	0.32	0.31	0.32
Number of Children	0.92	0.99	0.89	0.91	0.93	0.81	1.73	1.74	1.54	1.61	1.51	1.43	1.60	1.61	1.58	1.55	1.62	1.50

In summary, it is an important result that our model succeeds in fitting all these data patterns assuming *common preferences* across race/ethnic groups and across cohorts, using only the three exogenous factors (parental background, marriage market, labor market). This gives us some confidence in using the model to provide explanations for the key patterns in college graduation rates that we described in the introduction. Furthermore, because we fit the education differences across gender/race/cohort groups almost exactly using fixed preferences, our model decomposes these differences completely into parts due to each of the three exogenous factors.

V. Parameter Estimates

We seek to explain differences in behavior across cohorts and gender/race groups using three exogenous factors: (i) parental background, (ii) wages and job offer functions and (iii) marriage offer probabilities. It is interesting to examine estimates related to these factors.

V.A. Parental Background – Effects on Skill, Tastes for School, Tastes for Marriage

The mapping from mother's education to the labor market skill endowment is invariant across cohort, gender and race. The estimated mapping implies, not surprisingly, that a person whose mother is a college graduate is more likely to be the high skill type. A person from a two-parent household is also more likely to be the high skill type, although this effect is not as strong as the effect of mother's education. See Appendix H.1 for details on the estimates.

The mapping from mother's education to tastes for school is invariant to cohort and race/ethnicity, but importantly it differs by gender. Recall that we have:

(1') $U_{ijt}^{S} = \alpha_{0j} + \alpha_{1j} I(PE_i \geq CG) + \alpha_{2j} \mu_i^W(PB_i) + \alpha_{3j} \cdot I(E_{it} > HSG)$ for j=m,f

We estimate the parameters α_{1m} and α_{1f} to be 257 and 402, respectively. Given our estimated CRRA utility function, this translates into a consumption equivalent of roughly \$9,126 per year of school for men, and \$20,786 for women. Thus, we find that having a college educated mother substantially increases tastes for college, especially for daughters.[11]

Our estimates of parameter α_{2j} imply people with higher (labor market) skill also like school better, and this effect is stronger for men. In fact, our estimates imply that low and even medium ability men have a strong dislike for school. In contrast, medium ability women whose mothers did (did not) graduate have a modest positive (negative) taste for school.

We also find both men and women from two-parent households get more utility from marriage. So they are more likely to choose to marry as well. This is important for explaining the low marriage rates of Blacks, as it creates important intergenerational links in marriage.

V.B. Wage Offer and Job Offer Functions

Our model allows wage and job offer functions to differ by race, gender and cohort. Cohorts face different offer wage functions at a point in time because skills and training differ in important ways by cohort. For example, members of the 1980 birth cohort tend to have better computer skills (and better computers at work) than members of the 1960 birth cohort, due to improvements in technology over time. Returns to college will differ by cohort at a point in time because the set of skills taught in college differs by cohort, and skill-biased technical

[11] This could be interpreted as meaning people – especially women – whose mothers were college graduates enjoy school more, or get more utility from school because they are better at it (it is less work), or they simply value education more highly, or they get more help to pay tuition, or some combination of all four (our model cannot distinguish these stories). These factors create important intergenerational links in college attendance.

change will affect different cohorts differently because cohorts have different training. This differs from the usual treatment of technical change, which views it as shifting returns to college for all cohorts in a similar way at a point in time. We find important differences in the wage structure across cohorts. These differences in wage offer functions and job offer functions are important in explaining differences in education across ethnic, gender and cohort groups.

Table 6 summarizes offer wage function estimates for Whites. Starting wages of college graduate women and men both improved substantially from the 1960 to 1980 birth cohort. But women still lag behind men by .10 log points. Experience returns of women in the 1960 birth cohort were smaller than those for men, but by the 1980 cohort they have almost caught up.

Table 6: Selected Offer Wage Function Estimates, Whites

		Intercept			**Experience Coefficient**		
		1960	1980	**Δ 60-80**	1960	1980	**Δ 60-80**
Men	High School	10.00	10.05	**+.05**	.058	.065	**+.007**
	College	10.42	10.60	**+.17**	.076	.087	**+.011**
	College Premium	**+.42**	**+.54**	**+.12**	**+.018**	**+.022**	**+.004**
Women	High School	9.76	9.81	**+.05**	.041	.063	**+.022**
	College	10.30	10.50	**+.20**	.053	.082	**+.029**
	College Premium	**+.54**	**+.69**	**+.15**	**+.012**	**+.019**	**+.007**

Appendix H.2 shows starting wages of Black and Hispanic women almost caught up to White women, but experience returns did not. Differences in starting wages between White, Black and Hispanic men are modest, but differences in experience returns are substantial. Those of Hispanic men improved modestly but those of Black men stagnated. Thus, experience returns of Whites (both men and women) are well above those of Blacks and Hispanics.

Table 7 reports job offer rates for unemployed workers with 3 years of work experience. We show results for other levels of experience in Appendix K. Recall that an employed person has the option to keep his/her previous job, unless an exogenous separation occurs.

Table 7: Job Offer Rate, Experience = 3 Years

	Women 1960		**Men 1960**		**Women 1980**		**Men 1980**	
	HSG	CG	HSG	CG	HSG	CG	HSG	CG
White	0.41	0.46	0.52	0.59	0.48	0.55	0.51	0.60
Black	0.30	0.31	0.34	0.36	0.35	0.37	0.39	0.41
Hispanic	0.36	0.41	0.48	0.53	0.39	0.46	0.51	0.58

Job offer probabilities of White women were well below those of White men in the 1960 cohort. Since then, rates for women improved while those of men are almost unchanged, so by the 1980 cohort the women had almost caught up to the men. Job offer probabilities of Black men and women remain inferior to those of Whites, despite improving over cohorts. Interestingly,

job offer probabilities of Hispanic men now look similar to those of White men, but those of Hispanic women are in between those of Black and White women.

Table 8 reports job destruction rates. In the 1960 cohort job destruction rates of White women were somewhat higher than those of White men, but in the 1980 cohort they are almost identical (mostly because those of men got slightly worse). The job destruction rates of Hispanics are similar to, but slightly higher than, those of Whites.

Job destruction rates for Blacks are far above those for Whites, and they have improved only slightly across cohorts. In contrast to Whites, the destruction rates of Black women are slightly better than those of Black men.

Table 8: Job Destruction Rate, Experience = 3 Years

	Women 1960		**Men 1960**		**Women 1980**		**Men 1980**	
	HSG	CG	HSG	CG	HSG	CG	HSG	CG
White	0.15	0.12	0.12	0.10	0.14	0.11	0.14	0.12
Black	0.25	0.23	0.27	0.25	0.24	0.22	0.25	0.23
Hispanic	0.17	0.16	0.15	0.13	0.17	0.15	0.15	0.14

V.C. Marriage Market Parameters

As we see in Table 9, the probability a women can get marriage offers at older ages (especially 35 and 40) increased dramatically from the ’60 to ’80 cohort, and this was true for Whites, Blacks and Hispanics. As we will see, this increased the incentive for women to graduate from college, as it became easier to delay marriage and fertility.

