Is Marriage for White People? Incarceration and the Racial Marriage Divide

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Abstract

During the last few decades, there has been a dramatic decline of marriage among blacks in the US. About 89% of black women between ages 25 and 54 were ever married in 1970. Today only 51% of them are. Wilson (1987) suggests that the lack of marriageable black men due to incarceration and unemployment is responsible for low marriage rates among blacks. In this paper, we take a dynamic look at the Wilson Hypothesis. We argue that the current incarceration policies and labor market prospects make black men much riskier spouses than white men. They are not only more likely to be, but also to become, unemployed or incarcerated than their white counterparts. We develop an equilibrium search model of marriage, divorce and labor supply that takes into account the transitions between employment, unemployment and prison for individuals by race, education, and gender. We calibrate this model to be consistent with key statistics for the US economy. We then investigate how much of the racial divide in marriage is due to differences in the riskiness of potential spouses, heterogeneity in the education distribution, and heterogeneity in wages. We find that differences in incarceration and employment dynamics between black and white men can account for more than half of the existing black-white marriage gap in the data.

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1 Introduction

The black-white differences in marriages in the U.S. are striking. Never-married white women between ages 20 and 44 are about three times more likely to get married than never-married black women (Raley et al 2015). As a result, while 79% of white females between ages 25 and 54 are ever married, only 51% of black females are: a gap of 28 percentage points. The gap was only 5 percentage points in 1970. The growing differences between black and white households and family structure have been a concern for policy makers for a long time. In his famous report Moynihan (1965) saw a clear link between family structure and growing social problems, such as poverty and crime, among blacks. Today, the growing racial gap in marital status of the US population led some researcher to question whether marriage is only for white people (Banks 2011).

This dramatic racial gap in marriages matter since the marital structure has important implications for the living arrangements and well-being of children. In 2014, 70.9% of births among black women were to those who were unmarried, while the fraction of out-of-wedlock births among white women was much lower, just 29.2% (Hamilton et al 2015). Today about 50% of black children live with a single mother, while the percent of white children living with a single mother is about 20%.[1] Differences in family structure is a contributing factor to differences in economic resources. In 2006, just before the recent recession, 33.4% of black children were living below the poverty line, while only 14.1% of white children were.[2]

A growing body of literature suggests that the initial conditions under which children grow up matter greatly for their well-being as adults. Carneiro and Heckman (2003) and Cunha, Heckman, Lochner and Masterov (2006), among others, show that differences between children, appear at very early ages and that the family environment plays a significant role in generating these differences. Neal and Johnson (1996) show that pre-labor market conditions can account for almost all of the wage gap between black and white males.[3] Since Neal and Johnson (1996), others have tried to uncover the factors that account for the differ-

[1]The US Census data on the Living Arrangements of Children, Table CH2. https://www.census.gov/hhes/families/data/children.html

[2]The US Census data on Historical Poverty Tables: People and Families - 1959 to 2015. Table 3. http://www.census.gov/data/tables/time-series/demo/income-poverty/historical-poverty-people.html

[3]For quantitative analysis on the importance of initial conditions versus life-cycle shocks, see Keane and Wolpin (1997), Storesletten, Telmer and Yaron (2004), and Huggett, Ventura and Yaron (2011), and for the racial gap in particular, see Rauh and Valladares-Esteban (2018).

ent initial conditions that black and white children face. Badel (2010), for example, builds a model of neighborhood and school choice by parents and shows that segregation by race into separate neighborhoods has an important impact on the achievement gap between black and white children. Chetty et al (2018) document that black Americans have substantially lower rates of upward mobility and higher rates of downward mobility than whites, leading to large income disparities that persist across generations. There is also a large literature that documents the effects of family structure on children (McLanahan and Sandefur 2009 and McLanahan, Tach, and Schneider 2013). Gayle, Golan and Soytas (2015) point to the importance of differences in family structure by race for intergenerational mobility. They build and estimate a model of intergenerational mobility where parents invest goods and time into the human capital accumulation of their children. Their results indicate that differences in family structure between black and white parents play a key role in accounting for differences in children's outcomes. However, they take differences in family structure as exogenous.

Why do black individuals marry at such low rates compared to white individuals? Wilson (1987) suggests that characteristics of the black male population, and in particular the lack of marriageable black men, has been an important contributing factor to the black and white differences in marital status. This is usually referred to as *the Wilson Hypothesis* in the literature. Others, e.g. Murray (1984), point to the adverse effects of the welfare state that provides incentives for single motherhood. The empirical evidence, which goes back at least to Lichter, McLaughlin, and Landry (1991) and relies on variations across geographical locations, suggests that the incarceration of black males has an important effect on fertility, education and marriage behavior of black women.[4] More directly related to our work, Charles and Luoh (2010) show that higher incarceration rates of males lowers both the likelihood of women every getting married and the quality of their husbands. These papers belong to a larger empirical literature that emphasizes the importance of local labor market conditions on marriage and divorce behavior, such as Blau, Kahn and Waldfogel (2000). In a recent paper, Autor, Dorn and Hanson (2018) show that local trade (China) shocks that reduce male economic conditions reduce marriage and fertility. There are also papers, e.g. Angrist (2002) and Chiappori, Fortin and Lacroix (2002), that study how sex ratio, the number of

[4] See, among others, Lichter et al (1992), Brien (1997), Wood (1995), and Mechoulan (2011).

men for each woman, affect marriage outcomes. The basic idea is that a high (low) sex ratio improves marriage prospects for females (males) as well as their bargaining power within marriages.

Despite a growing empirical literature and public interest, there have been very few attempts to account for differences in black and white marriage rates within an equilibrium model of the marriage market. Keane and Wolpin (2010) try to understand differences in schooling, fertility and labor supply outcomes of black and white women. Their estimates suggest that black women have a higher utility cost of getting married than white women and that this difference might reflect the characteristics of the available pool of men. Their analysis is silent on why black women might have a higher utility cost of getting married. Seitz (2009) builds and estimates a dynamic search model of marriage to study how much the lack of marriageable black men, as reflected in a low sex ratio, affects the marriage gap between whites and blacks. She finds that differences in the sex ratio by race can account for about one-fifth of the marriage gender gap, and about an additional one-third is accounted for by differences in employment opportunities.

In this paper, we take a dynamic look at the Wilson hypothesis. Given current incarceration policies and labor market prospects, black men are much riskier spouses than white men. They are more likely to be unemployed or incarcerated than their white counterparts. As a result, marriage is a risky investment for black women (Oppenheimer 1988). Almost 11% of black men between ages 25 and 54 were in incarcerated in 2010. This is almost five time as high as the incarceration rate for the white men of the same age. Cumulative effects of incarceration on the lives of less educated black men are very large. For black men born between 1965 and 1969, the cumulative risk of imprisonment by ages 30 to 34 was 20.5%. This number is only 2.9% for equivalent white (Western 2006). For black men with less than a high school education, the cumulative risk is close to 60%. It is not surprising that missing black men gets so much media attention (Wolfers, Leonhardt and Quealy 2015). Black men, between ages 25 and 54, are also less likely to be employed, 60% vs. 85%, and more likely to be unemployed, 7.3% vs. 3.6%, as compared to their white counterparts. Fryer (2011) provides an overview of racial inequality in the U.S. Western (2006), Neal and Rick (2014), and Lofstrom and Raphael (2016) document the effects of the prison boom of recent decades on the economic prospects of the black community.

To understand the impact of these risks on marriage decisions, we develop an equilibrium model of marriage, divorce and labor supply that takes into account the transitions between employment, unemployment and prison. We build upon recent quantitative models of the family.[5]

In our model, each period single men and women who differ by productivity are matched in a marriage market segmented by race. They decide whether or not to marry taking into account what their next best option is. Husbands and wives also decide whether to stay married and whether the wife should work in the labor market. There is a government that taxes and provides welfare benefits to poor households. As in Burdett, Lagos and Wright (2003, 2004) individuals in our model move among three labor market states (employment, non-employment and prison).[6] In the model, faced with a pool of men whose future income prospects are highly uncertain, many single black women will become reluctant to enter into a marriage.

We calibrate this model to be consistent with key marriage and labor market statistics by gender, race and educational attainment for the US economy in 2006. We then investigate how much of the racial divide in marriage is due to differences in the riskiness of potential spouses, heterogeneity in the education distribution, and heterogeneity in wages. We find differences in employment and incarceration rates between black and white men can account for more than half of the existing black-white marriage gap in the data. We also study how "The War on Drugs" in the US might have affected the structure of the black families, and find that it can account for between 5% to 8% of the black-white marriage gap.

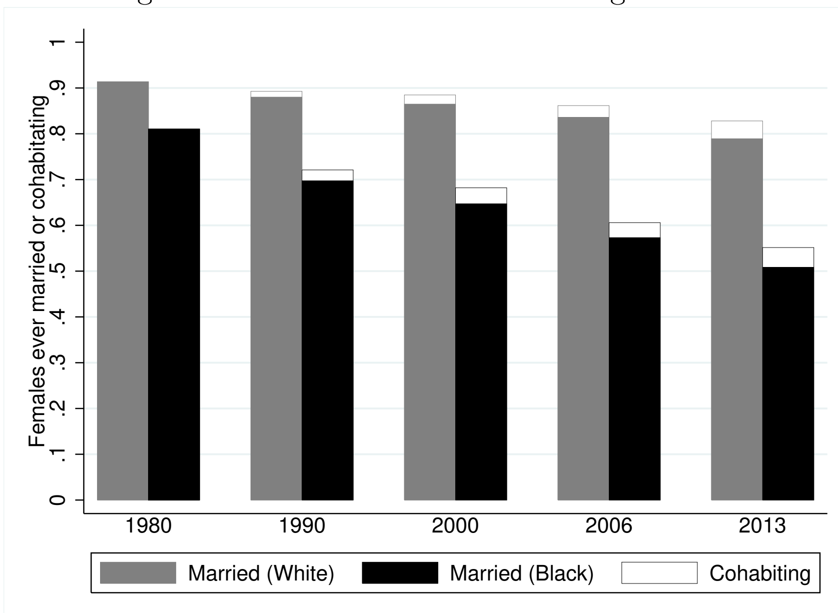
2 Incarceration and Marriage

In Table 1, we document the marital status of women by race since 1970 using data from the 1970-2000 US Censuses and the 2006 and 2013 American Community Survey (ACS). In 1970, 94% of white women between 25 and 54 were ever married. Black women married at a lower rate in 1970, 89%, but this racial gap was much smaller then than it is now. Since 1970, the

[5]See Regalia and Ríos-Rull (2001), Caucutt, Guner and Knowles (2002), Fernandez and Wong (2014), Guvenen and Rendall (2015), Greenwood et al. (2016), Santos and Weiss (2016), and Knowles and Vandenbroucke (2016). Doepke and Tertilt (2016) and Greenwood, Guner and Vandenbrouke (2016) review this literature.

[6]While in our model criminal activity is not a choice and transitions to prison are exogenous, our paper is also related to the large literature, going back to Becker (1968), on economics of crime. See, among others, Imrohoroglu, Merlo and Rupert (2004) and Lochner (2004).

Figure 1: Ever Married or Cohabiting Females



fraction of ever-married women fell for both races. By 2013, only 79% of white women were ever-married, a 15 percentage point decline from 1970. The drop for black females, however, was more pronounced. In 2013, only 51% of black women were ever married, a decline of 38 percentage points.

Table 1: Marital Status of Females by Race, 1970-2010 (%)

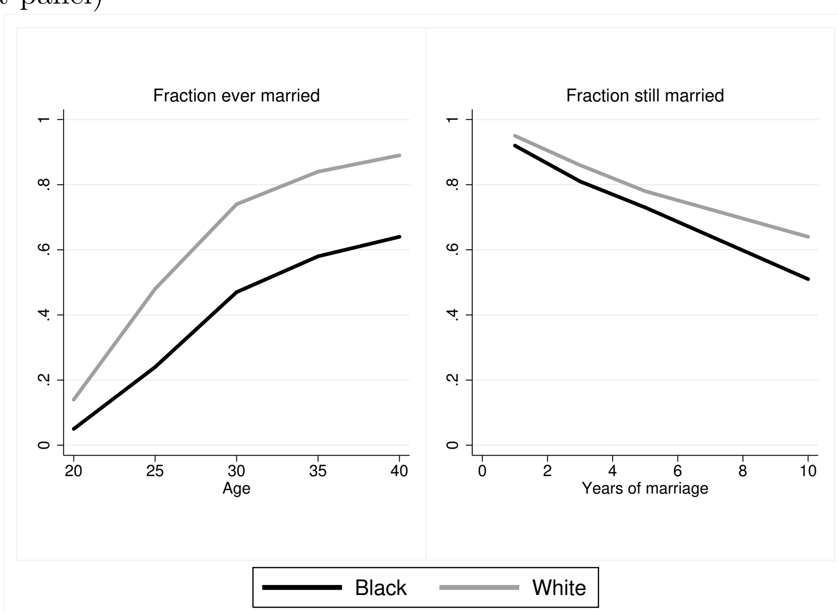
	Ever Married		Never Married		Divorced		Divorce or Separated	
	Black	White	Black	White	Black	White	Black	White
1970	.89	.94	.11	.06	.08	.05	.22	.07
1980	.81	.91	.19	.09	.14	.1	.27	.12
1990	.69	.88	.31	.12	.16	.13	.26	.15
2000	.65	.86	.35	.14	.16	.14	.24	.17
2006	.57	.84	.43	.16	.15	.15	.22	.18
2013	.51	.79	.49	.21	.14	.15	.2	.17

The story in Table 1 does not change if we incorporate cohabiting couples. Figure 1 shows the fraction of women between 25 and 54 who have ever married or are currently cohabiting. While cohabitation mutes the decline in marriage to some extent, the marriage gap between blacks and whites hardly changes.

Black individuals marry later and divorce more than white individuals. However, the lower marriage rate among blacks is primarily due to lack of entry into marriage rather than higher marital instability. The left panel of Figure 2 shows the fraction of ever-married by different ages in 2006-2007 (Copen et al 2012). While almost 90% of white women were married by age 40, while only 64% of black women were ever married by that age. As a result, the median age at first marriage is higher for black women than it is for white women. In 2010, black women married four years later than their white counterparts, 30 versus 26.4 years, while in 1970 the median age at first marriage was about 24 years for both white and black women. Before 1970 black women were marrying at an earlier age than white women (Elliot et al 2012).

Although black couples are more likely to divorce, differences in divorce rates are less pronounced than differences in entry into marriage. The right panel of Figure 2 shows the fraction of marriages that remain intact after different years of marriage in 2002 (Mosher et al 2010). After 5 years of marriage, about 22% and 27% of white and black women had a divorce, respectively. As a result, durations of black and white marriages are also comparable; the median duration for first marriages that end in divorce was 8.3 years for black women and 7.9 years for white women in 2009. However, upon divorce black women are again less likely to remarry. The median duration until remarriage after divorce was 4.7 years for black women and 3.6 for white women (Kreider and Ellis 2010).

Figure 2: Fraction ever-marrid by age (left panel) and Fraction still married by duration of marriage (right panel)



In a press conference in 1971, President Richard Nixon declared illegal drugs as public enemy number one, which the media popularized as the "War on Drugs". In 1982, President Ronald Reagan officially announced the War on Drugs. This led to a substantial increase in anti-drug funding and incentives for police agencies to arrest drug offenders. As part of the Comprehensive Crime Control Act of 1984, the Sentencing Reform Act and the Asset Forfeiture Program were introduced, of which the latter permitted federal and local law enforcement agencies to seize assets and cash under the suspicion of being related to illegal drug business.[7] The Sentencing Reform Act as well as the subsequent Anti-Drug Abuse Act of 1986 included penalties such as mandatory minimum sentences for the distribution of cocaine. The federal criminal penalty for crack cocaine relative to cocaine was set to 100:1, which disproportionately affected poor black, and in particular, urban, neighborhoods. It was not until the Fair Sentencing Act of 2010 that this disparity was reduced to 18:1. In 1994 President Bill Clinton endorsed the "three strikes and you're out" principal, which led to multiple states adopting laws that sentenced offenders to life for their third offense (West, Sabol and Greenman 2010). State prisoners held for drug offenses in 2006 nearly match the number of total state prisoners for any offense in 1980 (264,300 vs 304,759 (BJS 1981)).[8] A criminal record makes it difficult to find a job after time in prison, and as a result, the unemployment rate among black men has also soared (see Page 2007).

