Why Do Only 5.5% of Black Men Marry White Women?*

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Abstract

Only 5.5 percent of black males married white females in 1990, and at the same time 7 percent family-income premium was observed for intermarried black males. This paper estimates the impact of the mating taboo, courting opportunities, and individual endowments on the black male marriage market. Results indicate that eliminating the mating taboo would raise the intermarriage rate from 5.37 to 64 percent, and do away with the intermarriage premium. Improving black males' endowments or allowing black males to meet white females as frequently as they do black females would not increase intermarriage.

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1 Introduction

Black/white intermarriage is commonly used as an indicator of the health of race relations.[1] Improving race relations is considered a desirable social goal. Though creeping upward, the intermarriage rate of black males remains low.[2] In 1990, only 5.5 percent of black males married white females.[3] At the same time, 7 precent family-income premium was observed for intermarried black males.[4] Despite many studies focusing on the black/white intermarriage rate, there is still much debate over the causes of the low rate, and little analysis of the intermarriage premium.[5]

In this paper, I formulate and estimate an explicit decision model of partnership selection, provide quantitative explanations for the low intermarriage rate, and assess the impact of intermarriage behavior on its premium.[6] The model permits comparison of three competing explanations: (i) the mating taboo, (ii) individual differences in endowments, and (iii) the limited opportunities for courtship between blacks and whites.[7] The mating taboo, which can be either self-generated or societally-driven, amounts to a distaste for selecting a mate outside one's own racial group. Individual differences in endowments, such as market earning potential and educational attainment, affect black men's marriageability because black males may fail to attract white females through lack of these endowments. Endowments, in turn, affect black males' opportunities to court white females.

The marriage model assumes that agents are *ex ante* heterogeneous with respect to their race and endowments or types. Because the marital search process is costly, agents choose a range of partner types to maximize their expected discounted utility

[1] See, for example, Kalmijn (1993) and Aguirre et. al (1989).

[2] To check whether the intermarriage rate is low or not, I compare it with the random intermarriage rate, or the encounter rate, which corresponds to the rate at which there is no market friction or selection. In other words, conditioning on the race of a man, the probability that the man will meet a woman from another racial group is uniform across all pairs of members of the two groups, or is the fraction of white women out of all women in the market. The radom intermarriage rate was 85.4 percent in the 1990 Census.

[3] Similar patterns exist for black women. However, due to data limitations, I focus only on black men.

[4] The family-income premium is the ratio of the mean family income of black males who intermarried to those who intramarried. The earning premium was 12.2 percent. Data are based on the 1990 IPUMS.

[5] See, for example, Qian (1997), Alba (1995), Kalmijn (1993), and Jansen (1982).

[6] In this paper, I only examine how intermarriage premium responds to individuals' marriage behavior. Other forces may impact intermarriage premium, but they are beyond the scope of the present study.

[7] Identification of the mating taboo would be impossible in any reduced-form model because it is associated with other racial-specific fixed effects. The advantage of using a structural approach is that because the model explicitly solves an optimization problem and determines marriage decision rules, it permits the quantification of the effects of altering specific parameters of the model on marriage decisions. Precisely, the parameter mating taboo can be altered, holding other parameters constant, to assess its impact on the acceptable pool of potential partners, the intermarriage rate and its premium.

(following an optimal reservation-match policy) instead of waiting for ideal partners (as they do in Becker (1973) or Gale and Shapley (1962)). The solution to agents' marriage decision determines each agent's reservation-partner-type; the maximum-attainable type of each agent is endogenously determined in the equilibrium. A match occurs when agents of both sides, who follow optimal strategies, find each other acceptable. Otherwise, they part and wait for the next meeting to occur. In this way, sets of feasible outcomes of matches are generated.