Table 9: Women’s Marriage Offer Probabilities by Age, Cohort and Race

	White		**Black**		**Hispanic**	
Age	1960	1980	1960	1980	1960	1980
25	0.20	0.27	0.11	0.16	0.24	0.24
30	0.09	0.20	0.05	0.12	0.14	0.17
35	0.03	0.12	0.02	0.08	0.06	0.11
40	0.01	0.07	0.00	0.04	0.02	0.06

In contrast, we find that assortative mating patterns (i.e., the probability of getting offers from spouses of different education levels, conditional on an offer) changed little across cohorts, and that differences across ethnic groups were stable.

Our estimates imply the fixed utility cost of marriage is 748 greater for people from single parent households, which translates into a consumption equivalent of roughly $65,753. It is worth noting that fixed costs of marriage are typically very large in models where agents search for spouses, as marital formation is not a common event. Thus, a large “love” shock is needed to overcome the large fixed cost and induce people to marry.

VI. The Option Value of College

Here we explore how the value of college has changed over time. We construct the option value of college by running a counterfactual where we shut down the option to attend college. We then calculate initial assets (at age 16) that we must give to each type of agent to compensate for loss of the college option (returning their expected PV of lifetime utility to the baseline level). These option values reflect the returns to college in both the labor and marriage market, plus utility from college attendance.

Table 10 reports option values broken down by cohort, gender and type, focussing on Whites.[12] Values of college were similar for men and women in the 1960 cohort. For instance, for a high-skill man from a two-parent family whose mother graduated, the value of college was $660k, while for a similar woman it was $645k. Values are close for all other types as well. This explains why men and women graduated at similar rates in the 1960 cohort.

Table 10: Value of College by Type, for Whites (PV in thousands $)

			1960					1980				
Skill endowment	**Mother 's education**	**Mother's marital status**	Type proportion (%)	PV Women (1000 $)	CG rate (%)	PV Men (1000 $)	CG rate (%)	Type proportion (%)	PV Women (1000 $)	CG rate (%)	PV Men (1000 $)	CG rate (%)
High	HS	Married	23.8	600	77.8	570	83.3	17.8	885	98.4	700	97.6
High	COL	Married	6.4	645	98.7	660	99.7	10.4	930	97.7	755	98.4
High	HS	Single	1.0	560	74.3	540	73.5	2.5	835	98.6	635	99.1
High	COL	Single	0.3	615	99.6	630	97.4	1.9	890	99.2	710	98.7
Medium	HS	Married	36.8	95	0.0	97	0.0	27.5	140	0.5	105	0.0
Medium	COL	Married	5.6	**115**	**0.0**	100	0.0	9.0	**620**	**95.6**	220	26.3
Medium	HS	Single	1.9	11	0.0	5	0.0	4.9	75	0.0	15	0.0
Medium	COL	Single	0.4	**75**	**0.0**	60	0.0	2.0	**580**	**96.2**	200	19.7

Table 10 also shows graduation rates for each type. Amongst high skill types whose mothers were college graduates, almost 100% graduated from college. If the mother did not graduate from college, the value of college falls by $90k for men and $45k for women.[13] In this group, about three-quarters of women and 80% of men graduate from college.[14] And, if the person was from a single parent household, the value of college drops by about $30k for both men and women, and graduation rates drop about 10% for men and 4% for women.

Values of college for medium skill types are much smaller ($115k or less). A key point is that almost no medium ability men or women graduated from college in the 1960 cohort.

[12] Low skill types never go to college, so their option values are near zero. So we exclude them from the table.
[13] It is surprising the drop is greater for men, as mother's college has a bigger impact on daughter's utility from school. But the labor market returns to college are greater for men. So an increase in the utility "cost" of college that reduces the rate of college attendance causes a bigger drop in present value of lifetime earnings of men.
[14] The ex ante (at age 16) option value of college for women of this type was $600k in the 1960 cohort. But about 25% of these type agents do not attend college due to adverse draws of the stochastic terms in the model.

In the 1980 birth cohort, values of college are much higher, particularly for women. For instance, for a high-skill man from a two-parent family whose mother graduated, the value of college is $755k, while for a similar woman it is $930k. Compared to 1960, that is a $95k increase for men but a $285k increase for women. Roughly three-quarters of high skill women with high school mothers graduated from college in the 1960 cohort, but in the 1980 cohort it is close to 100%, as their option value of college increased from $600k to $885k.

The biggest change in the 1980 cohort is among medium skill women whose mothers graduated from college (5.9% of population in 1960, and 11% in 1980). Their value of college increased by roughly $500k from 1960 to 1980. This caused their college graduation rate to increase from near zero to above 95%. For similar men, the graduation rate in the 1980 cohort was only 20 to 25%. The much higher graduation rate for women vs. men in this medium skill group is an important factor driving the higher graduation rate of women overall. As we saw earlier, our estimates imply medium skill women get much more utility from school than men.

College graduate mothers are more likely to have high skill children. In Table 11 we show how skill type proportions vary by mother's college and across cohorts. We include model forecasts for future cohorts, a point we return to in Section VIII. Notice how, as mothers become more educated, the proportion of agents who are high skill increases. The higher fraction of single parent households is a factor working in the opposite direction. On net, the fraction of high skill agents increased only slightly from the 1960 to 1980 cohorts (from 31.6% to 32.6%).

Table 11: Skill Type Proportions by Cohort, Whites

	Mother no college			Mother college			ALL		
	low	medium	high	low	medium	high	low	medium	high
1960	22.5	38.7	24.8	1.3	5.9	6.8	23.8	44.6	31.6
1970	20.8	33.8	21.5	2.4	10.1	11.5	23.1	43.9	33.0
1980	21.3	32.4	20.3	2.8	11.0	12.3	24.0	43.4	32.6
1990	18.9	26.6	16.5	4.4	16.0	17.6	23.3	42.6	34.1
2000	16.2	23.9	14.9	4.9	19.0	21.1	21.1	42.9	36.0
2010	14.4	21.3	13.3	5.6	21.5	23.9	20.0	42.8	37.2

Thus, the impact of mother's education on child skill was not a major factor driving increased college graduation. Rather, in the 1980 cohort many medium skill women began to graduate from college, as their option value of college increased.[15] This was driven by increasing returns to college in the labor and marriage markets, and greater tastes for college.

[15] We cannot infer that women who graduated from college in the 1980 cohort were on average less skilled than those in the 1960 cohort, as absolute skill levels of medium and high skill types may have changed over time. Also, we cannot infer that women graduates on average are less skilled than male graduates, as skill types are defined *within* genders. Furthermore, labor market skill is only one dimension of skill, and women's greater utility from college may reflect that they are more skilled at studying and learning college material.

VII. Explaining Gender, Cohort and Race/Ethnic Gaps in College Attainment

In the following Sections we use the model to address the following three questions: (A) Why do recent cohorts of women get more education than men?, (B) Why has the college graduation rate increased across cohorts? And why has it increased more for women?, (C) What explains gaps in college education between Whites, Blacks and Hispanics?

VII.A. Why are Recent Cohorts of Women getting more Education than Men?