Table 2 shows the fraction of men between 25 and 54 who are incarcerated or not employed (i.e. unemployed or out of the labor force). In 1970, about 17% of black men and 7.4% of white men were either in prison or unemployed. By 2013, these numbers had risen to around 40% of black men and 17.5% of white men. During this period, there has been a more than four-fold increase in the fraction of black men who were incarcerated (from 2.1% to 9%) and a nearly twofold increase in the fraction of black men who were nonemployed (from 15% to

[7] Baicker and Jacobson (2007) find that police agencies responded by increasing drug arrest rates.
[8] 95% of prisoners are held in state rather than federal correctional facilities.

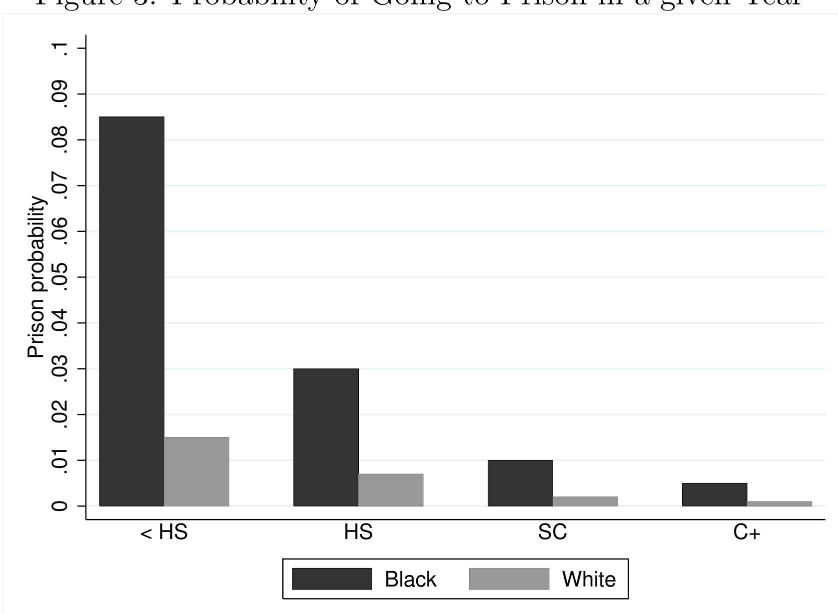
31%).

Table 2: Incarceration and Unemployment of Men by Race, 1970-2013

	Incarceration		Nonemployment	
	Black	White	Black	White
1970	.021	.003	.146	.071
1980	.027	.003	.220	.098
1990	.066	.010	.240	.096
2000	.096	.014	.291	.118
2006	.091	.013	.272	.129
2013	.090	.015	.309	.160

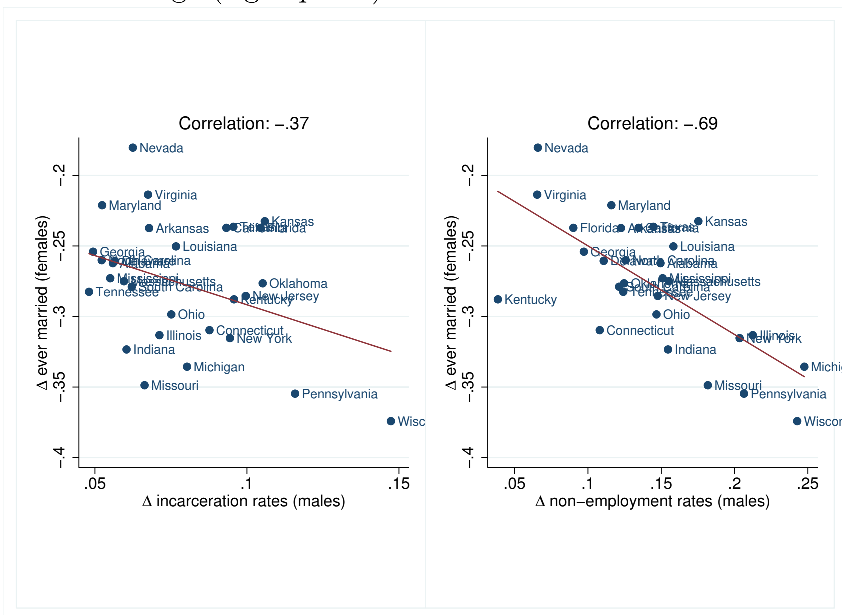
The numbers in Table 2 reflect very significant differences in the risk of incarceration between black and white men. Figure 3 shows the probability that a man between 25 and 54 goes to prison in a given year. A black man with less than a high school (with a high school) education has an 8% (3%) chance of going to prison. The risk is about 1.5% (0.7%) for a white man with the same level of education.

Figure 3: Probability of Going to Prison in a given Year



To better understand the relationship between incarceration and marriage, we turn to state level data. The left panel in Figure 4 shows the relationship between the racial differences in incarceration rates and marriage rates across US states in 2006. The states in which there is a larger racial gap in incarceration rates, such as Pennsylvania and Wisconsin, are also the ones in which we observe a high racial gap in marriage. The effects are even stronger if we look at the black-white differences non-employment rates, as can be seen in the right panel of Figure 4.

Figure 4: Black-White Differences in 2010: Incarceration versus Marriage (left panel), Non-Employment versus Marriage (right panel)

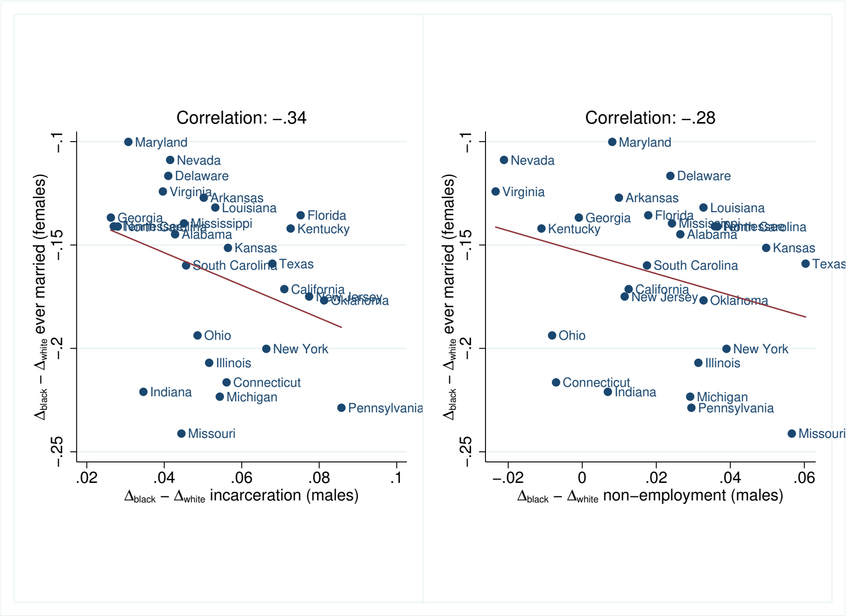


The negative relationships in Figure 4 could be due to racial differences in preferences for marriage. However, we find that these negative relationships also hold when we look at differences in changes between races across time, thereby removing any traits by race that are constant over time. In the left panel of Figure 5, we add a time dimensions to the cross-sectional dimension by taking the difference in difference between the increase in incarceration rates of black and white men between 1980 and 2006 by state and the difference in difference in black versus white women who are ever married. In Pennsylvania, for instance, the incarceration rate of black relative to white men increased by more than 8 percentage points, and during the same time period the likelihood of ever being married for black relative to white women fell by around 23 percentage points. In the right panel of Figure 5, we look at non-employed men. Again there remains a strong negative relationship of black relative to white between the increase in non-employment of men versus ever married women.[9] In Section 6, we investigate whether a calibrated version of our model economy is

[9]In Appendix Figure E1, we look at the relationship of both incarceration and non-employment together

able to generate an elasticity of marriage rates with respect to incarceration rates that is in line with the evidence provided in Figure 5.

Figure 5: Black-White Differences in Changes between 1980 and 2010: Incarceration versus Marriage (left panel), Non-Employment versus Marriage (right panel)



versus ever married females, finding the same patterns.

3 The Economic Environment

We study a stationary economy populated by a continuum of males and a continuum of females. Let $g \in \{f, m\}$ denote the gender of an individual. Individuals also differ by race, black or white, indicated by $r \in \{b, w\}$. Individuals face a constant probability of survival ρ each period. Those who die are replaced by a measure $(1-\rho)$ of newborns. Agents discount the future at rate $\widetilde{\beta}$, so $\beta = \rho\widetilde{\beta}$ is the discount factor taking into account the survival probabilities. Among individuals who enter the model economy each period, sex ratio (males/females) is assumed to be one for whites and it is assumed to be less than one for blacks.

Individuals born with a given education level. They can be high school dropouts, high school graduates, have some college education, or college graduates. We denote the education level of a female by x and that of a male by z. The education level is a permanent characteristic of an agent that remains constant over his/her life and maps directly into a wage level. Wages differ by gender, race and education and are denoted by $\omega_m^{z,r}$ and $\omega_f^{x,r}$. Each period, individuals also receive a persistent earnings shock denoted by $\varepsilon \in \mathcal{E} \equiv \{\varepsilon_1, \varepsilon_2, ..., \varepsilon_{N_\varepsilon}\}$.

Individuals participate in labor and marriage markets. At any point in time, men can be in one of three labor market states: employed (e), non-employed (u) or in prison (p). Women do not go to prison.[10] They can be employed (e) or non-employed (u). Single women and single men, who are not in prison meet each other in a marriage market, and decide whether or not to get married. Since some males are in jail and the sex ratio is less than one among blacks, there are more females than males in the marriage market, and the imbalance is potentially larger for blacks. As a result, some single females do not match with any male in the marriage market. Let S and M denote single and married individuals, respectively.

As a result of the underlying heterogeneity and decisions, some households in the model are married couples, while others are single-male or single-female households. In some married households both the husband and the wife work, while in others one or both members are unemployed, yet in others the husband is in prison. Similarly, some single females work, while others don't, and some single males might be in prison. Among individuals who work some are lucky and enjoy a high ε, while others are unlucky and have a low ε.

[10] According to Bureau of Justice Statistics, only about 7% of prison and 9% of jail populations were females in 2013 (http://www.bjs.gov/content/pub/pdf/cpus13.pdf).

3.1 Labor Markets and Prison Transitions for Males

There is an exogenous Markov process for men among the three labor market states, (e, u, p), which depends on their race and education. Men do not make a labor supply decision, whenever they are employed they supply an exogenous amount of hours, denoted by $\overline{n}_m^{S,r}$ and $\overline{n}_m^{M,r}$ for single and married men, respectively. All men who are employed also receive a persistent productivity shock, ε, and their earnings are given by $\omega_m^{z,r}\overline{n}_m^{S,r}\varepsilon$ or by $\omega_m^{z,r}\overline{n}_m^{M,r}\varepsilon$.

Let $\Pi^{z,r}(\lambda', \varepsilon'|\lambda, \varepsilon)$ be the probability that a man with current labor market status $\lambda \in \{e, u, p\}$ and labor market shock ε moves to state (λ', ε') next period. These transitions depend on the education (z) and race (r). We construct this transition in three steps. First, let $\Lambda^{z,r}(\lambda'|\lambda)$ be the transition matrix for labor market status λ:

$$
\Lambda^{z,r}(\lambda'|\lambda) = \begin{array}{c} \\ p \\ u \\ e \end{array} \begin{array}{c} \begin{array}{ccc} p & u & e \end{array} \\ \begin{pmatrix} \pi_{pp} & \pi_{pu} & \pi_{pe} \\ \pi_{up} & \pi_{uu} & \pi_{ue} \\ \pi_{ep} & \pi_{eu} & \pi_{ee} \end{pmatrix} \end{array}
$$

which determines how men move between employment, non-employment, and prison.

Next, we define a transition matrix for idiosyncratic productivity shocks ε, given by:

$$
\Upsilon_m^{z,r}(\varepsilon'|\varepsilon) = \begin{array}{c} \\ \varepsilon_1 \\ \varepsilon_2 \\ \vdots \\ \varepsilon_{N_\varepsilon} \end{array} \begin{array}{c} \begin{array}{cccc} \varepsilon_1 & \varepsilon_2 & \dots & \varepsilon_{N_\varepsilon} \end{array} \\ \begin{pmatrix} \pi_{11} & \pi_{12} & \dots & \pi_{1N_\varepsilon} \\ \pi_{21} & \pi_{22} & \dots & \pi_{2N_\varepsilon} \\ \vdots & \vdots & \vdots & \vdots \\ \pi_{N_\varepsilon 1} & \pi_{N_\varepsilon 2} & \dots & \pi_{N_\varepsilon N_\varepsilon} \end{pmatrix} \end{array}
$$

where $\pi_{i1} + \pi_{i2} + ... + \pi_{iN_\varepsilon} = 1 - \pi_{ep} - \pi_{eu} = \pi_{ee}$ for each i. An employed man becomes unemployed with probability π_{eu} or goes to prison with probability π_{ep}. With the remaining probability he stays employed and draws a new productivity shock according to $\Upsilon_m^{z,r}(\varepsilon'|\varepsilon)$. Finally, we assume that all men who move from prison to employment receive ε_1 (the lowest wage shock), while those who move from unemployment to employment draw ε from a distribution denoted by $\widetilde{\Upsilon}_m^{z,r}(.)$.

The composite of these three steps yields $\Pi^{z,r}(\lambda', \varepsilon'|\lambda, \varepsilon)$:

$$\Pi^{z,r}(\lambda', \varepsilon'|\lambda, \varepsilon) = \begin{array}{c} \\ p \\ u \\ \varepsilon_1 \\ \varepsilon_2 \\ \vdots \\ \varepsilon_{N_\varepsilon} \end{array} \begin{array}{c} \begin{array}{cccccc} p & u & \varepsilon_1 & \varepsilon_2 & \dots & \varepsilon_{N_\varepsilon} \end{array} \\ \begin{pmatrix} \pi_{pp} & \pi_{pu} & 1 & 0 & \dots & 0 \\ \pi_{up} & \pi_{uu} & \widetilde{\Upsilon}^{z,r}_m(\varepsilon_1) & \widetilde{\Upsilon}^{z,r}_m(\varepsilon_2) & \dots & \widetilde{\Upsilon}^{z,r}_m(\varepsilon_{N_\varepsilon}) \\ \pi_{ep} & \pi_{eu} & \pi_{11} & \pi_{12} & \dots & \pi_{1N_\varepsilon} \\ \pi_{ep} & \pi_{eu} & \pi_{21} & \pi_{22} & \dots & \pi_{2N_\varepsilon} \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ \pi_{ep} & \pi_{eu} & \pi_{N_\varepsilon 1} & \pi_{N_\varepsilon 2} & \dots & \pi_{N_\varepsilon N_\varepsilon} \end{pmatrix} \end{array}$$

Upon getting out of prison a man moves to unemployment with probability π_{pu} or gets a job with probability π_{pe}. If he gets a job, then his productivity shock is equal to ε_1. Similarly, an unemployed man goes to prison with probability π_{up} or finds a job with probability $\pi_{ue} = \widetilde{\Upsilon}^{z,r}_m(\varepsilon_1) + ... + \widetilde{\Upsilon}^{z,r}_m(\varepsilon_{N_\varepsilon})$. Finally, an employed man with current productivity shock ε_i goes to prison with probability π_{ep} or becomes unemployed with probability π_{eu}. Otherwise, he moves to another labor market shock ε_j next period with probability π_{ij}.

If a man has ever been in prison he faces a wage penalty. Let $P \in \{0, 1\}$ denote whether a man has ever been in prison. Let $\psi^r(P)$ be the associated wage penalty, where $\psi^r(0) = 1$, and $\psi^r(1) < 1$.[11] Earnings of a married (or single) type-z man with a current productivity shock ε and prison history P is given by $\omega^{z,r}_m \varepsilon \psi^r(P) \overline{n}^{M,r}_m$ (or $\omega^{z,r}_m \varepsilon \psi^r(P) \overline{n}^{S,r}_m$).