Women in the 1980 cohort graduated from college at a much higher rate than men, e.g., a gap of 44.8% vs. 35.4% for Whites. To better understand why, we run counterfactual experiments where we equalize, in turn, labor market opportunities and preferences for school of women and men. These results are reported in Table 12.

A key result is that the *labor market* returns to college are still greater for men than for women. If we give White women in the 1980 cohort the same wage offer function as men, their college graduation rate increases substantially from 44.9% to 51.4%.[16] Thus, if women had the same labor market opportunities as men, their graduation rate would increase even further, and the gender education gap would widen dramatically! The gender gap in college graduation does not arise because women have a higher labor market return to college than men.

Table 12: Explaining Gender Differences in College Graduation

	White	Black	Hispanic
Women's College Rate – 1980 cohort	44.8	23.6	17.7
Men's Labor Market Parameters	51.4	27.9	19.3
Men's Utility from School	34.5	21.0	16.9
Both	41.2	25.9	19.0
Men's College Rate – 1980 cohort	35.4	21.9	11.5

It is interesting to examine our offer wage function estimates in light of this result. According to our estimates (Table 6), having a college degree vs. a high school degree increases the log wage function intercept for White women in the 1980 cohort from 9.81 to 10.50. This 0.69 log point difference implies the starting wage for college women is exp(.69)-1 = 99% higher than that for high school women. In contrast, for White men in the 1980 cohort we have instead a 10.60 - 10.05 = 0.55 log point gap, which means the starting wage for college men is exp(.544)-1 = 73% higher than for high school men.

Thus, the so-called "college premium" for women is about 26% higher than for men. Just looking at the starting wage ignores differences in wage growth, but we find the 26% gap is quite stable at all levels of experience. This is because college workers enjoy faster wage

[16] If we also give women the same job offer probabilities as men, it increases their graduation rate only slightly more, to 51.7%. This is because job offer rates for White men and women were similar in the 1980 cohort.

growth with experience than high school workers, and the gap is similar for men and women.

This larger college premium for women may appear to contradict the finding from our counterfactual that the labor market return to college is greater for men. But the apparent contradiction only arises because economists have often tended to conflate the "college wage premium" with the actual labor market return to college education.

The labor market return to college is greater for men because, while women get a larger *percentage* gain in wages than men, men get a larger *absolute* gain in wages. This occurs for two reasons: First, high school men have higher earnings than high school women. On top of that, the men have higher employment rates than women. Of course, economic agents care about absolute gains in earnings that result from college when calculating the return to college – they do not care about percentage gains in wages (except as far as these influence earnings).

So why do women go to college more than men? If we give White women the men's tastes for college, their college graduation rate drops by 10.5 percentage points, from 44.8% to 34.5%. Thus, it is not a higher return to college, but rather a greater taste for college attendance that causes White women in the '80 cohort to graduate from college at a much higher rate than men. Given the structure of our model, this may subsume several factors: Women may be better at studying (or like it more), so they get less disutility from schooling. Or they may place greater value on learning for its own sake. Or they may get more utility from social activities at college.

The bottom row of Table 12 reports a counterfactual where we give White women both the labor market constraints and tastes for school of White men. Their college graduation rate then drops from 44.8% to 41.2%. Thus, the drop due to tastes outweighs the increase due to better wage offers. However, this 41.2% graduation rate is still 5.8 points higher than the 35.4% rate of men. The 5.8 percentage point gap arises because marriage market returns to college are greater for women than for men. In particular, as women are likely to have children and spend time out of the labor force, their gain from finding a college educated (high income) husband exceeds a male's gain from finding a college educated wife.

VII.A.1. Does the Explanation of the Gender Gap differ by Race/Ethnic Group?

Consider next the results for Blacks. According to our estimates, college leads to larger wages gains for Black men than Black women. And job offer probabilities are slightly better for Black men. Thus, when we give Black women the wage offers and job offers of men their college graduation rate increases from 24.5% to 28.5%. Again, the labor market returns to college are greater for men than women. If we give Black women the same tastes for school as men their college graduation rate drops to 21.6%. So again, Black women derive more utility from school attendance than Black men.

If we give Black women *both* the labor market opportunities and tastes for school of Black men, their college graduation rate *increases* from 24.5% to 26.4%. This contrasts to White women, whose college graduation rate dropped in this experiment. The difference arises because Black women's taste for school is not as strong as White women's. Recall that tastes for school depend on mother's education. Black women's taste for school is less strong than White women's (on average) because their mothers are less educated.

When we give Black women *both* the labor market opportunities and tastes for school of Black men, their graduation rate of 26.4% exceeds the 22.6% rate of Black men. In contrast to Whites, the marriage market does not provide a strong incentive for Black women to attend college, as their marriage probability after college is very low. Instead, Black women have an incentive to get more education than Black men so they can afford to raise children as singles.

Hispanics graduate from college at much lower rates than Blacks. In the 1980 cohort, graduation rates for Hispanic women and men were only 17.9% and 12.2%. As we see in Table 12, giving Hispanic women the labor market opportunities of men *increases* their graduation rate to 19.7%. So again, labor market returns do not explain their higher graduation rate. Giving Hispanic women the men's taste for school only causes their graduation rate to drop slightly, to 17.4%. Thus, a higher return in the marriage market is a key reason Hispanic women get more college education than men, similar to what we saw for White women.

VII.B. Why has the College Graduation Rate Increased? Especially for Women?

In the 1960 cohort the college graduation rates of White women and men were 25% and 27%, respectively. But in the 1980 cohort these rates increased to 45% and 35%. Thus, the college graduation rate of men increased by a substantial 8 percentage points, but the rate for women increased by a staggering 20 percentage points, opening up a 9 point gender gap. The patterns are similar for Blacks and Hispanics (see Figure 1).[17] Here we ask what exogenous factors drove this huge increase in college graduation, and the opening of the gender gap.

To address this question, we analyze the marginal contribution of each of the three main exogenous factors (family background, labor market and marriage market) to changes in graduation rates. It is important to recall that preferences are fixed across cohorts.

Table 13 reports the marginal contribution of each factor to the change in the college graduation rate from the 1960 birth cohort to the 1980 birth cohort. Note that mother's marital status affects both ability and taste for marriage. In Table 13 we decided to allocate the first effect to the parental background category, and the second to the marriage market category.

[17] For Blacks the increases for men and women were 8% and 13%, while for Hispanics they were 2% and 8%.

Parental background: We consider first the results for Whites: Changes in parental background, which affects skill endowments and taste for school, caused the graduation rate of women to increase by 5.4 pp between the '60 and '80 cohorts, while generating a much smaller 1.3 pp increase for men. Why is the effect of parental background so much greater for women?

Between the 1960 and 1980 birth cohorts, the graduation rate of mothers increased from 14% to 24% (see Table 1), and this increased tastes for schooling. But our parameter estimates imply *this effect is stronger for daughters*. Having a college graduate mother also increases the probability a person is the high skill type, but it does so equally for men and women, so the skill channel does not explain why women's graduation increased much more than men's.

Table 13: Factors Driving Increasing Education Across Cohorts

	White		Black		Hispanic	
	Men	**Women**	**Men**	**Women**	**Men**	**Women**
College Graduation Rate – 1960	**27.2%**	**25.4%**	**12.6%**	**13.3%**	**8.3%**	**11.0%**
Family Background						
Mother's Education	.017	.051	.022	.040	.016	.029
Mother's Marital Status (ability)	-.008	-.002	-.006	-.005	-.003	-.003
Total	**.013**	**.054**	**.016**	**.035**	**.010**	**.027**
Labor Market Opportunities						
Tax Rules	.001	.005	.003	.001	.002	.002
Welfare rules	.000	.012	.003	.022	.003	.017
Job Offers	.020	.054	.025	.052	.007	.012
Wage Offers	.047	.078	.041	.056	.017	.031
Total	**.053**	**.105**	**.058**	**.072**	**.019**	**.043**
Marriage Market						
Mother's Marital Status (tastes)	.000	.012	.001	.000	.001	-.001
Assortative Matching	.011	.014	.003	.006	.005	.009
Offer Probability by Age	.015	.040	.001	.011	.004	.014
Total	**.019**	**.043**	**.012**	**.026**	**.006**	**.023**
College Graduation Rate – 1980	**35.4%**	**44.8%**	**21.9%**	**23.6%**	**11.5%**	**17.7%**

Mother's marital status is a second dimension of parental background. It affects both the skill endowment and taste for marriage. But as we see in Table 13 these effects are very small compared to the effects of mother's education.[18]

Impacts of parental background are similar for Blacks and Hispanics: For Blacks the fraction of college graduate mothers increased from 6% to 13%, and for Hispanics it increased from 7% to 11%, while for Hispanics the percentage of native born mothers increased from 42% to 52%.[19] The changes in parental background caused the college graduation rate of Black women to increase by 3.5 pp, compared to 1.6 pp for Black men, while causing the college graduation rate of Hispanic women to increase by 2.7 pp, compared to 1 pp for Hispanic men.

[18] The rate of single parent households increased greatly between the '60 and '80 cohorts (from 6.4% to 11.8% for Whites). This had two opposite effects on college: It lowered ability, causing college to fall, but also reduced tastes for marriage. And if women are less likely to be married it creates an incentive to get more education.

[19] Recall that for Hispanics we assume that only having a native born college educated mother increases taste for school and the skill endowment.

Labor Market: Next we consider changes in the labor market. These include offer wages and job offer probabilities, as well as taxes and welfare rules. As we see in Table 13, these caused the college graduation rate of White women to increase by 10.5 pp between the ’60 and ’80 cohorts, while causing that of White men to increase by a much smaller 5.3 pp. For both men and women it is changes in the job offer probabilities and especially offer wages that are the main factors. Changes in taxes and welfare rules led to small increases in education for White women, but negligible changes for men.

Why did the labor market have a much bigger effect on women?

As we saw in Section V, Table 6, starting wages of White male and female college graduates both improved between the 1960 and 1980 birth cohorts. The college vs. high school wage premium for men increased from .42 to .54 log points, while for women it increased from .54 to .69. Thus, it increased by slightly more for women (+.15 vs. +.12 log points).

More importantly, experience returns for college women improved much more than for men: As we see in Table 6, for White college women the experience coefficient increased from .053 to .082, and increase of .029, compared to an increase of only .011 for men. Experience returns of White college women in the 1960 birth cohort were much smaller than those for White college men, but by the 1980 cohort they have almost caught up (.082 vs. .087).

In addition, job offer and destruction probabilities of White women improved across the three cohorts, so by the 1980 cohort they are very similar to those for men (see Tables 7 and 8). These improvements in experience returns and offer probabilities explain why changes in labor market opportunities led to larger increases in education for women than for men.

For Black women the story is similar: Changes in labor market opportunities caused the college graduation rate of Black women to increase by 7.2 pp compared to 5.8 pp for Black men. For Hispanics effects are smaller but still much larger for women: the figures are 4.3 pp for women and only 1.9 pp for men. A key reason college grew less for Black and Hispanic women than for White women is that experience returns for Black and Hispanic college women grew much less than for White college women. On the other hand, welfare reform was a significant factor for Black women, as it drove up their graduation rate by 2.2 pp. It was also important for Hispanic women (1.7 pp), but less so for White women (1.2pp).

Marriage Market: Finally we turn to the marriage market. As we see in Table 13, changes in marriage market opportunities caused the college graduation rate of White women to increase by 4.3 pp between the 1960 and 1980 cohorts, compared to a 1.9 pp increase for men. So all three factors (parental background, labor market, marriage market) caused the college graduation rate of White women to increase roughly twice as much as that of men.

The key marriage market change that drove up the college graduation rate of women was an increase in the probability of getting marriage offers at older ages (see Table 9). As we see in Table 13, this caused the graduation rate of White women to increase by 4 pp. College became more attractive for women as college attendance does not crowd out opportunities for marriage (and fertility) to the extent that it did in the past. The results for Blacks and Hispanics are similar, except the effects are more modest than for whites.

One popular explanation for the increase in women's education is increased returns to college in the marriage market, due to an increase in assortative mating. But results in Table 13 indicate this is not a very important factor. It is interesting to explore further why not:

Table 14 reports assortative mating patterns for the '60 to '80 birth cohorts for Whites.[20] Clearly the fraction of couples where both spouses are college graduates increased substantially (from 18.9% to 35.0% of all marriages). But this 85% increase in college couples is roughly what we would expect, given the increase in college education across cohorts (i.e., the fraction of college graduate women increased 73% from 26.3% to 45.5%). The degree of assortative mating did not change to any appreciable degree. In fact, the conditional probability of a college women matching with a college man fell very slightly from 69% to 68%.[21]

Table 14: Assortative Mating Patterns by Cohort, Whites only

1960		HUSBANDS		
		HSD + HSG	SC	CG + PC
WIVES	HSD +HSG	29.5%	9.3%	4.4%
	SC	9.5%	12.3%	7.7%
	CG + PC	3.3%	5.3%	18.9%

1970		HUSBANDS		
		HSD + HSG	SC	CG + PC
WIVES	HSD +HSG	19.3%	6.2%	2.9%
	SC	9.8%	13.0%	7.2%
	CG + PC	5.3%	8.1%	28.1%

1980		HUSBANDS		
		HSD + HSG	SC	CG + PC
WIVES	HSD +HSG	13.3%	4.7%	2.2%
	SC	9.0%	12.8%	6.4%
	CG + PC	6.0%	10.6%	35.0%

Summary, Factors Causing Increase in College: If we sum the marginal effects of parental background, labor market and marriage market, we get roughly the total increase in education. For example, for White women we have 25.4 + (5.5 + 10.5 + 4.3) = 45.7 compared to 44.8. This suggests that interaction effects among the three factors are small.

For White women, the relative importance of the three factors driving the increase in college are: mother's education 27%, labor market 52%, marriage market 21%. The breakdown is similar for other groups. But in absolute terms all three factors improved less for the other groups, which is why White women had the largest increase in college.

[20] Appendix I shows assortative matching patterns for Blacks and Hispanics.

[21] One can also see in Table 14 that the probability a woman marries a man with less education than her increased substantially, from 18.1% in the 1960 cohort to 25.6% in the 1980 cohort, while the probability a man marries a women with less education than him fell from 21.4% to 13.3%. Gihleb and Lifshitz (2022) show that women who "marry down" tend to supply more labor than women who "marry up," so these changes tend to increase married women's labor supply. They find this is important in cohorts earlier than those we study.