3.2 Labor Market Transitions for Females

Because women do not go to prison, each period they are either employed (e) or non-employed (u). Unlike men, women make a labor force participation decision. We assume that each period an unemployed woman receives an opportunity to work with probability $\theta^{x,r}$. She decides whether to work or not. If she works, then she supplies $\overline{n}^{S,r}_f$ or $\overline{n}^{M,r}_f$ hours, which depends on her marital status and race. Each period an employed woman faces a probability $\delta^{x,r}$ of losing her job and becoming unemployed.

Like men, each period women receive a productivity shock ε. If a married (or single) female decides to work, her earnings are given by $\omega^{x,r}_f \varepsilon \overline{n}^{M,r}_f$ (or $\omega^{x,r}_f \varepsilon \overline{n}^{S,r}_f$). As long as a

[11] Waldfogel (1994) and Western (2006) document the wage and employment penalties suffered by ex-convicts, while Kling (2006) shows that conditioning on conviction, the length of incarceration has no additional impact. Our model assumptions are consistent these findings, i.e. the extensive margin of incarceration brings a wage penalty with it which is independent of the intensive margin.

woman is employed, her productivity shock ε follows a Markov process denoted by $\Upsilon_f^{x,r}(\varepsilon'|\varepsilon)$. When an unemployed woman becomes employed, she draws a new productivity shock from $\widetilde{\Upsilon}_f^{x,r}(\varepsilon)$.

Working is costly for a woman and her family. If a woman does not work, then she (if she is single) or both she and her husband (if she is married) enjoy a utility benefit q. We assume that q is distributed among women according to $q \sim Q(q)$. Women draw q at the start of their lives and it remains with them forever. This captures additional heterogeneity in female labor force participation decisions.[12] The labor supply decision of a woman depends on her education level, her marital status and her husband's characteristics, her current labor market shocks, as well as on her value of staying at home.

3.3 Marriage and Divorce

We assume that there is a marriage market in which single people from each race meet others of the same race.[13] Some females, however, do not match with any male since some of the males are in prison. Furthermore, when individuals enter into the model, there are more black females than males. As a result these two factors, a female matches with a male with probability $\kappa^r < 1$. Furthermore, within each marriage market, a person of race r meets someone with the same education with probability $\varphi^{x,r}$ and meets other singles, from the education distribution of current singles, randomly with the remaining probability $1 - \varphi^{x,r}$. The parameter φ captures forces that give rise to assortative mating by education, but that are not explicitly modeled here.[14]

Upon a meeting, couples observe a permanent match quality γ, with $\gamma \sim \Gamma(\gamma)$. The value of γ remains constant as long as the couple remains married. Couples also observe a transitory match quality shock ϕ, with $\phi \sim \Theta(\phi)$. Unlike γ, couples draw a new value of ϕ each period. Besides, γ and ϕ, individuals observe their partner's permanent education and home value characteristics, i.e. z, x, and q, their labor market status λ (which can be e, u or p), labor market shocks ε, as well as the prison history of the man P at *the start of a*

[12]Guner, Kaygusuz and Ventura (2012) and Greenwood et al. (2016) follow a similar strategy to model female labor force participation.

[13]We abstract from inter-racial marriages. Chiappori, Oreficce and Quintana-Domeque (2016) provide an empirical analysis of black-white marriage and study the interaction of race with physical and socioeconomic characteristics. Wong (2003) estimates a structural model of inter-racial marriages, and factors behind the low level of black-white marriages in the US.

[14]Fernandez and Rogerson (2001) follow a similar strategy to generate positive assortative mating.

period, and decide whether to get married based on this information. A marriage is feasible if and only if both parties agree. Once marriage decisions are made, labor market status and labor market shocks for *the current period* are realized, and agents, married or single, make consumption and labor supply decisions. We assume that a married woman whose husband is in prison, suffers a utility cost, denoted by ζ.

Because labor market status and labor market shocks are revealed only after marriage decisions are made, people decide whether or not to marry based on the expected value of being married conditional on their own and their partners' current labor market status and labor market shocks. After getting married, the husband or the wife might lose his/her job or draw a better or worse wage shock, or the husband might go to prison.

Each period, currently married couples decide whether or not to remain married or get divorced. These decisions are also made based on all available information at the start of the period. Divorce is unilateral, and if a couple decides to divorce, each party suffers a one-time utility cost, η. Note that given this information structure, a wife whose husband ends up in prison in a period can opt for divorce only at the start of the next period.

Finally, we assume that married couples must finance a fixed consumption commitment, $\underline{c}(x, z)$, each period. This consumption commitment captures expenditures, such as the fixed cost of a larger house and basic furniture, or costs associated with children, that a married couple cannot avoid. This model feature follows Santos and Weiss (2016) and Sommer (2016). Santos and Weiss (2016) suggest that an important factor for the decline and delay of marriage in the US was the rise in idiosyncratic labor income volatility. In their model, consumption commitments make marriage less attractive when there is higher income volatility. In Sommer (2106) consumption commitments lowers fertility in the face higher idiosyncratic income risk. In the current model, consumption commitments play a similar role. Black individuals, who face more labor market uncertainty, both in terms of transitions to unemployment and prison, as well as productivity shocks, will tend to marry less frequently to avoid incurring this fixed cost.[15]

[15] Chetty and Szeidl (2007) study how consumption commitments affect risk preferences and show that they amplify risk aversion. Using data from CEX they document that more than 50% of the average household budget is hard to change in the face of moderate income shocks.

3.4 Government

There is a government that taxes labor earnings at a proportional rate τ and finances transfers to households. These transfers depend on pre-tax, household income. Let $T_f^S(Y)$, $T_m^S(I)$ and $T^M(I)$ denote the transfers received by single female, single male and married couple households with total pre-tax household income Y, respectively. We assume that these transfer functions take the following form (where we suppress the dependence on gender and marital status)

$$T(Y) = \begin{cases} b_0 \text{ if } Y = 0 \\ \max\{0, b_1 - b_2 Y\} \text{ if } Y > 0 \end{cases}.$$

If a household has zero earnings, they receive b_0. If they have positive earnings, transfers decline at rate b_2. As a result, there is an income level above which transfers are zero.

4 Household Problems

4.1 Single Females

We begin by thinking about the household decision problems facing single people and couples, once all uncertainty in a period is realized. These value functions depend on current utility and the value of starting next period either single or married before marriage markets take place and before any uncertainty is realized. In the next section we define the start-of-period value functions. The within period (post-marriage decision and after all uncertainty is realized) value functions are denoted as V, while the start of period (pre-marriage decision/market and before all uncertainty is realized) value functions are denoted as $\tilde{V}$. Because marriage markets are segmented by race, we do not indicate explicitly the race of an individual with the understanding that wages, hours worked, and exogenous labor market and prison transitions for men, and arrival of employment opportunities and job destruction probabilities for women differ by race.

Start with the problem of a single woman whose state is given by $\mathcal{S}_f^S = (x, q, \varepsilon)$, and employment draw, λ. She decides whether or not to work. If $\lambda = e$, she can choose to work $\overline{n}_f^S$ or decide not to work. If $\lambda = u$, she is non-employed and does not have any labor income. A single woman's pre-tax labor household income is given by $Y_f^S = \omega_f^x \overline{n}_f^S \varepsilon$, if she works and by $Y_f^S = 0$, if she does not. Given government transfers, a single woman's after tax-and-transfer income is $Y_f^S(1-\tau) + T_f^S(Y_f^S)$. Finally, if she chooses not to work, she enjoys the utility of staying home, q.

At the start of a period, she enters the marriage market. The value of being in the marriage market at the start of the next period depends on her state, $\mathcal{S}_f^S$ and her employment status, λ'. This is denoted by the value function $\widetilde{V}_f^S(\mathcal{S}_f^S, \lambda')$. As it will be come clear below $\tilde{V}$ depends on the distribution of single males that are available in the marriage market next period. Given $\widetilde{V}_f^S(\mathcal{S}_f^S, \lambda')$, the value of being a single female in the current period is given by

$$V_f^S(\mathcal{S}_f^S, \lambda) = \max_{n_f^S}\{\frac{c^{1-\sigma}}{1-\sigma} + \chi_{(n_f^S=0)}q + \beta\widetilde{V}_f^S(\mathcal{S}_f^S, \lambda')\},$$

subject to

$$c = Y_f^S(1-\tau) + T_f^S(Y_f^S)\ ,\ n_f^S = \begin{cases} \in \{0, \overline{n}_f^S\} \text{ if } \lambda = e \\ 0 \text{ if } \lambda = u \end{cases}\ ,\ \lambda' = \begin{cases} e \text{ if } n_f^S > 0 \\ u, \text{ otherwise} \end{cases}\ ,$$

where χ is an indicator function such that $\chi_{(n_f^S=0)} = 1$. Note that her labor market status at the start of next period, λ', is determined by her current labor market status, λ and her labor supply decisions this period. If $\lambda = u$, then $\lambda' = u$ as well. If $\lambda = e$ and she decides to work, then $\lambda' = e$, and $\lambda' = u$, otherwise.

4.2 Single Males

Once uncertainty is realized, a single man's state is given by $\mathcal{S}_m^S = (z, \lambda, \varepsilon)$ and his prison history indicator, P. A single man makes no decisions. If $\lambda = e$, he works $\overline{n}_m^S$ and earns pre-tax income $Y_m^S = \omega_m^z \overline{n}_m^S \psi(P)\varepsilon$. His consumption is then, $c = Y_m^S(1-\tau) + T_m^S(Y_m^S)$, where the second term represents transfers from the government. Recall that criminal history results in a wage penalty of $\psi(P)$. If a man is unemployed, he does not work, and $Y_m^S = 0$, and his only income is government transfers. Finally, when a man is in prison we assume that he consumes an exogenously given level of consumption c_p.[16] Let $\widetilde{V}_m^S(\mathcal{S}_m^S, P')$ be the value of starting next period as a single man, which will again depend on the distribution of single females next period. Then the value of being a single man in the current period is given by

$$V_m^S(\mathcal{S}_m^S, P) = \frac{c^{1-\sigma}}{1-\sigma} + \beta\widetilde{V}_m^S(\mathcal{S}_m^S, P'),$$

subject to

$$c = \begin{cases} Y_m^S(1-\tau) + T_m^S(Y_m^S) \text{ if } \lambda \neq p \\ c_p \text{ if } \lambda = p \end{cases} \text{ and } P' = \begin{cases} 1 \text{ if } \lambda = p \\ P \text{ otherwise.} \end{cases} .$$

[16]Because we do not conduct any normative analysis, and also do not finance c_p by taxes, its exact value does not matter for the quantitative analysis.

Note that if a man is in prison this period, $\lambda = p$, then next period P' is 1 (regardless of his criminal history). Otherwise, $P' = P$ and his criminal record is not updated.

4.3 Married Couples

The problem of a married couple, with uncertainty resolved, depends on their current state $\mathcal{S}^M = (x, q, \varepsilon_f; z, \lambda_m, \varepsilon_m; \gamma, \phi)$, which combines the characteristics of the wife, (x, q, ε_f), those of the husband, $(z, \lambda_m, \varepsilon_m)$, and the match qualities γ and ϕ, and the wife's employment status, λ_f, and the husband's prison history indicator, P. We assume that a married household maximizes the weighted sum of their utilities, with exogenous weight on the female given by μ.

The only decision a married couple makes is whether or not the wife should work, and this is relevant only when $\lambda_f = e$. This decision, along with the husband's employment/prison shock determines household pre-tax income, I^M. If the wife works, she contributes, $\omega_f^x \overline{n}_f^M \varepsilon_f$. If the husband works, he contributes, $\omega_m^z \overline{n}_m^M \psi(P)\varepsilon_m$. Consumption for each household member is then given by $c = \frac{1}{1+\xi}(I^M(1-\tau) + T^M(Y^M) - \underline{c})$, where $0 \leq \xi < 1$ captures economies of scale in household consumption. Note, if the husband is in prison $\xi = 0$, and the husband consumes, c_p. Whatever the labor market status of the couple is (even if the husband is in prison), the non-incarcerated part of the household still pays the fixed cost $\underline{c}(x, z)$. Whenever the wife does not work, both the wife and the husband enjoy q.

At the start of each period, a married couple decides whether to get divorced or stay married. Recall that couples make their marriage/divorce decisions after they observe the new value of the match quality, ϕ, but before their labor market statuses update. Let $\widetilde{V}_g^m(\mathcal{S}^M, \lambda_f', P')$ for $g \in \{f, m\}$ be the value of being married at the start of the next period, with an option to divorce.

The problem of a married couple in the current period is:

$$\max_{n_f^M} \left[\mu \frac{c_f^{1-\sigma}}{1-\sigma} + (1-\mu)\frac{c_m^{1-\sigma}}{1-\sigma} + \chi_{(n_f^M=0)} q + \gamma + \phi + \mu\beta E_{\phi'} \widetilde{V}_f^M(\mathcal{S}^M, \lambda_f', P') + (1-\mu)\beta E_{\phi'} \widetilde{V}_m^M(\mathcal{S}^M, \lambda_f', P') \right]$$

subject to

$$c_f = \frac{1}{1+\xi}\left[I^M(1-\tau) + T^M(Y^M) - \underline{c}\right] \text{ where } \xi = 0 \text{ if } \lambda_m = p,$$

and

$$c_m = \begin{cases} c_p, & \text{if } \lambda_m = p \\ c_f, & \text{otherwise} \end{cases}, n_f^M = \begin{cases} \in \{0, \overline{n}_f^M\} \text{ if } \lambda_f = e \\ 0 \text{ if } \lambda_f = u \end{cases},$$

$$P' = \begin{cases} 1 \text{ if } \lambda = p \\ P \text{ otherwise} \end{cases}, \text{ and } \lambda_f' = \begin{cases} e \text{ if } n_f^M > 0 \\ u, \text{ otherwise} \end{cases}.$$

Note that the labor market status of the wife at the start of next period is determined by her employment status and labor supply choice in the current period. The prison history indicator for the husband at the start of next period is updated if the husband is in prison that period. Let the value functions for females and males associated with this problem be given by $V_f^M(\mathcal{S}^M, \lambda_f, P)$ and $V_m^M(\mathcal{S}^M, \lambda_f, P)$, respectively.

4.4 Start-of-the-Period Values

Consider now the value of being a single woman at the start of a period. A single female meets a single male with probability κ, observes his start-of-the-period state, i.e. $\lambda_m \in \{e, u, p\}$, ε_m and P. Upon a match, the couple draws γ (the permanent match quality) and ϕ (the transitory match quality). Then they decide whether to get married or not. A marriage is only feasible if both parties agree. Note that κ is an endogenous object, which depends on the fraction of men who are in prison.

Let $EV_f^M(x, q, \lambda_f, \varepsilon_f; z, P, \lambda_m, \varepsilon_m; \gamma, \phi)$ be the expected value of entering into a marriage for a female *before* the labor market shocks are updated, and let the function $I_m(.)$ indicate whether this marriage is acceptable for the male. Finally, let $\Omega(z, P, \lambda_m, \varepsilon_m)$ be the distribution of single males in the marriage market, which is an *endogenous* object. In the marriage market, a woman of type x meets men of the same type, $x = z$, with probability φ, and matches randomly with probability $(1 - \varphi)$.