VII.C. Explaining Race Gaps in College Graduation

Our next major task is to account for different college graduation rates of race/ethnic groups. In Table 15 we assess the impact of giving Blacks and Hispanics the same exogenous factors facing Whites (parental background, labor market, marriage market). If all three are equated their graduation rates are equalized to those of Whites, as these are the only ways the groups differ in our model (all race/ethnic groups have identical preferences).

Table 15: Explaining College Gaps between Whites, Blacks and Hispanics, 1980 Cohort

	Black		Hispanic	
	Men	**Women**	**Men**	**Women**
College Graduation Rate – 1980 Cohort	**21.9%**	**23.6%**	**11.5%**	**17.7%**
Family Background				
Mother's Education + Immigration Status	.033	.053	.032	.051
Mother's Marital Status (on ability only)	.015	.020	.002	.004
Mother's Immigration Status			.023	.018
Total	**.043**	**.073**	**.047**	**.071**
Labor Market Opportunities				
Job Offers	.037	.051	.023	.034
Wage Offers	.029	.042	.117	.102
Total	**.079**	**.096**	**.133**	**.141**
Marriage Market				
Mother's Marital Status (on marriage)	.000	-.017	.004	.008
Assortative Matching	.003	.005	.009	.010
Offer Probability by Age	.005	.012	.012	.014
Total	**.015**	**.032**	**.026**	**.035**
College Graduation for Whites – 1980	**35.4%**	**44.8%**	**35.4%**	**44.8%**

Parental Background: If we give Black women the same mother's education as Whites (i.e., increase the mother's graduation rate from 13% to 26%) we predict their college graduation rate would increase by 5.3 percentage points. For men the increase is 3.3 pp.

The rate of single parent households was 61% for Blacks in the 1980 birth cohort, compared to only 18.7% for Whites. In Table 15 we split the impact of mothers' marital status into two components: its impact on skill endowments and its impact on fixed costs of marriage. We include the former effect under family background, and the latter effect under the marriage market.[22] If we give Blacks the family structure of Whites, and consider only the positive effect on ability, the college graduation rate of Black women increases by 2.0 points.

The combined impact of equalizing mother's education and the rate of single parent households (ability effect only) raises Black women's college graduation rate by 7.3 points, eliminating 35% of the gap with Whites. If we look at Black men, we get an increase of 4.3 points, eliminating 32% of the gap with Whites.

[22] Thus, our decomposition has three main parts: (i) the effect of family background on skill endowments and tastes for school, (ii) effects of labor market opportunities (wage and job offers), and (iii) the effect of the changes in marriage offer functions, plus the effect of parents' marital status on fixed costs of marriage.

For Hispanics, the effect of equalizing mother's education is very similar. Recall that we only count a mother as college educated if she was born in the US.[23] If we equalize mother's education with Whites, and assume all parents were born in the US, then the college graduation rate of Hispanic men and women increases by 3.2 and 5.1 points. If we also equalize the rate of single parent status (reducing it from 25.9% to 18.7%), the college graduation rate of Hispanic men and women increases by 4.7 and 7.1 points.

Labor Market: Whites, Blacks and Hispanics in the 1980 cohort have similar starting wages *conditional* on schooling, but White men and women have much higher returns to experience. Black men have inferior job offer rates and higher job destruction rates compared to both White and Hispanic men (see Tables 7 and 8). Black women also have inferior job offer/destruction rates compared to White women. The Hispanic women are in between.

If we give Blacks the same labor market opportunities as Whites it increases their rates of college graduation by 7.9 and 9.6 pp for men and women. This closes the college gap with Whites by about 58% for men and 45% for women. Thus, labor market opportunities explain roughly half the college gap between Blacks and Whites.

If we give Blacks the same offer wage functions as Whites, we get increases of 2.9 and 4.2 percentage points, while if we give them the same job offer rates we get increases of 3.7 and 5.1 percentage points. So the difference in offer rates is more important. The overall results for Hispanics are similar, but for them the wage offer function matters much more than the job offer functions (as their baseline job offer functions are more similar to Whites).

The very low college graduation rate of Hispanic men (11.5%), as well as its very slow growth from the '60 to '80 cohorts, is notable. According to our estimates, the college vs. high school wage premium for Hispanic men was only .46 log points in the 1980 cohort, and this is the lowest of any group. It compares to .54 log points for both Black and White men, .69 for White women, and .55 for Hispanic women. Black women at .47 is the next smallest.

Marriage Market: Probabilities that Black and Hispanic women receive offers from college spouses, conditional on own education, are only slightly lower than for Whites. In fact, assortative mating patterns differ little by race, once one accounts for the different graduation rates in each group. Hence, giving Blacks and Hispanics the conditional offer functions of Whites only increases their graduation rates by 0.5 pp and 1.0 pp, respectively.

[23] In 1980, 52% of Hispanic mothers were born in US, and their college rate is 11%, so we set the rate of college mothers to (.52)(.11) = 5.5%. In the row of Table 15 labelled "Mother's Education + Immigration Status," we increase the mother's college rate from 5.5% to 26%, the rate for Whites. In the row labelled "Mother's Immigration Status", where we assume all mothers are born in the US, we increased mothers college rate from 5.5% to 11%. Obviously that has a much smaller effect.

White women have somewhat higher marriage offer rates than Hispanics, and much higher offer rates than Blacks (Table 9). If we apply the Whites' offer probabilities to Blacks and Hispanics, it increases their return to education in the marriage market, so graduation rates increase modestly, by 1.2 pp for Black women and 1.4pp for Hispanic women.

In our model, parents' marital status effects the fixed cost of marriage (or, equivalently, taste for marriage). If we replace the rate of single mothers for Blacks (61.5%) with the rate for Whites (18.7%) we reduce their fixed cost of marriage substantially, causing their marriage rate at age 32-36 to increase from 26% to 53%. Interestingly, for Black women, the effect on college graduation is negative (minus 1.7 points). With marriage more likely, Black women foresee they will work less, which reduces the return to college.

However, if we give Black women the same marriage market opportunities as Whites on all three dimensions – fixed cost of marriage, offer probabilities and education distribution of offers – their graduation rate increases by 3.2 pp. There is a strong complementarity between the three factors: When the lower fixed cost is combined with a higher chance of getting offers and a higher chance of meeting college spouses, the women can complete college and marry later, so marriage market returns to education increase substantially.

For Hispanics equalizing marriage market opportunities with Whites increases college graduation rates by 2.6 and 3.5 percentage points for men and women, respectively. Overall, we find that equalizing marriage market constraints closes 11% and 15% of the college gap for Black men and women, and 11% and 13% of the gap for Hispanic men and women.

Race Gaps Summary: The sum of the three exogenous factors (parental background, labor market, marriage market) closes 85% to 95% of the graduation rate gap between Whites, Blacks and Hispanics. We assume common preferences for all three groups. So equalizing these three factors equalizes graduation rates by construction. Thus, the model implies a small complementarity when the three factors are changed simultaneously, and that fills the remining gap. What drives this complementarity is that marriage market returns to education go up when spouses have better labor market opportunities.