The value of being a single female at the start of the period (before the matching takes place) is then given by:

$$
\begin{aligned}
\widetilde{V}_f^S(x,q,\lambda_f,\varepsilon_f) \;=\;& (1-\kappa)EV_f^S(x,q,\lambda_f,\varepsilon_f) + \qquad (1)\\
& \kappa\varphi \sum_{P,\lambda_m,\varepsilon_m,\gamma,\phi} \max\{EV_f^M(x,q,\lambda_f,\varepsilon_f;x,P,\lambda_m,\varepsilon_m;\gamma,\phi)\\
& I_m(x,q,\lambda_f,\varepsilon_f;x,P,\lambda_m,\varepsilon_m;\gamma,\phi),\\
& EV_f^S(x,q,\lambda_f,\varepsilon_f)\}\Gamma(\gamma)\Theta(\phi)\Omega(z,P,\lambda_m,\varepsilon_m|z=x)\}\\
& +\kappa(1-\varphi) \sum_{z,P,\lambda_m,\varepsilon_m,\gamma,\phi} \max\{EV_f^M(x,q,\lambda_f,\varepsilon_f;z,P,\lambda_m,\varepsilon_m;\gamma,\phi)\\
& I_m(x,q,\lambda_f,\varepsilon_f;z,P,\lambda_m,\varepsilon_m;\gamma,\phi),\\
& EV_f^S(x,q,\lambda_f,\varepsilon_f)\}\Gamma(\gamma)\Theta(\phi)\Omega(z,P,\lambda_m,\varepsilon_m)\}.
\end{aligned}
$$

Figure 6 illustrates the decision tree behind the values function in equation 1. The expected value of being single, $EV_f^S(x,q,e,\varepsilon_f)$, depends on how labor market λ_f and wage shocks ε_f evolve next period. Similarly, the expected value of being married to a type-$(z,P,\lambda_m,\varepsilon_m)$ male with match qualities γ and ϕ, $EV_f^M(x,q,u,\varepsilon_f;z,P,\lambda_m,\varepsilon_m;\gamma,\phi)$, depends on how labor market and wage shocks for both parties evolve. We detail these functions as well as $\widetilde{V}_m^S$ values in Appendix A.

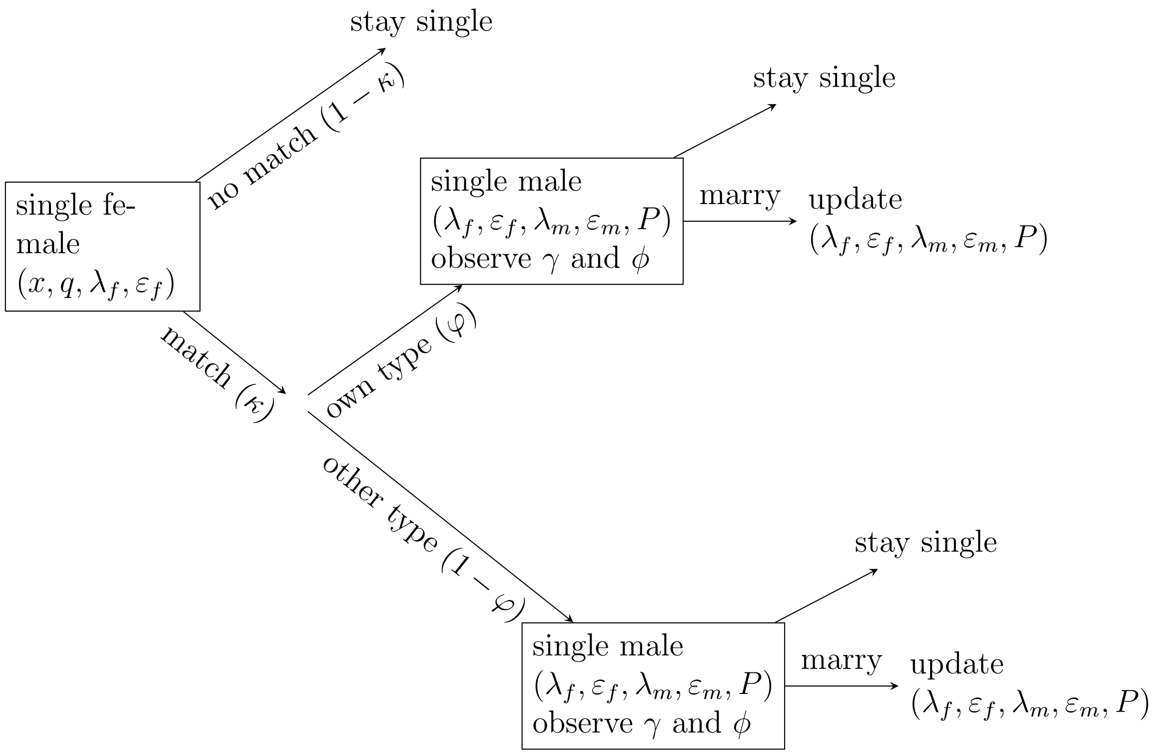
5 Quantitative Analysis

We fit our model economy to U.S. data for 2006. We assume that the length of a period is one year. Let β (the subjective discount factor) be 0.96, a standard value in macroeconomic studies.[17] All the targets for the estimation are calculated for individuals between ages 25 and 54, which corresponds to an operational lifespan of 30 years. We set $(1-\rho) = 1/30 = 0.033$, so that individuals in the model also live 30 years on average.

The quantitative analysis focuses on black and white non-hispanics and non-immigrants. We assume that there are four types (education groups): less than high school (< HS), high school (HS), some college (SC), and college and above (C). Table 3 shows how the population is distributed across gender, and education within each race based on the 2006 US American Community Survey (ACS) from the Integrated Public Use Microdata Series (King 2010). The fractions for each race sum to one in Table 3. In the benchmark economy,

[17]See, e.g., Prescott (1986).

Figure 6: Female decision tree



88% of the population is white and the rest are black. Based on Table 3, we assume that when individuals enter into the model economy, there are 0.87 black males for each black female. The sex ratio for whites is set to 1. This exogenous sex ratio, together with males who are in prison determines κ^r, the probability that a single female does not match with a male in the marriage market.

Whites on average are more educated than blacks, and females are more educated than males. The college-education gap between black females and males is particularly striking. About 10% of the black population consist of college-educated females while only 6.5% are college-educated males. This gap is smaller for whites (17% versus 15.5%).

Table 3: Distribution of Population

	Black			White	
	Female	Male		Female	Male
< HS	5.64	6.57	< HS	2.53	3.38
HS	22.67	22.84	HS	17.76	19.72
SC	14.95	10.54	SC	12.96	11.35
C	10.26	6.52	C	16.82	15.48
Total	53.53	46.47	C	50.07	49.93

Wages Table 4 shows hourly wages in the data, which map directly to $\omega_f^{x,r}$ and $\omega_m^{z,r}$ for $r \in \{b, w\}$ in the model. We compute mean hourly wages conditional on gender and race from the 2006 American Community Survey (ACS). We then normalize mean hourly wages for each group by the overall mean of hourly wages in the economy ($20.70). For each gender and education level, whites have greater average hourly wages than blacks. Males have higher wages than females, but the gender wage gap is much smaller for blacks than it is for whites.[18] Finally, based on Western (2006), the earnings penalty after prison is set to $\psi(P) = .642$ for whites, and $\psi(P) = .631$ for blacks.

Table 4: Hourly Wages
(normalized by mean wages)

	Blacks		Whites	
	Female	Male	Female	Male
<HS	0.496	0.561	0.510	0.682
HS	0.624	0.757	0.654	0.900
SC	0.710	0.846	0.796	0.993
C	1.062	1.183	1.200	1.679

Hours Worked Table 5 shows hours worked per week from the ACS 2006 (conditional on working) by gender, race and education. Across the board, hours worked increase with level of education. While black females tend to work more hours than equivalently educated

[18] See Neal (2004) for an analysis of black-white wage gap.

white females, the opposite holds for males.

Table 5: Usual Hours Worked per Week
(conditional on working)

	Black			White	
	Female	Male		Female	Male
$<$ HS	35.93	38.77	$<$ HS	35.95	42.74
HS	38.17	41.28	HS	37.13	44.22
SC	39.29	42.70	SC	37.35	44.68
C	40.86	44.37	C	38.89	45.98

5.1 Incarceration

Despite the large prison population, data on prison stocks and flows is rather scarce.[19] The available data does not allow us to directly identify transitions by race and education for the entire prison population. The most detailed and reliable survey is the Survey of Inmates in State and Federal Correctional Facilities (SISCF), which is an extensive and representative survey of inmates providing a snapshot of the composition of prisoners at one point in time. We provide a detailed description of the SISCF in Appendix C. We restrict our sample to prisoners between ages 25 and 54 who enter into a state of federal prison within a year. The average prisoner in our sample is about 36 years old. Indeed, despite the common belief that crime is mainly a young man's activity, the age distribution of inmates is surprisingly uniform between ages 20 and 50. The average sentence of inmates in our sample is about 6.4 years for those in state prisons and about 9.4 years for those in federal prisons. Most of the inmates have high school graduates are drop outs. In state prisons, for example, almost 90% of inmates have at mots a high school degree. Finally, most common crimes, in particular for blacks are those related to drugs.

In order approximate transitions into and out of prison for males, we follow an approach similar to Pettit and Western (2004). First, using the 2004 SISCF, we compute the fraction of prisoners between ages 25 and 54 who were admitted within the last 12 months for each level of education and race. We don't know, however, whether an agent entered into prison from employment or unemployment. As a result, we assume that these probabilities are equal. Second, we multiply these shares by the total number of admissions to state and federal prisons in 2004, which we can be obtained from the Bureau of Justice Statistics (BJS). This

[19]The available data allows us to consider state and federal prison but not to include transitions into and out of jail.

approach assumes the SISCF is representative of total admissions in 2004. Third, using the Current Population Survey (CPS) and the number of people for each race and level of education obtained in the second step, we compute the fraction of the total population of a given race and level of education who were admitted to prison in 2004.

Table 6: Probability of Going to Prison (yearly)

Education	Black	White
< HS	.085	.015
HS	.030	.007
SC	.010	.002
C	.005	.001

The results are reported in Table 6, and are used to calibrate $\pi_{up} = \pi_{ep}$ for each race and education level. Blacks are about five times more likely to transition into prison within each education category.

Next we calibrate π_{pp}. Using the SISCF, we find that the average sentence length of blacks and whites between ages 25 and 54 who were admitted to prison in 2004 is around 6 years. Most sentences, however, are not fully completed. According to the National Corrections Reporting Program from the BJS, the average share of sentences in terms of time served was 49% in 2004 for males, which suggests that the average time spent in prison is 3 years.[20] Given that one model period is one year, the average prison stay is three model periods. Therefore, for both whites and blacks we set $\frac{1}{1-\pi_{pp}} = 3$ or $\pi_{pp} = 0.67$. We also assume that π_{pp} is independent of an individual's education.

Finally, using the survey on Religiousness and Post-Release Community Adjustment in the United States 1990-1998 (Sumter 2005), we compute the probabilities of moving to employment or non-employment upon release from prison, by race. In the data, white males are slightly more likely to transit directly into employment. In particular, conditional on being released, a white inmate has a 43.6% chance of moving to employment and a 56.4% chance of moving to unemployment. For a back inmate, the probabilities are 37.5% and 62.5%, respectively. As a result, since a white inmate has $1 - \pi_{pp} = 1 - 0.67$ probability of being released, his chances of moving from prison to employment and unemployment are given by $\pi^w_{pe} = (1 - 0.67) \times (0.436) = 0.144$ and $\pi^w_{pu} = (1 - 0.67) \times (1 - 0.436) = 0.186$,

[20]See http://www.bjs.gov/index.cfm?ty=pbdetailiid=2056.

respectively. For a black inmate, the chances are $\pi^r_{pe} = (1 - 0.67) \times 0.375 = 0.124$ and $\pi^r_{pu} = (1 - 0.67) \times (1 - 0.375) = 0.206$, respectively. Again, due to data limitations, these probabilities are assumed to be independent of a male's education.

5.2 Labor Market Transitions, Males

We compute the transition matrix $\Lambda(\lambda'|\lambda)$ based on data on labor market transitions by exploiting the Merged Outgoing Rotation Group (MORG) of the Current Population Survey. We consider two states, employment ($\lambda = e$) and non-employment ($\lambda = u$). The latter comprises unemployment as well as being out of the labor force. The resulting yearly transition matrices are shown in Table 7 for 2000-2006 period.

Table 7: Yearly Employment Transitions, 2000-2006
(yearly)

		Black				White			
		Female		Male		Female		Male	
		e	u	e	u	e	u	e	u
< HS	e	.812	.188	.850	.150	.847	.153	.911	.089
	u	.154	.846	.157	.843	.151	.849	.195	.805
HS	e	.882	.118	.897	.103	.914	.086	.947	.053
	u	.249	.751	.244	.756	.219	.781	.309	.691
SC	e	.900	.100	.918	.082	.923	.077	.954	.046
	u	.304	.696	.328	.672	.251	.749	.368	.632
C	e	.950	.050	.950	.050	.952	.048	.975	.025
	u	.403	.597	.354	.646	.280	.720	.478	.522

For males, we then combine the estimates for employment transitions with transition probabilities in and out of prison in order to complete the labor market transition matrices between the three states, i.e. employed ($\lambda = e$), non-employed ($\lambda = u$), and prison ($\lambda = p$). Consider, black male high school drop-outs (top right quadrant of Table 7). According to Table 6, the probability of going to prison for this group is 0.085. As we mentioned above, we assume this is the same whether he is employed or unemployed as we do not have information to separate the two, i.e. $\pi_{ep} = \pi_{up} = 0.085$. We also know that the chances of a black man moving from prison to non-employment is about 0.625, and from prison to employment is 0.375. Furthermore, for all black men $\pi_{pe} = 0.124$ and $\pi_{pu} = 0.206$. Putting all these pieces together, and noting that the transition matrix for u and e contains the non-prison population and therefore needs to be multiplied by the size of the civilian population, 0.915 in the CPS sample, we get:

$$\Lambda_m^{<HS,b}(\lambda'|\lambda) = \begin{array}{c} \\ p \\ u \\ e \end{array} \begin{array}{c} \begin{array}{ccc} p & u & e \end{array} \\ \begin{pmatrix} .670 & .206 & .124 \\ .085 & .771 & .144 \\ .085 & .137 & .778 \end{pmatrix} \end{array}$$

We repeat this procedure for other education types as well as for whites to obtain the corresponding matrices, which are reported in the Appendix.

5.3 Wage Shocks

We construct the transition matrix $\Upsilon^{z,r}(\varepsilon'|\varepsilon)$ in the following way. We interpret ε as deviations from the mean, i.e. when $\varepsilon = 1$, the individual has mean earnings. We again use data from the Merged Outgoing Rotation Group (MORG) from the CPS for the years 2000-2006 to compute yearly earnings transition probabilities by race and level of education to construct transition matrices $\Upsilon^{z,r}(\varepsilon'|\varepsilon)$ for those who were employed. We also construct a productivity distribution for those agents who move from unemployment to employment and use this to calibrate $\widetilde{\Upsilon}^{z,r}(e)$.

We assume that ε takes five values. These five levels represent wage changes, relative to the mean, that are more than -17.5%, between -17.5% and -5%, between -5% and 5%, between 5 and 17.5%, and more than 17.5%, respectively in the data. We then set $\varepsilon_1 = 0.75, \varepsilon_2 = 0.9, \varepsilon_3 = 0, \varepsilon_4 = 1.10, \varepsilon_5 = 1.25.$[21]

The transition matrix for black high school dropout males, for example, takes the follow-

[21] Given that for some categories we do not have large sample sizes, we drop the top and bottom 0.5% of observations within each year, degree, race, and gender in order to prevent outliers from affecting the wage bins.

ing form

$$\Upsilon_m^{<HS,b}(\varepsilon'|\varepsilon) = \begin{array}{c} \\ \varepsilon_1 \\ \varepsilon_2 \\ \varepsilon_3 \\ \varepsilon_4 \\ \varepsilon_5 \end{array} \begin{array}{c} \begin{array}{ccccc} \varepsilon_1 & \varepsilon_2 & \varepsilon_3 & \varepsilon_4 & \varepsilon_5 \end{array} \\ \begin{pmatrix} .365 & .282 & .200 & .094 & .059 \\ .104 & .377 & .251 & .126 & .142 \\ .042 & .170 & .420 & .231 & .137 \\ .052 & .117 & .240 & .403 & .188 \\ .043 & .148 & .174 & .113 & .522 \end{pmatrix} \end{array}$$

For a high school dropout black male, if $\varepsilon = \varepsilon_1$, he earns about 25% less than the mean for his type. In this case there is a 37% chance that he will again face the same shock next period, while there is a 6% chance that next period his wage will be 25% above the mean wage for his type. Using a similar procedure, we compute matrices for each gender, race, and level of education. Tables A1 and A2 in the Appendix show the resulting transitions for all cases.

5.4 Government

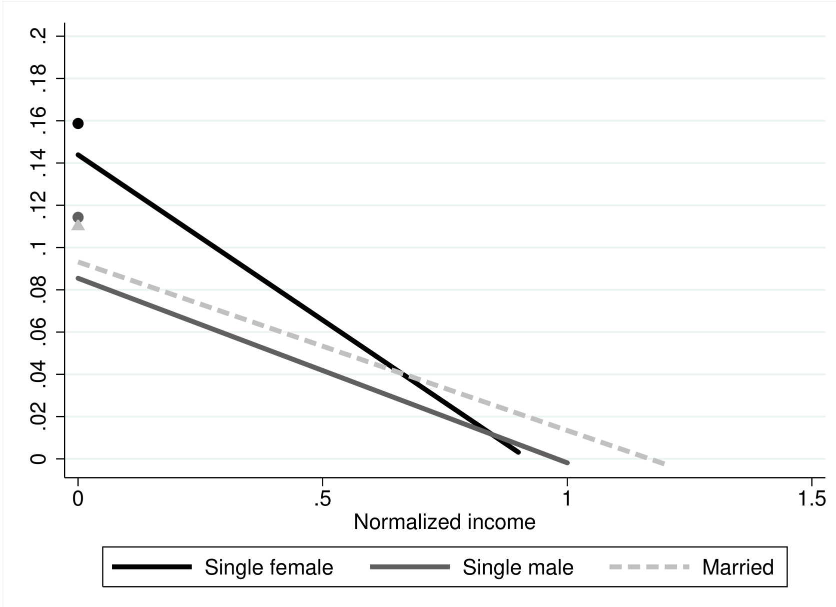
We use the 2004 wave of the Survey of Income and Program Participation (SIPP) to approximate a welfare schedule as a function of labor earnings for different household types, $T_f^s(Y), T_m^s(Y)$, and $T^m(Y)$. The SIPP is a panel surveying households every three months retrospectively for each of the past three months.[22] We compute the average amount of welfare, unemployment benefits, and monthly labor earnings corrected for inflation for each household. The welfare payments include all the main means-tested programs, namely Supplemental Social Security Income (SSSI), Temporary Assistance for Needy Families (TANF formerly AFDC), social security income, Supplemental Nutrition Assistance Program (SNAP formerly food stamps), Supplemental Nutrition Program for Women, Infants, and Children (WIC), Housing Assistance, and Medicaid.[23]

Using the monthly household average as the unit of observation, we first compute the average amount of the sum of welfare and unemployment benefits received by households

[22] The sample of black and white household heads aged 25-54 spans 911,273 observations across 34,367 households. Per household there are between 1 and 48 monthly observations with an average of nearly 27 monthly observations per household.

[23] The SIPP only provides information of whether households received Housing Assistance and Medicaid but no information about value or amounts. We use the methodology of Scholz, Moffitt and Cowan (2009) to value Medicaid and Housing Assistance reception. For all other transfer programs the SIPP provides information on the actual amount received.

Figure 7: Welfare Functions



with zero labor earnings. This allows us to pin down b_0. Then via ordinary least square estimation, we estimate the slope and intercept of the sum of welfare and unemployment benefits as a function of positive labor earnings by household type and determine b_1 and b_2. Table 8 reports the resulting estimates. A single female that is not working, for example, receives benefits that are about 16% of mean earnings, which is more than married or single male households receive.[24] Figure 7 presents the welfare schedule graphically, where both household income and benefits are reported as a fraction of mean household earnings in the economy.

Table 8: Welfare Functions

Parameter	Description	Married	Single male	Single female
b_0	Benefit when not working	0.11	0.11	0.16
b_1	Intercept when working	0.09	0.07	0.14
b_2	Slope when working	-0.07	-0.07	-0.14

[24]Using data from the ACS 2006 we compute mean per capita earnings to be $37,632.

6 Benchmark Economy

The parameters that can be set based on a priori information or available evidence are listed in Table 9.

Table 9: Parameter Values
(a priori information)

Parameter	Description	Value
σ	curvature	2 (standard)
β	discount factor	0.96 (standard)
ξ	economies of scale	0.7 (OECD scale)
μ	weight on female	0.5
ρ	survival	$1/(1-\rho)=30$
$\psi(P)$	wage penalty for prison	0.642 (white), 0.631 (black)

We assume that the values of q are drawn from a flexible Gamma distribution with parameters α_1 and α_2, and set $\alpha_1 = 0$.[25] Finally, we assume that both $\gamma \sim \Gamma(\gamma)$, the permanent match quality shock, and $\phi \sim \Theta(\phi)$, transitory match quality shock come from normal distributions with parameters $(\mu_\gamma, \sigma_\gamma)$ and (μ_ϕ, σ_ϕ). We set $\mu_\phi = 0$. Finally, we assume that $\underline{c}(x,z) = c_0 + c_1 \overline{I}(z,x)$, where $\overline{I}(z,x)$ is the mean income for all (x,z) couples.

As a result, we have 32 parameters to be determined:

$$\theta = \{\underbrace{\eta, c_0, c_1, \zeta, \varphi^{x,w}, \varphi^{x,b}}_{\text{marriage}}, \underbrace{\theta^{x,w}, \delta^{x,w}, \theta^{x,b}, \delta^{x,b}}_{\text{labor markets}}, \underbrace{\alpha_2, \mu_\gamma, \sigma_\gamma, \sigma_\phi}_{\text{heterogeneity-shocks}}\}$$

These parameters are chosen to match:

1. Marital status of population by race, gender, and education level (Table 12, 16 moments).

2. Fraction of women married by ages 20, 25, 30, 35, and 40, by race (top panel of Table 13, 10 moments).

3. Fraction of marriages that last 1, 3, 5, and 10 years by race (bottom panel of Table 13, 8 moments).

4. The degree of marital sorting among whites and blacks (Table 14, 2 moments).

[25] Hence, $q \sim Q(q) \equiv q^{\alpha_1 - 1} \frac{\exp(-q/\alpha_2)}{G(\alpha_1)\alpha_2^{\alpha_1}}$, where $G(\alpha_1)$ represents the gamma function.

5. Labor market and prison status of population by race, gender, education level and marital status (Table 15, 48 moments).

Let **M** represent the vector of these 84 moments. A vector of the analogous 84 moments can be obtained from the steady state of the model. The moments for the model are a function of the parameters to be estimated. Let $\mathcal{M}(\theta)$ represent this vector of moments, where θ denotes the vector of 15 parameters to be estimated. Define the vector of deviations between the data and the model by $\mathbf{G}(\theta) \equiv \mathbf{M} - \mathcal{M}(\theta)$. Minimum distance estimation picks the parameter vector, θ, to minimize a weighted sum of the squared deviations between the data and the model, i.e.,

$$\widehat{\theta} = \arg\min \mathbf{G}(\theta)'\mathbf{W}\mathbf{G}(\theta).$$

The estimated prameteres $\widehat{\theta}$ is consistent for any semi-definite matrix **W**. We set **W** equal to the identity matrix.

6.1 Calibrated Parameters and Fit

Table 10 and 11 contain the calibrated parameters.

Table 10: Calibrated Parameters
(preferences and match quality shocks)

Parameter	Description	Value
τ	tax rate	0.0331
η	divorce cost	29.716
c_0	cost of a married household	0.021
c_1	proportional cost of a married household	0.008
α_2	shape parameter of home stay gamma distrib	7.214
μ_γ	mean of γ draw	-5.485
σ_γ	s.d. of γ draw	11.433
σ_ϕ	s.d. of ϕ draw	15.569
ζ	utility cost when husband is in prison	0
$\varphi^{<HS,b}$	Probability of meeting own type (black, <HS)	0.000
$\varphi^{HS,b}$	Probability of meeting own type (black, HS)	0.371
$\varphi^{SC,b}$	Probability of meeting own type (black, SC)	0.015
$\varphi^{C,b}$	Probability of meeting own type (black, C)	0.133
$\varphi^{<HS,w}$	Probability of meeting own type (white, <HS)	0.000
$\varphi^{HS,w}$	Probability of meeting own type (white, HS)	0.367
$\varphi^{SC,w}$	Probability of meeting own type (white, SC)	0.000
$\varphi^{C,w}$	Probability of meeting own type (white, C)	0.541

Table 11: Calibrated Parameters
(labor market transitions, females)

	Job arrival θ		Job destruction δ	
	Black	White	Black	White
<HS	.16	.15	.20	.15
HS	.24	.24	.12	.08
SC	.32	.30	.10	.07
C	.51	.48	.04	.04

Table 12 shows the measure of the population that is not married by gender, race, and education in the model and in the data. We compute marital status by gender, race, and level of education using the ACS 2006. White males and females of all levels of education are more likely to be married than their black counterparts. The model does a good job matching marital status of the population. The match for whites is better than for blacks, while for both races the marriage probabilities for individuals with less than high school education in the model is quite a bit smaller than in the data. The relative differences in marriage rates by race help us to pin down the consumption cost of a married household, $\underline{c}$, and the utility cost of having a husband in jail, ζ, while the general levels of married couples help determine the match quality shock parameters.

Table 12: Fraction Not-Married
model (data)

	Education	Black	White
Females	<HS	.83 (.79)	.51 (.47)
	HS	.69 (.69)	.42 (.35)
	SC	.62 (.65)	.39 (.35)
	C	.41 (.58)	.32 (.32)
Males	<HS	.80 (.75)	.56 (.52)
	HS	.62 (.62)	.44 (.42)
	SC	.49 (.53)	.40 (.38)
	C	.37 (.47)	.32 (.31)

The top panel of Table 13 shows the probability of marriage for black and white woman by a given age in the model and in the data. The probability of first marriage for women comes from data from the 2006-2010 National Survey of Family Growth (NSFG), as reported in Copen et al (2012). In our model, we simply compute how long it takes for women in a new birth cohort (education and employment shocks match the steady state values by gender and race) to marry. White women are more likely to marry for the first time at younger ages than black women. The entry into marriage moments determine the parameters of the initial permanent match quality distribution, μ_γ and σ_γ. The model does well matching these statistics, although it slightly underpredicts the speed of entry into marriage for white women, while the opposite occurs for black women.

Table 13: Marriage Dynamics for Women
model (data)

By age	20	25	30	35	40
Black	.05 (.05)	.28 (.24)	.45 (.47)	.58 (.58)	.67 (.64)
White	.10 (.14)	.46 (.48)	.67 (.74)	.80 (.84)	.87 (.89)

Duration	1 year	3 years	5 years	10 years
Black	.90 (.92)	.75 (.81)	.65 (.73)	.50 (.51)
White	.94 (.95)	.85 (.86)	.79 (.78)	.67 (.64)

The bottom panel of Table 13 contains the probability that a marriage remains intact after so many years for black and white couples. The probability of the first marriage remaining intact also comes from data from the 2002 NSFG, as reported in Goodwin, Moshe and Chandra (2010). Even though black females tend to marry later, in Table 13 we see that their marriages on average dissolve at a faster rate. These targets help us to select the divorce cost parameter, η, and the parameters of the transitory match quality distribution, μ_ϕ and σ_ϕ. In the model, with no memory beyond the last period, there is no distinction between first and subsequent marriages. Therefore, we compute this moment for all marriages. In the model, black marriages are less likely to survive over time than we observe in the data. For white marriages the probability of survival is matched for the first three years, but becomes slightly higher than it is in the data afterwards.

Table 14 shows the marriage matrix by education, which serves an indicator of assortative mating in the model and the data. We compute a marriage matrix in terms of education for blacks and whites aged 25-54 using the 2006 ACS. Whites are slightly more likely than blacks to marry alike in terms of education. These targets directly affect the probability that an individual matches with his/her own education type, φ_x^r. Both in data and model whites are more likely to marry assortatively than blacks, although the model underestimates the degree of assortative mating for both races.

Table 14: Assortative Mating by Race and Education model vs (data)

Black								
	Wife							
Husband	<HS		HS		SC		C	
<HS	**0.001**	**(0.018)**	0.010	(0.039)	0.018	(0.013)	0.036	(0.004)
HS	0.012	(0.029)	**0.237**	**(0.245)**	0.117	(0.126)	0.084	(0.063)
SC	0.020	(0.005)	0.076	(0.070)	**0.101**	**(0.117)**	0.077	(0.067)
C	0.014	(0.002)	0.040	(0.027)	0.049	(0.046)	**0.107**	**(0.128)**
White								
	Wife							
Husband	<HS		HS		SC		C	
<HS	**0.001**	**(0.013)**	0.014	(0.025)	0.019	(0.008)	0.016	(0.002)
HS	0.014	(0.019)	**0.204**	**(0.205)**	0.092	(0.095)	0.059	(0.055)
SC	0.014	(0.004)	0.070	(0.070)	**0.089**	**(0.089)**	0.056	(0.065)
C	0.010	(0.001)	0.047	(0.042)	0.057	(0.068)	**0.236**	**(0.240)**

Finally, Table 15 contains the data and model moments on employment transitions for women, and employment, no-employment and prison status for men by race, marital status, and education. To compute labor market status and prison status we use the ACS 2006. Once again we restrict the sample to non-hispanic, non-immigrant, black and white individuals aged 25-54. These moments help to pin down the parameters of the utility cost of work, α_2, as well as the probability of finding and losing a job for females, $\theta^{x,r}$ and $\delta^{x,r}$.

Because there is not a labor supply decision for men in our model and the transition matrix between employment states is exogenously given, the only decision that affects these moments for men is their marriage decision. Therefore, the model is expected to, and does do well in matching these statistics for men. There is, however, an extensive labor supply decision for single and married women.

The model does quite well at matching the employment status of women, both black and white. First, there is a significant fraction of black men with less than high school education who are in prison. About 21% and 28% of single black men with less than high school education are in prison in the model and the data, respectively. Not all black men who are in prison are, however, single. About 18% and 14% of married black men with less than high school education are incarcerated in the model and the data, respectively. For each education category, white men, married or single, are much less likely to be in prison than black men, and for both races the fraction of men who are in prison declines rapidly by education. Second, black males who are single, are much more likely to be unemployed than white man and the gap persists even for those with college education. About 17% of single black men with a college degree are unemployed, while the same number for whites is only 7%. A similar gap, 10% versus 4%, exists for married men with a college degree. Finally, while educated (those with some college or above) black women are more likely to be employed than their white counterparts, the opposite is true for less educated black women. The model captures these qualitative differences well.