Parental background explains over 1/3 of the graduation rate gap between Blacks and Whites. Roughly ¾ of this is due to the gap in mother's education, and ¼ is due to the impact of Black's high rate of single parent households. For Hispanics the role of parental background is a bit smaller, as the single parent rate for Hispanics is similar to whites. Labor market opportunities account for half the Black/White graduation rate gap, and about 60% of the Hispanic/White gap. The marriage market explains about $1/7^{th}$ of the gap for each group.

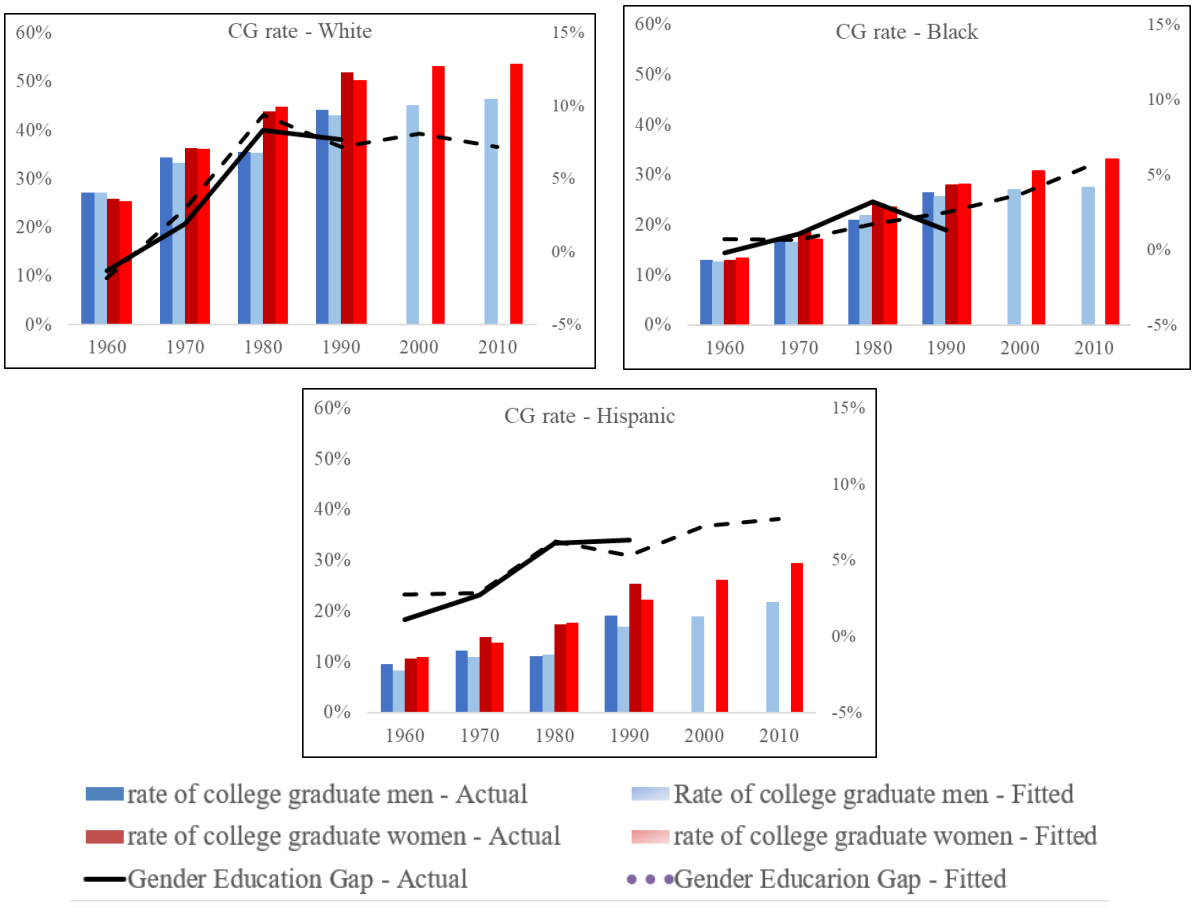
VIII. Will Graduation Rates Continue to Increase? Will Gender/Race Gaps Continue to Grow?

Next we use our model to address three questions about *future* college graduation rates: Will graduation rates continue to increase? Will the gender gap continue to grow? Will Blacks and Hispanics catch up to Whites, or will race gaps continue to increase?

We use the family background of the 1990, 2000 and 2010 birth cohorts (see Table 1), to predict their college graduation rates. In this exercise, we assume labor market and marriage market opportunities of these cohorts are the same as the 1980 cohort.

Enough time has passed that we can see the collge graduation rates of the 1990 cohort (at age 30). As we see in Figure 5, our predicted rates are very close to what we observe in the data, with a deviation of at most two percentage points. The main reason our prediction is so accurate is that wage paths for the 1990 cohort do not appear to be much different from the 1980 cohort (at least at young ages where we observe data). Notice that the college graduation rates of men and women in all race/ethnic groups continued to increase with the 1990 cohort – but gender gaps did not widen as men kept up with women. Our model predicts these patterns.

Figure 5: Actual and Predicted Graduation Rates, 1960 to 2010 cohorts



Given this prediction success for the 1990 cohort, it seems reasonable to also predict the collge graduation rates of the 2000 and 2010 cohorts based on their family background:

Consider first the results for Whites. The college graduation rate of White mother's increased from 38% in the 1990 cohort to 51% in the 2010 cohort. However, as we see in Figure 5, our model predicts that growth in the graduation rate of White women will slow down and stabilize at about 53% to 54% in the 2000 and 2010 cohorts.

We predict the graduation rate of White women will stabilize because, by the 2000 cohort, essentially all medium skill women with college graduate mothers are graduating themselves. Hence, the marginal group consists largely of medium skill women whose mothers did not graduate. It is difficult to induce these women to graduate from college, because they get disutility from school (see Section V.A.). We also predict the college graduation rate of White men will grow slighly faster than for White women. As a result, the gender gap will narrow slightly, from 9 pp in the 1980 cohort to 7 pp for the 2010 cohort.

The story is very different for Blacks and Hispanics. For Black women the college graduation rate of mother's increased from 13% in the 1980 cohort to 19% in the 1990 cohort and 28% in 2010. As a result, we predict the college graduation rate of Black women will increase from 24% in the 1980 cohort to 28% in the 1990 cohort and 33% in 2010. This brings the college graduation rate of Black women to roughly the rate of White women in the 1970 cohort. These substantial increases arise because the marginal Black women is still high skill in these cohorts, making it easier to induce them into attending college.

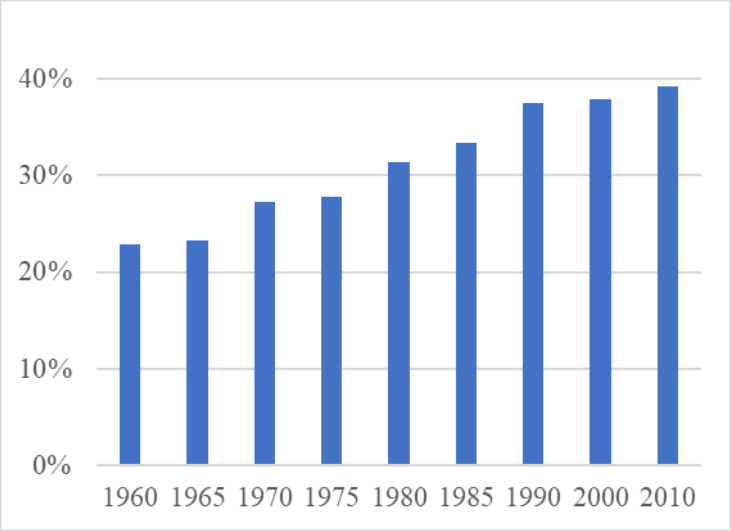
For Hispanic women the fraction of US born college graduate mothers increased from 5.7% in the 1980 cohort to 10.5% in the 1990 cohort to 17.3% in 2010. As a result, we predict the college graduation rate of Hispanic women will increase from 18% in the 1980 cohort, to 22% in 1990 and to 29% in 2010. Again, these large increases occur because the marginal Hispanic woman is still high skill in this period.

For Black men, we predict the college graduation rate will increase modestly, from 22% in the 1980 cohort to 27% in the 2010 cohort. Hence the gender gap for Blacks will widen from 2 pp in the 1980 cohort to 6 pp in the 2010 cohort. Interestingly, for Hispanic men, we predict the graduation rate will increase substantially, from 11% in the 1980 cohort to 22% in the 2010 cohort. But the gender gap for Hispanics will still increase from 6 pp to 8 pp.

In summary, we predict increases in college graduation for all demographoc groups. The largest increases from 1980 to 2010 are for Hispanic women (11.8 pp), followed by White men (11.1pp), Hispanic men (10.3pp), Black women (9.6pp), White women (8.9pp) and finally Black men (5.5pp). The large predicted increases for Hispanics are notable.

All these predictions are based on changes in family background, and the mother's graduation rate is the key factor. But the increase in single parent families, which tends to reduce ability, also plays a role. From the 1980 to 2010 cohorts, the rate of single parent households for Whites only increases slightly, from 18.7% to 21.9% (3 pp). But for Blacks the increase is 61.5% to 74.5% (13 pp), and for Hispanics it is 25.9% to 40.0% (14.1 pp). These large increases in single parent rates hold back the graduation rates of Blacks and Hispanics.

Figure 6: Aggregate College Graduation Rate



Finally, in Figure 6 we aggregate across genders and ethnic groups to construct the overall college graduation rate by cohort. This is historical from the 1960 to 1990 cohorts, and predicted for the 2000 and 2010 cohorts (whose true rates will not be observed until roughly 2030 and 2040). Our model predicts that the aggregate college graduaiton rate will only increase by 2 percentage points from the 1990 to 2010 cohorts.

This result may seem surprising, as our model predicts increases at least as large as 2pp for each *individual* group: If we compare the 1990 and 2010 cohorts, the largest predicted increase is for Hispanic women (7pp), followed by Black women (5pp), Hispanic men (5pp), White women (3.4pp), White men (3.4pp), and finally Black men (2pp).

What holds down the aggregate graduation rate is the dramatic drop in the population share of Whites, from 63% in the 1990 birth cohort to only 52% in the 2010 birth cohort. At the same time there is an increase in the share of Hispanics, from 25% in the 1990 cohort to 35% in the 2010 cohort. As the Hispanics have the lowest college graduation rate of any group, the increase in their population share drives down the aggregate rate. This is despite the fact that we predict large increases in college graduation rates for Hispanics. It is interesting how demographic shifts at the micro level affect the aggregate stock of human capital.

IX. College Tuition Subsidy Experiments

Finally, we use the model to determine tuition subsidies that would negate the impact of parental background on college graduation.

Our model implies that, in the 1980 cohort, differences in mother's college graduation accounted for 5.1 points of the college gap between Hispanic and White women, see Table 15. We predict that a tuition subsidy of $12.9k per year would increase the college graduation rate of Hispanic women by 5.1 pp, eliminating this source of difference with White women.

Assuming their children are in the 2000 birth cohort (20 years later), and the subsidy is eliminated, we further predict this would cause the graduation rate of their daughters to increase by 3.5 pp, and their sons by 2.1 pp. Thus, there is a large passthrough of the subsidy impact to the next generation, via the parental background transmission mechanism.

Interestingly, the same size subsidy would only increase the graduation rate of Black women by 2.3 pp. This is because, in the 1980 cohort, over 90% of high ability Black women were already graduating, compared to only 60% of high ability Hispanic women, see Table 16. So it is more difficult to induce additional Black women to graduate using subsidies.

Table 16.A: Values of College for Blacks

			1960					1980				
Skill endowment	mother 's education	mother's marital status	type proportion (%)	PV women (1000 $)	CG rate (%)	PV men (1000 $)	CG rate (%)	type proportion (%)	PV women (1000 $)	CG rate (%)	PV men (1000 $)	CG rate (%)
High	HS	Married	27.0	200	47.4	260	52.2	15.3	680	89.6	620	82.3
High	COL	Married	1.6	600	99.2	640	97.3	2.1	790	97.5	710	97.6
High	HS	Single	12.4	180	36.3	250	46.5	19.0	670	96.4	550	81.2
High	COL	Single	0.9	590	98.4	620	98.5	3.3	775	98.3	640	97.8
Medium	HS	Married	14.7	10	0.0	15	0.0	8.3	70	0.0	25	0.0
Medium	COL	Married	0.3	60	0.0	45	0.0	0.4	90	0.0	80	0.0
Medium	HS	Single	16.0	0	0.0	0	0.0	24.7	0	0.0	10	0.0
Medium	COL	Single	0.4	0	0.0	0	0.0	1.6	20	0.0	20	0.0

Table 16. B: Values of College for Hispanics

			1960					1980				
Skill endowment	mother 's education	mother's marital status	type proportion (%)	PV women (1000 $)	CG rate (%)	PV men (1000 $)	CG rate (%)	type proportion (%)	PV women (1000 $)	CG rate (%)	PV men (1000 $)	CG rate (%)
High	HS	Married	24.0	190	32.4	240	32.1	19.5	510	57.3	360	37.3
High	COL	Married	3.0	570	98.4	600	98.3	4.0	760	95.9	700	97.4
High	HS	Single	2.2	180	27.8	230	27.6	4.2	490	53.2	340	33.9
High	COL	Single	0.3	540	99.2	585	99.3	1.1	740	98.2	620	98.2
Medium	HS	Married	37.1	0	0.0	0	0.0	30.1	35	0.0	15	0.0
Medium	COL	Married	2.6	70	0.0	60	0.0	3.5	85	0.0	70	0.0
Medium	HS	Single	4.2	0	0.0	0	0.0	8.2	0	0.0	0	0.0
Medium	COL	Single	0.4	0	0.0	0	0.0	1.2	15	0.0	20	0.0

Returning to Table 15, we see that differences in mother's college graduation accounted for 5.3 points of the college gap between Black and White women. We predict that a tuition subsidy of $26.3k per year would be required to increase the college graduation rate of Black women by this amount. This, in turn, would increase the graduation rate of their daughters in next generation (2000 cohort) by 2.6 pp, and their sons by 1.4 pp. So the passthrough of subsidy impact to the next generation is substantial, but not as large as we saw for Hispanics.