Table 15a: Labor Market and Marital Status, Blacks
model (data)

Educ	Marital St.	Females (Transition)		Males (Stock)		
		EE	UU	E	U	P
< HS	Single	.79 (.80)	.84 (.84)	.36 (.29)	.43 (.43)	.21 (.28)
	Married	.77 (.83)	.85 (.86)	.48 (.57)	.34 (.29)	.18 (.14)
HS	Single	.87 (.88)	.76 (.76)	.57 (.56)	.34 (.32)	.09 (.12)
	Married	.87 (.91)	.76 (.71)	.71 (.78)	.23 (.18)	.06 (.04)
SC	Single	.89 (.90)	.68 (.68)	.72 (.71)	.24 (.22)	.04 (.07)
	Married	.88 (.90)	.70 (.70)	.81 (.85)	.17 (.13)	.02 (.02)
C	Single	.95 (.96)	.50 (.49)	.81 (.82)	.17 (.16)	.02 (.02)
	Married	.92 (.95)	.57 (.65)	.89 (.92)	.10 (.07)	.01 (.01)

Table 15b: Labor Market and Marital Status, Whites
model (data)

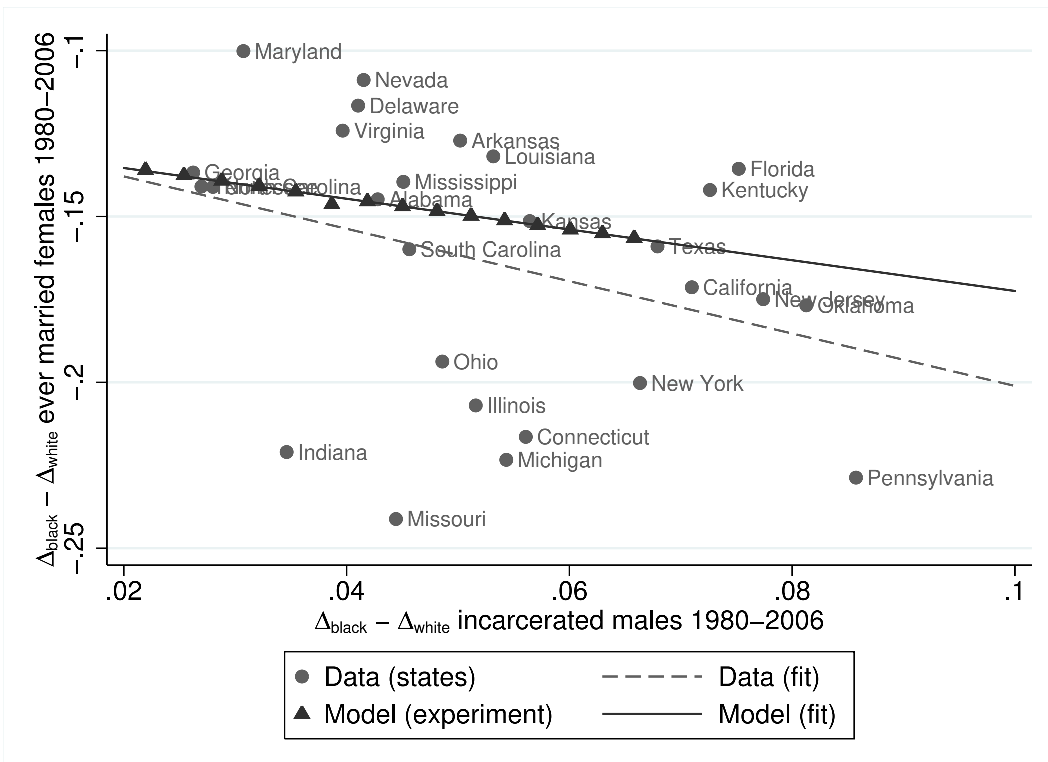
Educ	Marital St.	Females (Transition)		Males (Stock)		
		EE	UU	E	U	P
< HS	Single	.85 (.85)	.85 (.85)	.60 (.54)	.36 (.38)	.06 (.08)
	Married	.79 (.86)	.87 (.84)	.71 (.75)	.26 (.23)	.03 (.02)
HS	Single	.92 (.92)	.76 (.76)	.78 (.74)	.19 (.22)	.03 (.04)
	Married	.88 (.91)	.79 (.79)	.86 (.90)	.12 (.10)	.02 (.00)
SC	Single	.93 (.93)	.70 (.70)	.85 (.82)	.15 (.17)	.00 (.01)
	Married	.88 (.92)	.75 (.76)	.91 (.92)	.09 (.07)	.00 (.01)
C	Single	.95 (.96)	.53 (.52)	.93 (.89)	.07 (.11)	.00 (.00)
	Married	.85 (.95)	.65 (.75)	.96 (.96)	.04 (.04)	.00 (.00)

6.2 The Benchmark Economy in Historical Perspective

Figure 5 shows the relationship between difference-in-difference between black and white incarceration and marriage rates from 1980 to 2006 and indicates that increases in incarceration rates were associated with lower marriage rates. We now investigate whether the model is able to generate a similar decline in the ever married black females. To find this elasticity, we conduct the following experiment. We decrease the probabilities of going to prison for black and white males, i.e. we reduce the parameters $\pi^r_{ep} = \pi^r_{up}$, by small percentage increments, and for each new value of $\pi^r_{ep} = \pi^r_{up}$, we recalculate $\Lambda^r(\lambda'|\lambda)$ and solve our model economy (keeping all other parameters fixed). This procedure implies a series of counterfactual levels of marriages. We then compare the relationship between incarceration and marriage implied by our model with the same relationship implied by the US historical experience. For the data we take the difference in differences between black and white individuals in 1980 and 2006 across US states, whereas for the model we take the difference in differences between black and white individuals in the benchmark model versus the outcomes that result from the incremental reductions in $\pi^r_{ep} = \pi^r_{up}$.

Figure 8 shows the results of this experiment. The dashed line is a similar regression line as in Figure 5. The solid line is the model-implied relation. The model does remarkably well as the model-implied relation between incarceration and marriage behavior is in line with what we observe in the data.

Figure 8: Black-White Differences in Changes in Incarceration versus Marriage, Model and Data



7 Understanding Black-White Marriage Gap

In the model economy, the white and black population differ by their wages, their education distribution, and the rates at which they transition between prison, unemployment, and various employment shocks. In this section we investigate the importance of each source of heterogeneity for the black-white marriage gap. First, give black males and females the same education distribution as white males and females. The results in the second column of Table 17 show that within each level of education, the fraction of single individuals doesn't change much. In this counterfactual economy, there is a compositional shift amongst the black population towards higher levels of education, and people with higher levels of education are more likely to marry in general. Therefore, the size of black single population declines by about 4 percentage points. This represents about 31% of the observed racial marriage gap which is reported in the bottom row.

We next replace the wages and wage transitions of the black population with those of the white population to see how much that heterogeneity matters for the difference in the share of single individuals.[26] To this end, we impose the wage distribution of white men in Table 4 on black men and use the wage shock transitions of white men from Tables A1 and A2 for both white and black men. The results in the third column of Table 17 suggest that wages do not play a role in marriage differences.

Next, we impose the transitions between employment and non-employment of white men on black men. Employment transitions are important and close 39% of the racial marriage gap. Lastly, we impose the prison transitions of white men on black men. This has a considerable impact, accounting for 11% of the aggregate racial gap in singles.

Table 18 highlights interaction affects. When we impose both prison and wage transitions, marriage rates of black individuals remain similar as when only changing prison transitions, closing 12% of the racial gap. Imposing both employment and prison transitions accounts for about 54% of the racial marriage gap. For these experiments, we find that the combined effect is larger than the sum of the two separate experiments.

[26]The counterfactual transition probability matrices are presented in Appendix B.

Table 17: Accounting for the Black-White Marriage Gap
Fraction not married

		Black	Sex Ratio	Educ.	Wage	Emp.	Prison	White
Females	<HS	.83	.79	.77	.84	.69	.81	.51
	HS	.69	.63	.66	.69	.59	.65	.42
	SC	.62	.56	.58	.62	.52	.60	.39
	C	.41	.36	.36	.43	.36	.39	.32
Males	<HS	.80	.81	.82	.79	.70	.76	.56
	HS	.62	.62	.62	.62	.49	.57	.44
	SC	.49	.50	.50	.49	.39	.47	.40
	C	.37	.38	.38	.40	.28	.35	.32
$\Delta_{b,w}$ accounted for (%)			24	31	-1	39	11	

Table 18: Accounting for the Black-White Marriage Gap (Interactions)
Fraction not married

		Black	Prison&Wage	Prison&Emp.	White
Females	<HS	.83	.81	.64	.51
	HS	.69	.65	.54	.42
	SC	.62	.60	.48	.39
	C	. 41	.40	.33	.32
Males	<HS	.80	.75	.61	.56
	HS	.62	.57	.44	.44
	SC	.49	.47	.36	.40
	C	.37	.39	.26	.32
$\Delta_{b,w}$ accounted for (%)			12	54	

7.1 Counterfactual Criminal Justice Policies

In order to understand the effect of harsher sentencing and the War on Drugs on the formation of black families, we conduct two experiments. First, we reduce the average prison term from three to two years and then to one year by reducing the probability of remaining in prison from 0.67 to 0.50 and 0, respectively. Second, we simulate the economy whilst correcting transitions into prison for drug offenses in the SISCF.[27] Given the limitations of the prison data we experiment with two scenarios. In the first scenario (which we label low), we try to identify those prisoners convicted for drug offenses only, whereas in the second

[27] See Appendix D for the transition probabilities.

experiment (high) we consider individuals with a drug offense but who might have committed multiple offenses. Then we remove these inmates in our calculations of the transitions presented in Table 6. The resulting transitions are shown in Table A3.

The results of these experiments are presented in Table 18. We find that reducing the average time in prison has a substantial effect on marriage. If males spend two years on average, or only one year with certainty, the racial marriage gap is closed by 7% and 15%. For the low and high War on Drug experiments we find that the gap is diminished by 5% and 8%, respectively. Eliminating the wage penalty after having been to prison accounts for 7% of the gap.

Table 18: Criminal Justice Policies and the Black-White Marriage Gap (fraction not-married)

	Educ.	Black	Average term		War on drugs		Wage	White
			2 years	1 year	(low)	(high)	penalty	
Females	<HS	.83	.82	.81	.82	.82	.81	.51
	HS	.69	.66	.64	.67	.67	.67	.42
	SC	.62	.60	.58	.60	.61	.61	.39
	C	.41	.40	.39	.40	.40	.39	.32
Males	<HS	.80	.77	.72	.79	.78	.78	.56
	HS	.62	.59	.56	.60	.59	.60	.44
	SC	.49	.48	.48	.48	.48	.48	.40
	C	.37	.36	.36	.36	.35	.35	.32
$\Delta_{b,w}$ accounted for (%)			7	15	5	8	7	

In Table 19 we present the marriage responses when welfare transfers b_0 are reduced or increased for single women without any income. In the first experiment we reduce the amount to 75% of the benchmark value and find that the marriage gap is closed by 2%. In the second experiment the corresponding amount is increased to 125% the benchmark value which increases the marriage gap by 6%. These mild changes indicate that welfare and transfers might be contributing to the racial marriage gap but play a minor role.

Table 19: Changing transfer payments for single women without income (fraction not-married)

	Educ.	Black	75%	125%	White
Females	<HS	.83	.83	.85	.51
	HS	.69	.68	.70	.42
	SC	.62	.62	.64	.39
	C	.41	.39	.43	.32
Males	<HS	.80	.81	.82	.56
	HS	.62	.61	.64	.44
	SC	.49	.48	.51	.40
	C	.37	.36	.39	.32
$\Delta_{b,w}$ accounted for (%)			2	-6	

8 Concluding Remarks

The racial marriage gap has widened substantially over the past decades. In this paper, we study the potential drivers of this gap. Changes in U.S. labor markets in recent decades left many low-skilled workers jobless. The number of people behind bars has increased so much that the U.S. now holds 25% of the world's prison population, while only accounting for about 5% of the world's population. Both the decline in low-skilled jobs as well as the era of mass incarceration have disproportionately affected black communities, and in particular black males. We investigate whether the bleak labor market prospects of black males and the considerable risk of being incarcerated can explain why so many black women are choosing not to marry. Using an equilibrium model of marriage, divorce and labor supply that takes into account the transitions between employment, unemployment, and prison, we are able to disentangle and quantify the key contributors to the racial marriage gap.

We conduct a range of counterfactual experiments within our calibrated model, in which we assign labor market and prison characteristics of white males to black males. We find that the higher the likelihood black men face in terms of incarceration can account for about 11% of the racial marriage gap. Adding differences in employment transitions narrows the aggregate gap by more than half.

Finally, we find that changes in incarceration policies, such as decreased term lengths, could lead to increases in marriage within the black population. None of our experiments are meant to be interpreted as normative judgements as we neither model decisions leading to incarceration nor do these decisions exhibit any negative externalities within the model. Nonetheless, we think it is important to understand how labor market characteristics and incarceration policies are affecting marriage formation. There are several ways to extend the model developed here. In particular, questions about how incarceration and unemployment are affecting fertility and investment in children are left for future research.

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Appendix

A Value functions

In this Appendix, we define the start-of-the-period value functions that we use in Section 4.

A.1 Start-of-the-Period Values

In order to construct the expected value for a woman of being single or married to a specific match next period, we need to incorporate how both her and her match's uncertainty evolve. To this end, it is helpful to note that, given the definition of $\mathcal{S}_f^S = (x, q, \varepsilon)$, $V_f^S(\mathcal{S}_f^S, \lambda) = V_f^S(x, q, \varepsilon, \lambda)$.

Consider first a single woman who is currently employed. Next peirod, she can loose her job with probability δ^x. Then she is unemployed next period and has a value function of $V_f^S(x, q, \varepsilon, \lambda = u)$. Note that when a person is unemployed, it does not matter what their wage shock is. If she keeps her job, which happens with probability $1 - \delta^x$, she draws a new wage shock according to $\Upsilon_f^x(\varepsilon'|\varepsilon)$, and enjoys $V_f^S(x, q, \varepsilon = \varepsilon', \lambda = e)$. As a result, for a single female who is employed at the start of the period, i.e. $\lambda = e$, the expected value of remaining single is given by

$$EV_f^S(x, q, \varepsilon, \lambda = e) = \delta^x V_f^S(x, q, \varepsilon, \lambda = u) + (1 - \delta^x) \sum_{\varepsilon'} \Upsilon_f^x(\varepsilon'|\varepsilon) V_f^S(x, q, \varepsilon = \varepsilon', \lambda = e). \quad (2)$$

A single woman who is currently unemployed, on the other hand, receives a job offer with probability θ^x and draws a wage shock from $\widetilde{\Upsilon}_f^x(\varepsilon'_f)$. If she does not receive a job offer, then she is unemployed next period. Therefore, for a single female who is unemployed the expected value of remaining single is given by:

$$EV_f^S(x, q, \varepsilon, \lambda = u) = \theta^x \sum_{\varepsilon'} \widetilde{\Upsilon}_f^x(\varepsilon') V_f^S(x, q, \varepsilon = \varepsilon', \lambda = e) + (1 - \theta^x) V_f^S(x, q, \varepsilon, \lambda = u). \quad (3)$$

A single woman who is currently employed can also match with a potential partner next period. Again recall that given the definitions of $\mathcal{S}_f^S = (x, q, \varepsilon)$ and $\mathcal{S}_m^S = (z, \lambda, \varepsilon)$, $EV_f^M(\mathcal{S}_f^S, \mathcal{S}_m^S, \lambda_f, P; \gamma, \phi) = EV_f^M(x, q, \lambda_f, \varepsilon_f; z, P, \lambda_m, \varepsilon_m; \gamma, \phi)$. For a single woman who is currently employed, the expected value of being married to a type-$(z, \lambda_m, \varepsilon_m, P)$ man with match qualities γ and ϕ is then given by

$$
\begin{aligned}
& EV_f^M(x, q, \varepsilon_f, z, \lambda_m, \varepsilon_m, \gamma, \phi, \lambda_f = e, P) \qquad (4) \\
= \; & \delta^x \sum_{\varepsilon_m', \lambda_m'} \Pi^z(\lambda_m', \varepsilon_m' | \lambda_m, \varepsilon_m) V_f^M(x, q, \lambda_f = u, \varepsilon_f; z, P', \lambda_m', \varepsilon_m'; \gamma, \phi) \\
& +(1 - \delta^x) \sum_{\varepsilon_f', \varepsilon_m', \lambda_m'} \Upsilon_f^x(\varepsilon_f' | \varepsilon_f) \Pi^z(\lambda_m', \varepsilon_m' | \lambda_m, \varepsilon_m) V_f^M(x, q, \lambda_f = e, \varepsilon_f; z, P', \lambda_m', \varepsilon_m'; \gamma, \phi),
\end{aligned}
$$

where

$$
P' = \begin{cases} 1 \text{ if } \lambda_m' = p \\ P \text{ otherwise} \end{cases},
$$

with V_f^M defined as in Section 4.3 in the main text. Note that for a single woman, the expected value of being married is determined both by the labor market transitions of her potential husband, $\Pi^z(\lambda_m', \varepsilon_m' | \lambda_m, \varepsilon_m)$, as well as her own labor market transitions, δ^x and $\Upsilon_f^x(\varepsilon_f' | \varepsilon_f)$.

Finally, for a single female who is currently unemployed, the expected value of being married to a type-$(z, \lambda_m, \varepsilon_m, P)$ male with match qualities γ and ϕ is given by

$$
\begin{aligned}
& EV_f^M(x, q, \varepsilon_f, z, \lambda_m, \varepsilon_m, \gamma, \phi, \lambda_f = u, P) \qquad (5) \\
= \; & \theta^x \sum_{\varepsilon_f', \varepsilon_m', \lambda_m'} \widetilde{\Upsilon}_f^x(\varepsilon_f') \Pi^z(\lambda_m', \varepsilon_m' | \lambda_m, \varepsilon_m) V_f^M(x, q, \lambda_f = e, \varepsilon_f; z, P', \lambda_m', \varepsilon_m'; \gamma, \phi) \\
& (1 - \theta^x) \sum_{\varepsilon_m', \lambda_m'} \Pi^z(\lambda_m', \varepsilon_m' | \lambda_m, \varepsilon_m) V_f^M(x, q, \lambda_f = u, \varepsilon_f; z, P', \lambda_m', \varepsilon_m'; \gamma, \phi),
\end{aligned}
$$

where

$$
P' = \begin{cases} 1 \text{ if } \lambda_m' = p \\ P \text{ otherwise} \end{cases}.
$$

A.2 Start-of-the-Period Value for a Single Male

For a single man it is easier to define the start-of-the-period value functions conditional on whether he is in prison or not.

A.2.1 If in prison

If a single man is in prison, his current state is given by $\mathcal{S}_m^S = (z, \lambda = p, \varepsilon)$, and $P = 1$ (i.e. he has a criminal record), and it doesn't matter what his wage shock is as he does not work. Next period, with probability π_{pu} he is released as an unemployed person and $\lambda' = u$, while he becomes employment with probability π_{pe}. In that case, he starts working at the lowest wage shock ε_1. Finally, with the remaining probability, π_{pp}, he stays in the prison. If a man moves to unemployment or employment from prison, he remains single for one period, before he participates again in the marriage market. Therefore, his continuation value is given by

$$\widetilde{V}_m^S(z,p,\varepsilon,1) = \pi_{pu} V_m^S(z,u,\varepsilon,1) + \pi_{pe} V_m^S(z,e,\varepsilon_1,1) + (1-\pi_{pu}-\pi_{pe}) V_m^S(z,p,\varepsilon,1). \quad (6)$$

A.2.2 Not in prison

A single man, who is not in the prison, meets a single woman, draws γ and ϕ, and decides whether or not to get married. His decisions are based on expected values of being single and married. The start-of-the period value function can be written as

$$\widetilde{V}_m^S(\mathcal{S}_m^S, P) =$$

$$\sum_{\mathcal{S}_f^S,\lambda_f,\gamma,\phi} \max\left\{EV_m^M(\mathcal{S}_f^S,\mathcal{S}_m^S,\lambda_f,P;\gamma,\phi)I_f(\mathcal{S}_f^S,\mathcal{S}_m^S,\lambda_f,P;\gamma,\phi), EV_m^S(\mathcal{S}_m^S,P)\right\}\Gamma(\gamma)\Theta(\phi)\Phi(\mathcal{S}_f^S,\lambda_f),$$

where, $\Phi(\mathcal{S}_f^S,\lambda_f)$ is the *endogenous* distribution of single females.

The expected value of being a single man is given by

$$EV_m^S(z,\lambda,\varepsilon,P) = \sum_{\varepsilon',\lambda'} \Pi^z(\lambda',\varepsilon'|\lambda,\varepsilon) V_m^S(z,\lambda',\varepsilon',P'), \quad (7)$$

with

$$P' = \begin{cases} 1 \text{ if } \lambda' = p \\ P \text{ otherwise} \end{cases}.$$

The expected value of being married to a woman who is employed at the start of the period is:

$$\begin{aligned} & EV_m^M(x,q,\varepsilon_f,\lambda_f=e;z,P,\lambda_m,\varepsilon_m;\gamma,\phi) \quad (8) \\ = \; & \delta^x \sum_{\varepsilon'_m,\lambda'_m} \Pi^z(\lambda'_m,\varepsilon'_m|\lambda_m,\varepsilon_m) V_m^M(x,q,\varepsilon_f,\lambda_f=u;z,P',\lambda'_m,\varepsilon'_m;\gamma,\phi) \\ & +(1-\delta^x) \sum_{\varepsilon'_f,\varepsilon'_m,\lambda'_m} \Upsilon_f^x(\varepsilon'_f|\varepsilon_f)\Pi^z(\lambda'_m,\varepsilon'_m|\lambda_m,\varepsilon_m) V_m^M(x,q,\varepsilon'_f,\lambda_f=e;z,P',\lambda'_m,\varepsilon'_m;\gamma,\phi), \end{aligned}$$

with

$$P' = \begin{cases} 1 \text{ if } \lambda'_m = p \\ P \text{ otherwise} \end{cases}.$$

Finally, the expected value of being married to a woman who is unemployed at the start of the period is defined as:

$$\begin{aligned} & EV_m^M(x, q, \varepsilon_f, \lambda_f = u; z, P, \lambda_m, \varepsilon_m; \gamma, \phi) \qquad (9) \\ = \; & \theta^x \sum_{\varepsilon'_f, \varepsilon'_m, \lambda'_m} \widetilde{\Upsilon}_f^x(\varepsilon'_f) \Pi^z(\lambda'_m, \varepsilon'_m | \lambda_m, \varepsilon_m) V_m^M(x, q, \varepsilon'_f, \lambda_f = e; z, P', \lambda'_m, \varepsilon'_m; \gamma, \phi) \\ & (1 - \theta(x)) \sum_{\varepsilon'_m, \lambda'_m} \Pi^z(\lambda'_m, \varepsilon'_m | \lambda_m, \varepsilon_m) V_m^M(x, q, \varepsilon_f, \lambda_f = u; z, P', \lambda'_m, \varepsilon'_m; \gamma, \phi), \end{aligned}$$

where again

$$P' = \begin{cases} 1 \text{ if } \lambda'_m = p \\ P \text{ otherwise} \end{cases}.$$

A.3 Indicators for Marriage

For a single male who is contemplating marriage, the indicator function is defined as

$$I_m(\mathcal{S}_f^S, \mathcal{S}_m^S, \lambda_f, P; \gamma, \phi,) = \begin{cases} 1, \text{ if } EV_m^M(\mathcal{S}_f^S, \mathcal{S}_m^S, \lambda_f, P; \gamma, \phi,) \geq EV_m^S(\mathcal{S}_m^S, P) \\ 0, \text{ otherwise.} \end{cases}$$

Similarly for females, we have

$$I_f(\mathcal{S}_f^S, \mathcal{S}_m^S, \lambda_f, P; \gamma, \phi,) = \begin{cases} 1, \text{ if } EV_f^m(\mathcal{S}_f^S, \mathcal{S}_m^S, \lambda_f, P; \gamma, \phi,) \geq EV_f^s(\mathcal{S}_f^S, \lambda_f) \\ 0, \text{ otherwise.} \end{cases}$$

A.4 Start-of-the-Period Value for a Married Female

Now consider the value of being married at the start of a period for a married women. Given the state $(\mathcal{S}_f^S, \mathcal{S}_m^S, \lambda_f, P; \gamma, \phi)$, of her marriage, a woman decides whether to stay married or divorce. She will do this before she observes her and her partner's new labor market status. Her problem is then given by:

$$\widetilde{V}_f^M(\mathcal{S}_f^S, \mathcal{S}_m^S, \lambda_f, P; \gamma, \phi) = \max\{EV_f^M(\mathcal{S}_f^S, \mathcal{S}_m^S, \lambda_f, P; \gamma, \phi) I_m^d(\mathcal{S}_f^S, \mathcal{S}_m^S, \lambda_f, P; \gamma, \phi), EV_f^S(\mathcal{S}_f^S, \lambda_f) - \eta\},$$

where $EV_f^S(.)$, the expected value of being single, is defined above by Equations (2) and (3), and her expected value of continuing with the current marriage, $EV_f^M(.)$, is defined by Equations (4) and (5). Note that $I_m^d(.)$ indicates whether her husband wants to continue the current marriage or not. If she decides to divorce, then she suffers the utility cost η.

A.5 Start-of-the-Period Value for a Married Male

Similarly, given the state $(\mathcal{S}_f^S, \mathcal{S}_m^S, \gamma, \phi, \lambda_f, P)$, of his marriage, a man has to decide whether to stay married or divorce. He makes this decision based on the following comparison

$$\widetilde{V}_m^M(\mathcal{S}_f^S, \mathcal{S}_m^S, \lambda_f, P; \gamma, \phi) = \max\{EV_m^M(\mathcal{S}_f^S, \mathcal{S}_m^S, \lambda_f, P; \gamma, \phi) I_f^d(\mathcal{S}_f^S, \mathcal{S}_m^S, \lambda_f, P; \gamma, \phi), EV_m^S(\mathcal{S}_m^S, P) - \eta\},$$

where $EV_m^S(.)$ is defined by Equations (6) and (7), and $EV_m^M(.)$ is defined by Equations (8) and (9). Note that $I_f^d(.)$ indicates whether his wife wants to stay married or not. A married man who is in prison can decide to continue his marriage as his wife agrees. If he or his wife decide to divorce, then he is a single man the next period. He is a single man in prison or is released and enters into the labor market.

A.6 Indicators for Divorce

For a married man who is contemplating a divorce, the indicator function is given by

$$I_m^d(\mathcal{S}_f^S, \mathcal{S}_m^S, \lambda_f, P; \gamma, \phi) = \begin{cases} 1, \text{ if } EV_m^M(\mathcal{S}_f^S, \mathcal{S}_m^S, \lambda_f, P; \gamma, \phi) \geq EV_m^S(\mathcal{S}_m^S, P) - \eta \\ 0, \text{ otherwise.} \end{cases}$$

Similarly for women, we have

$$I_f^d(\mathcal{S}_f^S, \mathcal{S}_m^S, \lambda_f, P; \gamma, \phi) = \begin{cases} 1 \text{ if } EV_f^M(\mathcal{S}_f^S, \mathcal{S}_m^S, \lambda_f, P; \gamma, \phi) \geq EV_f^S(\mathcal{S}_f^S, \lambda_f) - \eta \\ 0, \text{ otherwise.} \end{cases}$$

Note that these are identical to singles' indicators, except for the fact that divorce involves a one-time utility cost η.

B Transitions

In this Appendix, we present wage transitions, initial wage draws for males and females, and full transition matrices for males.

Table A1: Wage Transitions, Males

		Black					White				
		ε_1	ε_2	ε_3	ε_4	ε_5	ε_1	ε_2	ε_3	ε_4	ε_5
< HS	ε_1	.209	.313	.239	.164	.075	.361	.234	.197	.102	.107
	ε_2	.076	.418	.271	.138	.098	.094	.484	.206	.123	.093
	ε_3	.057	.208	.371	.201	.163	.051	.178	.445	.224	.101
	ε_4	.038	.173	.269	.375	.144	.025	.101	.198	.501	.175
	ε_5	.008	.093	.217	.217	.465	.033	.071	.133	.179	.584
HS	ε_1	.385	.294	.161	.095	.065	.464	.251	.134	.085	.067
	ε_2	.128	.418	.229	.145	.081	.123	.481	.216	.11	.071
	ε_3	.072	.183	.389	.217	.139	.058	.162	.482	.204	.094
	ε_4	.063	.123	.212	.389	.213	.041	.099	.187	.51	.162
	ε_5	.048	.13	.131	.224	.467	.038	.088	.119	.191	.564
SC	ε_1	.392	.267	.122	.136	.083	.459	.268	.127	.084	.062
	ε_2	.134	.39	.192	.159	.126	.108	.509	.216	.103	.064
	ε_3	.088	.174	.419	.204	.115	.066	.167	.471	.214	.082
	ε_4	.067	.15	.19	.388	.205	.046	.097	.169	.516	.171
	ε_5	.06	.129	.131	.225	.454	.047	.077	.094	.172	.609
C	ε_1	.403	.266	.162	.097	.071	.518	.239	.113	.085	.046
	ε_2	.176	.403	.195	.131	.096	.136	.49	.211	.109	.055
	ε_3	.105	.197	.352	.223	.123	.073	.166	.452	.228	.081
	ε_4	.062	.121	.179	.429	.208	.052	.091	.167	.522	.168
	ε_5	.057	.082	.13	.209	.522	.043	.069	.102	.209	.577

Table A2: Wage Transitions, Females

		Black					White				
		ε_1	ε_2	ε_3	ε_4	ε_5	ε_1	ε_2	ε_3	ε_4	ε_5
< HS	ε_1	.365	.282	.200	.094	.059	.392	.265	.114	.136	.093
	ε_2	.104	.377	.251	.126	.142	.120	.427	.201	.160	.091
	ε_3	.042	.170	.420	.231	.137	.075	.175	.410	.253	.087
	ε_4	.052	.117	.240	.403	.188	.044	.118	.169	.504	.165
	ε_5	.043	.148	.174	.113	.522	.054	.099	.127	.203	.517
HS	ε_1	.310	.268	.149	.134	.139	.456	.241	.138	.108	.057
	ε_2	.110	.400	.205	.161	.124	.117	.456	.230	.135	.061
	ε_3	.068	.234	.353	.213	.132	.060	.135	.480	.219	.076
	ε_4	.049	.157	.207	.394	.193	.051	.105	.190	.501	.153
	ε_5	.070	.169	.140	.191	.429	.044	.099	.126	.238	.493
SC	ε_1	.346	.210	.198	.156	.091	.450	.246	.146	.104	.055
	ε_2	.175	.392	.186	.166	.082	.121	.457	.230	.132	.059
	ε_3	.080	.250	.362	.225	.083	.072	.174	.462	.218	.074
	ε_4	.043	.153	.185	.403	.216	.048	.102	.191	.504	.155
	ε_5	.068	.114	.117	.203	.498	.036	.078	.108	.223	.555
C	ε_1	.377	.266	.178	.103	.075	.483	.264	.124	.085	.045
	ε_2	.175	.385	.246	.124	.069	.141	.478	.223	.104	.053
	ε_3	.113	.194	.329	.232	.132	.075	.177	.464	.206	.077
	ε_4	.071	.133	.210	.409	.177	.048	.095	.183	.496	.179
	ε_5	.054	.099	.150	.165	.533	.043	.070	.095	.225	.566

Table A3: Initial Wage Shocks Coming Out of Unemployment

		Black					White				
	Educ.	ε_1	ε_2	ε_3	ε_4	ε_5	ε_1	ε_2	ε_3	ε_4	ε_5
Females	< HS	.110	.362	.178	.209	.141	.181	.316	.204	.173	.127
	HS	.210	.299	.219	.156	.115	.316	.310	.178	.112	.085
	SC	.221	.351	.188	.137	.103	.301	.292	.181	.118	.108
	C	.304	.240	.179	.118	.160	.353	.219	.162	.141	.125
Males	< HS	.184	.218	.299	.126	.172	.212	.320	.138	.193	.138
	HS	.230	.302	.159	.183	.127	.267	.256	.203	.158	.117
	SC	.196	.314	.209	.150	.131	.305	.210	.234	.171	.080
	C	.310	.239	.197	.120	.134	.354	.241	.171	.131	.104

Table A4: Full Transition Matrix for Males

Educ.		Black							White						
		P	U	ε_1	ε_2	ε_3	ε_4	ε_5	P	U	ε_1	ε_2	ε_3	ε_4	ε_5
<HS	P	.67	.206	.124	0	0	0	0	.67	.186	.144	0	0	0	0
	U	.085	.771	.026	.031	.043	.018	.025	.015	.793	.041	.061	.026	.037	.026
	ε_1	.085	.137	.283	.22	.155	.073	.046	.015	.088	.352	.238	.102	.122	.083
	ε_2	.085	.137	.081	.293	.195	.098	.111	.015	.088	.108	.384	.181	.144	.082
	ε_3	.085	.137	.033	.132	.326	.18	.106	.015	.088	.067	.157	.368	.227	.078
	ε_4	.085	.137	.04	.091	.187	.313	.146	.015	.088	.04	.106	.152	.452	.148
	ε_5	.085	.137	.034	.115	.135	.088	.406	.015	.088	.049	.089	.114	.182	.464
HS	P	.67	.206	.124	0	0	0	0	.67	.186	.144	0	0	0	0
	U	.03	.733	.054	.071	.038	.043	.03	.007	.686	.082	.079	.062	.049	.036
	ε_1	.03	.1	.27	.233	.13	.117	.121	.007	.053	.429	.226	.129	.102	.054
	ε_2	.03	.1	.095	.348	.178	.14	.108	.007	.053	.11	.429	.217	.127	.058
	ε_3	.03	.1	.059	.204	.307	.186	.115	.007	.053	.057	.155	.451	.206	.071
	ε_4	.03	.1	.043	.137	.18	.343	.168	.007	.053	.048	.098	.179	.471	.144
	ε_5	.03	.1	.061	.147	.122	.167	.373	.007	.053	.041	.094	.118	.224	.463
SC	P	.67	.206	.124	0	0	0	0	.67	.186	.144	0	0	0	0
	U	.01	.665	.064	.102	.068	.049	.043	.002	.631	.112	.077	.086	.063	.03
	ε_1	.01	.081	.314	.191	.18	.142	.082	.002	.046	.428	.234	.139	.099	.052
	ε_2	.01	.081	.159	.356	.169	.15	.074	.002	.046	.115	.435	.22	.126	.056
	ε_3	.01	.081	.073	.227	.329	.204	.075	.002	.046	.068	.166	.44	.208	.07
	ε_4	.01	.081	.039	.139	.169	.366	.196	.002	.046	.046	.097	.182	.48	.148
	ε_5	.01	.081	.062	.104	.106	.185	.453	.002	.046	.034	.075	.103	.213	.529
C	P	.67	.206	.124	0	0	0	0	.67	.186	.144	0	0	0	0
	U	.005	.643	.109	.084	.069	.042	.047	.001	.522	.169	.115	.082	.062	.05
	ε_1	.005	.05	.356	.252	.169	.097	.071	.001	.025	.47	.257	.121	.083	.043
	ε_2	.005	.05	.166	.364	.233	.117	.065	.001	.025	.138	.465	.217	.102	.052
	ε_3	.005	.05	.106	.183	.312	.219	.125	.001	.025	.073	.172	.453	.2	.075
	ε_4	.005	.05	.067	.125	.199	.387	.167	.001	.025	.047	.092	.178	.483	.174
	ε_5	.005	.05	.051	.093	.142	.156	.504	.001	.025	.042	.068	.093	.219	.552

C Survey of Inmates in State and Federal Correctional Facilities

In this Appendix, we present further details on our sample from the Survey of Inmates in State and Federal Correctional Facilities (SISCF).Table C1 summarizes key characteristics in for state (left columns) and federal (right columns) prisoners that entered prison within the last twelve months. As in our quantitative study, we restrict the sample to 25-54 year olds. The average age is 36 for both state and federal prisoners, while the average sentence length is substantially longer in federal prison (nine vs. six years). While in state prison the sample is nearly balanced in terms of race, in federal prison inmates are predominantly black (63%). In terms of education, in state prison 36% did not complete high school, 52% completed at most high school, 10% have some college education, while 3% have completed college. Federal prisoners, on average, are more educated than state prisoners.