In summary, the results of this section illustrate how education generates social mobility via the impact of parent education on children's skills and taste for school.

X. Conclusion

In this paper we have developed a model of individual and household decision making where education, labor supply, marriage, fertility and welfare participation are all endogenous. We use the model to explain changes in college graduation rates in the 1960 through 1980 birth cohorts, by gender and race (White, Black, Hispanic), based on three exogenous factors: family background, labor market opportunities and marriage market constraints. We discipline the model by imposing fixed preferences across cohorts and race/ethnic groups. We use the model to assess the contribution of each exogenous factor to changes in graduation rates by cohort/gender/ethnic group, and to predict graduation rates in more recent birth cohorts.

One key finding is that the questions "Why do women *currently* graduate from college at a higher rate than men?" and "Why has the gender gap in college graduation *increased* over time?" have different answers. The gender gap has grown because women's return to college education has increased faster than men's in both the labor and marriage markets, and because the increasing share of college educated mothers across cohorts has had a larger positive effect on tastes for college for daughters than sons.

However, while women's labor market returns to college education have grown over cohorts, they have not yet caught up to men. Thus, women are currently graduating at higher rates than men *despite* having lower labor market returns. Two factors explain this:

First, women get more utility from school. Given the structure of our model, this may subsume a number of factors: Woman may be better at studying (or like it more), so they get less disutility from putting in effort at college.[24] Or they may place greater value on learning for its own sake, or get more utility from social activities at college.

[24] This result is consistent with a large literature in economics, sociology and psychology arguing that girls like school better than boys, or that they are find school less difficult than boys, or that they do better in school because they have more self-control. See for example, Becker, Hubbard and Murphy (2010a, b), Autor et al (2016), Heckman and Masterov (2004), Jacob (2002) and Voyer and Voyer (2014).

The second reason, roughly half as important, is that women get greater marriage market returns to college than men. Women are likely to have children and spend time out of the labor force, so their gain from finding a college educated (high income) husband exceeds a male's gain from finding a college educated wife.

There are two primary reasons that women's labor market returns to college have improved over cohorts: First, returns to *work experience* for college educated women have improved substantially, and although they still lag a bit behind men. Second, job offer and destruction rates for women have improved over the three cohorts ('60, '70 and '80).

Women's marriage market returns to college have improved primarily because of an increase in the probability of getting marriage offers at older ages, which has made it easier for women to delay marriage and fertility while pursuing a college degree. Interestingly, we find that changes in assortative matching patterns were a much smaller factor.

The rapid growth in the gender gap can obscure the fact that men's graduation rates also increased substantially in the '60 to '80 cohorts. The largest factor was, not surprisingly, increasing labor market returns to education. However, increases in mother's education across cohorts also contributed importantly. Mother's education increases a child's labor market skill endowment (at age 16) as well as tastes for (ability at) college.[25]

Although college graduation rates have increased for all demographic groups, race gaps have widened in recent cohorts. A key reason is that the labor market returns to college have grown more slowly for minorities. Experience returns of college graduates have grown, but not as quickly as for Whites. In general, we find that differences in starting wages between White, Black and Hispanic college graduates are modest, but that differences in experience returns are substantial and have even widened across the cohorts we study.

Again, explanations for level differences in graduation rates differ from those for changes. Differences in parental background can explain roughly 1/3 of the college graduation rate gap between Blacks and Whites, for both men and women. Roughly ¾ of this parental background effect is due to the gap in mother's education, and ¼ is due to the impact of Black's high rate of single parent households. For Hispanics the role of parental background is a bit smaller, as the single parent rate for Hispanics is similar to whites.

[25] This is consistent with important work by Sayer et al (2004), Guryan, Hurst and Kearney (2008), Kalil, Ryan and Corey (2012) and Potter and Roska (2013), showing that college educated mothers spend much more time in educational activities with children.

We also use the model to predict future trends in college graduation rates. These are intergenerationally linked, as mother's college affects children's tastes for college (especially for daughters), and children's ability. Our results differ substantially by demographic group:

We predict growth in White women's graduation rate will slow down considerably in the 2000 and 2010 cohorts. This is because the marginal woman is now a medium ability person whose mother did not attend college. Such women get disutility from school attendance, and their labor market returns to college are not as great as for high ability women. So it is difficult to induce them to attend college and graduate. Thus, we predict the college graduation rate of white women will plateau at about 54%. We predict the graduation rate of White men will (very) slowly catch up, so gender gaps amongst Whites will slowly narrow.

The story is different for Blacks and Hispanics. We predict the college graduation rate of Black women will increase from 28% in the 1990 cohort to 34% in the 2010 cohort. This will bring them to roughly the rate of White women in the 1970 cohort. Similarly, for Hispanic women we predict the graduation rate will increase from 23% in the 1990 cohort to 30% in the 2010 cohort. These substantial gains arise because the marginal Black or Hispanic women is still a high ability type in these cohorts, making it easier to induce them to attend college.

In general, if we compare the 1990 and 2010 cohorts, our largest predicted increase in the graduation rate is for Hispanic women (7pp), followed by Black women (5pp), Hispanic men (5pp), White women (3.4pp), White men (3.4pp), and finally Black men (2pp). Thus, we predict the gender gap will continue to grow for Blacks and Hispanics. As for race/ethnic groups, we predict the White/Hispanic gap will narrow, but the Black/White gap will not.

Aggregating over demograhic groups, we predict the aggregate graduation rate will only increase by only 2 pp from the 1990 to 2010 cohorts. This is less than the growth rate we predict for any single group. This is because Hispanics, who have the lowest graduation rate, make up large shares of the 2000 and 2010 birth cohorts. Thus, we do not expect the overall education level of the US workforce to increase substantially over the next few cohorts.

Finally, we use our model to predict impacts of tuition subsidies on college attendance. We predict a tuition subsidy of $12.9k per year would increase the college graduation rate of Hispanic women in the 1980 birth cohort by 5.1 pp. This would close the part of the gap with White women due to lower mother's education. Going forward, and assuming the subsidy is removed, this increase in mother's education would increase the college graduation rate of their daughters in the 2000 birth cohort (20 years later) by 3.5 pp, and their sons by 2.1 pp. Thus, there is a large passthrough of the subsidy impact to the next generation.

Interestingly, the same size subsidy would only increase the college graduation rate of Black women by 2.3 pp. This is because, in the 1980 cohort, over 90% of high ability Black women were already graduating from college. So it is hard to induce additional Black women to graduate. In contrast, only about 60% of high ability Hispanic women were graduating.

In conclusion, our work contributes to understanding how education generates social mobility. We find it is an important factor, but we also find labor market returns to experience are worse for women and minorities even conditional on college education. In future work, it is important to explore why – i.e., is it due to differences in occupational choice, or differences in within-occupation wage growth? We also contribute to understanding how demographic shifts at the micro level affect the aggregate stock of human capital – as illustrated by our prediction that aggregate education will grow more slowly than that of any gender/race group. More generally, our work illustrates how studying behavior of different demographic groups and successive birth cohorts helps one to understand aggregate outcomes.

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