Table C1: Descriptive statistics of inmate sample

	State		Federal	
	Mean	[SD]	Mean	[SD]
Age	36.07	[7.53]	35.71	[7.21]
Sentence (years)	6.37	[9.13]	9.38	[8.06]
Race				
White	.48	[.5]	.37	[.48]
Black	.52	[.5]	.63	[.48]
Education				
<HS	.36	[.48]	.19	[.39]
HS	.51	[.5]	.56	[.5]
SC	.1	[.30]	.17	[.37]
C	.03	[.18]	.08	[.27]
Observations	1652		311	

Notes: About 14% (86%) of the total inmate population is held in federal (state) prison.

One common fallacy is that predominantly young males enter prison. Figure C1 plots the age distribution of non-immigrant and non-hispanic male inmates that report having entered into prison within the last twelve months. The gray bars represent the share of blacks, whereas the white bars represent the share of whites by age. The left panel displays the distribution for state and the right panel for federal prison. It is important to note that only about 14% of the prison population are in federal prison. The probability of entering into prison seems to be declining with age and nearly tampers off above the age of 60. However, it also becomes apparent that a substantial fraction of recent new entries into (state) prison are in their forties for both blacks and whites, and the age distribution, in particular in state prisons, is rather uniform between ages 20 and 50.

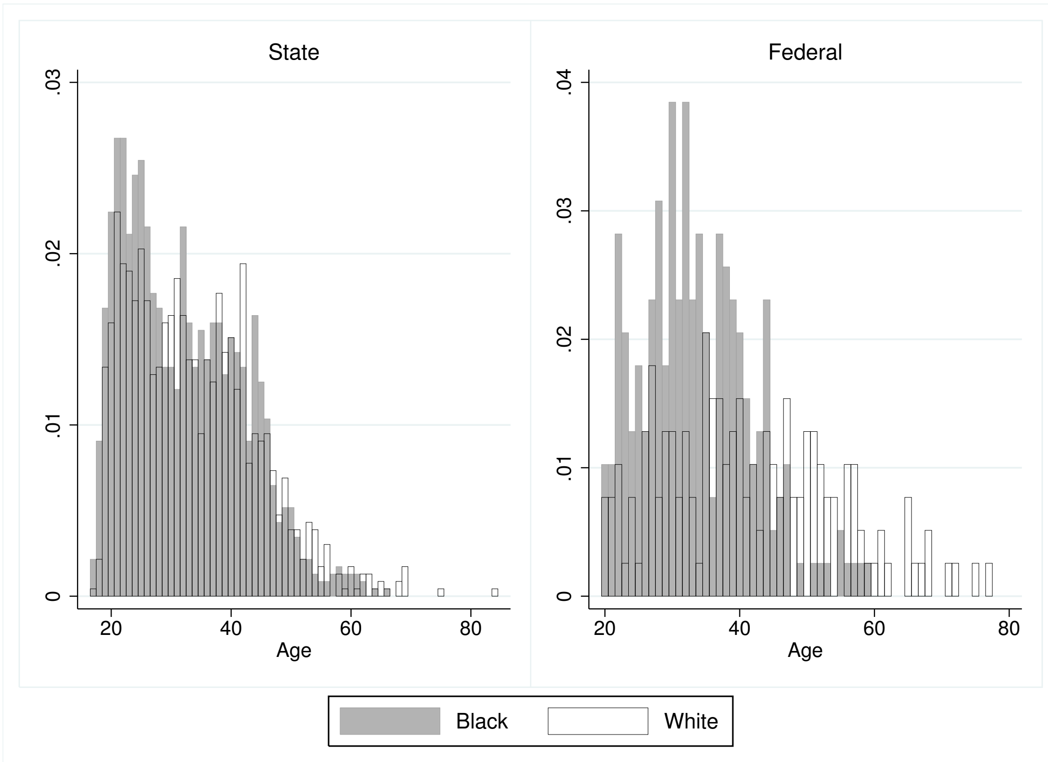

Figure C1: Age distribution of inmates by race that entered prison within last year (2004)

In Figure C2, we plot the probability of transitioning into prison at a given age by race and education using the methodology described in Section 5.1. Each panel is dedicated to one of the levels of education, while the solid line refers to blacks and the dashed line to whites. It becomes apparent that black males are more likely to transition into prison than white males at all ages within each level of education.

In Figure C3 we plot the distribution of sentence lengths for blacks (gray bars) and whites (white bars) for state (left) and federal (right) inmates in our restricted sample. In state prison the modal sentence length for blacks and whites is two years and more than 50% have sentences of less than five years. In federal prison we see that, in particular for blacks, the share of inmates with lengthy sentences is higher. Almost 10% of black inmates face sentences of more than 25 years and about 30% of at least 10 years. For whites these shares

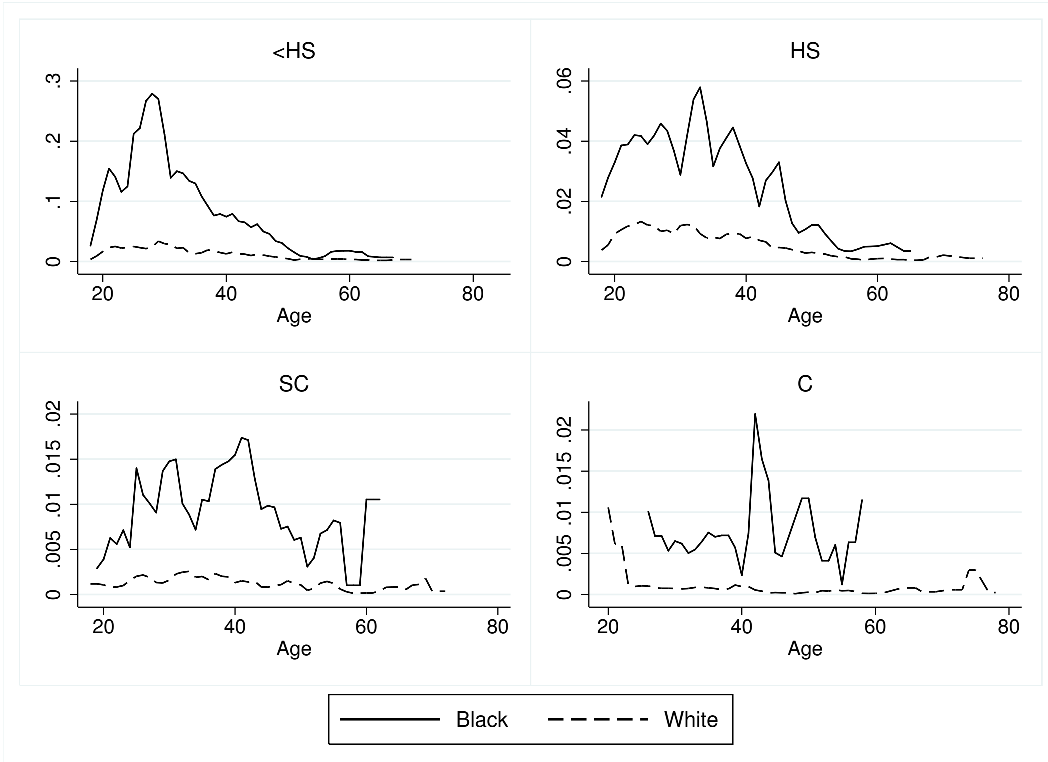

Figure C2: Probability of transitioning into prison by age, education, and race (2004)

are less than half of what they are for blacks.

The distribution of offenses by race is displayed in Figure C4. For blacks in state prisons (black bars in left panel) the most frequent offense is drug trafficking, followed by burglary, armed robbery, and aggravated assault. For whites in state prison (white bars in left panel), the three most frequent offenses are burglary, theft, and driving under the influence of alcohol. In federal prison (right panel), the three most frequent offenses for blacks are cocaine/crack trafficking, offenses involving illegal possession of weapons, and drug trafficking. For whites, drug trafficking, weapon offenses, and trafficking of controlled substances are the most frequent offenses.[28]

[28] In many cases the type of illegal drug is not specified. Surprisingly, cocaine and crack are bunched in the same category even though under mandatory sentence lengths under federal law the sentencing disparity was 100:1 for crack versus cocaine in 2004. For blacks, crack is likely to be the dominant substance within the crack/cocaine category. For whites, methamphetamines, and "crystal meth" in particular, are likely to be the dominant substances within the controlled substances category.

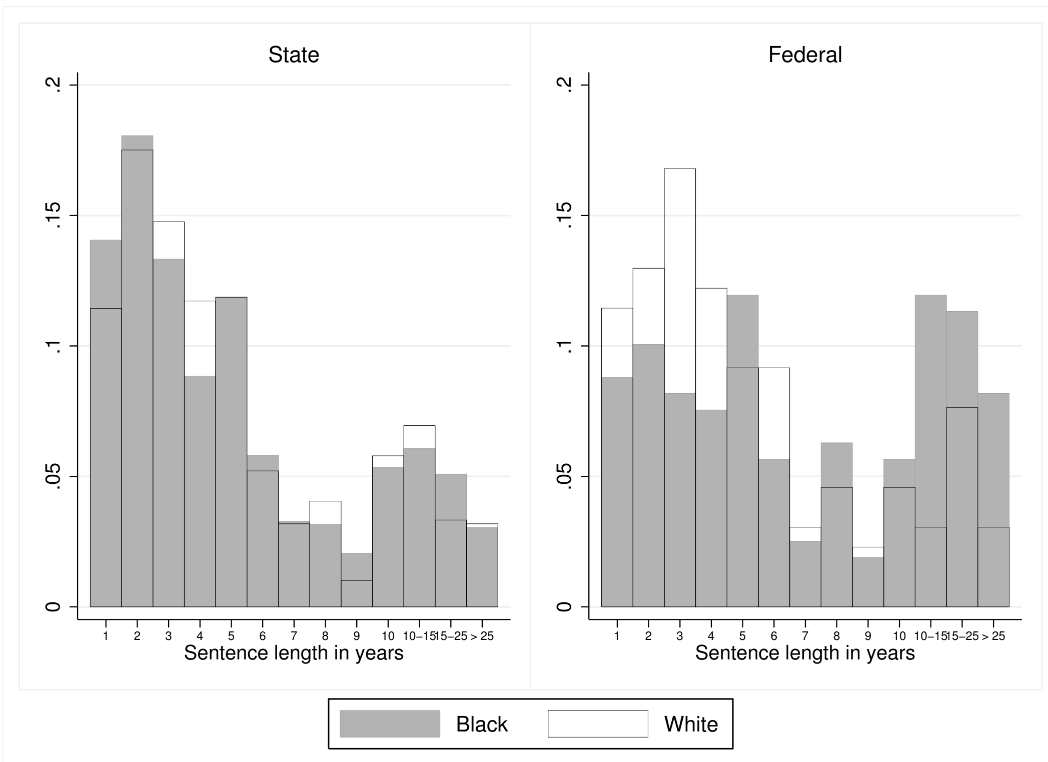

Figure C3: Sentence distribution of inmates by race that entered prison within last year (2004)

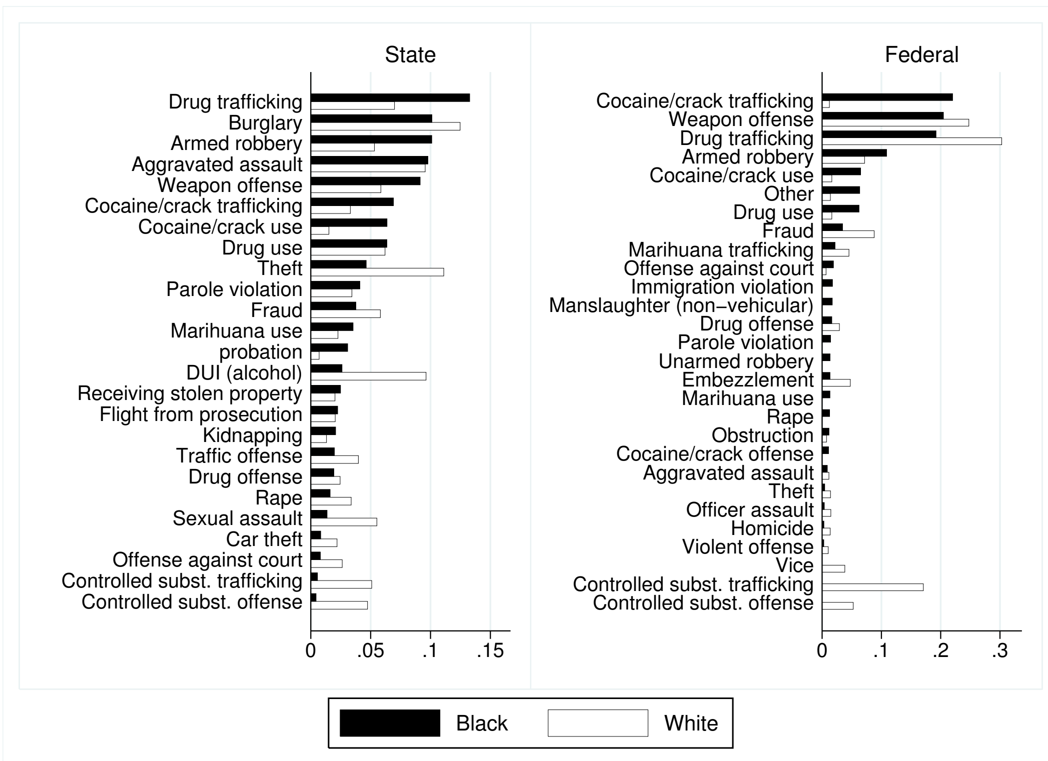

Figure C4: Offenses of inmates by race that entered prison within last year (2004)

D Counterfactual Prison Transitions

In this Appendix, we present the counterfactual prison transitions used in Section 7.1.

Table A5: Probability of Going to Prison (yearly)

Education	High Scenario	Low Scenario
< HS	.0516	.0632
HS	.0177	.0215
SC	.0057	.0066
C	.0031	.0041

E Additional Figures

Figure E1: Black-White Differences in Incarceration plus Unemployment versus Marriage (left panel), Changes between 1980 and 2010 Incarceration plus Unemployment versus Marriage (right panel)