The mating taboo devalues intermarriage output. As a consequence, agents have incentives to intermarry only if they can be more selective *ex ante,* choosing more productive partners to offset the devalued match output. Such selective behavior to offset the mating taboo reduces the admissible pool of partners of dissimilar race, and hence lowers the intermarriage rate. Selective matching may also lead to an intermarriage premium if the acceptance probability for intermarrying is sufficiently lower than for intramarrying. If there were no mating taboo, race would matter only insofar as it was related to characteristics valued in the marriage market.

The model is estimated using data from the Panel Studies of Income Dynamics (PSID) 1968-97. The estimation method combines the numerical solution of the marriage model with the maximization of a likelihood function. The method contains three parts. First, individuals are ranked by mapping a set of observable characteristics into a single "marriage index".[8] Second, the equilibrium acceptable pool of partners is computed according to the optimal behavioral rules of the agents in the model. Third, a likelihood function is constructed based on the equilibrium outcomes of the model.

Identification of heterogeneous types is important as a means of blocking unwarranted inferences. However, agents' types are not measurable. Types not only subsume many observable traits but also contain traits that are unobserved, which nevertheless may be critical in determining who matches with whom. The approach that I adopt classify agents' observable traits into types. Because agents' observed types may be classified incorrectly, the likelihood function is a mixture over classification error probabilities.

The model's estimates show that education is a relatively more desirable marriage trait than earning potential as measured by the wage. However, taken together, the two traits account for only 16 percent of black men's marriage index.

Given these estimates, the mating taboo is found to be the greatest factor accounting for the low intermarriage rate. Eliminating the mating taboo explains 74 percent of the low rate and accounts for all the intermarriage premium. Equalizing courtship opportunities reduces the intermarriage rate and accounts for at most half of the intermarriage premium, while equalizing endowments has trivial effects on the intermarriage rate and its premium.

[8] A more general technique would be to characterize individuals' types directly based on their multi-dimensional characteristics. Although not impossible, this technique would complicate matching and estimation substantially.

This paper builds on the random two-sided matching model of Burdett and Coles (1999, 1997), Bloch and Ryder (1998), and Collins and McNamara (1990), where agents are *ex ante* heterogeneous. In contrast to those authors, and as in Smith (1997), in the model developed here agents are productive. Marriage output technology depends on the race of the partner. The role of race is technological: intermarriage affects output and increased selectivity is the response. The paper also builds on the empirical literature on search-based spousal selection.[9] For example, Montgomery and Sulak (1989) apply the search approach used in Keifer and Neumann's (1979) model of the labor market to study female ages at first marriage. However, they consider only a single characteristic, education, and do not structurally estimate an underlying search model. As in Anderson and Saenz (1994) and Grossbard (1993), individual heterogeneity is found to have a significant effect on the low intermarriage rate. However, this paper goes beyond existing efforts in that it is capable of assessing the quantitative significance of alternative explanations for the low intermarriage rate and of studying their relationships to the intermarriage premium.

This paper is organized as follows. Section 2 presents the matching model. Estimation strategies are presented in section 3. Section 4 describes the data. Section 5 shows estimation results. The paper concludes in section 6.

2 The Model[10]

A marriage model, based on a random-matching search model, is presented in this section. The environment of the model is described in subsection 2.1. Subsection 2.2 describes marriage decisions and defines the equilibrium. Comparative static results of the key element of interest, the mating taboo, is presented in subsection 2.3.

2.1 The Environment

The main assumptions of the model are:

Time: Time is continuous, and the horizon is infinite.

Agents: There are two groups of infinite-lived agents, men and women, who discount future income at rate β. All agents are either single or married. The total mass of agents in each group is normalized to one. The population is constant.

Across-Group Heterogeneity: Across-group heterogeneity represents agents who differ by their race. Let there be two race groups, $k = 1, 2$. Let φ and $(1-\varphi)$ be the exogenous proportions of race 1 and 2 agents in the population respectively. Agents of either race can be accepted by agents of the opposite sex. Let π be the

[9] Some examples of use of spousal selection in a complete marriage market include Bergstrom and Lam (1994), the first to apply the theory of optimal assignment to study matching by age and its relationship to the marriage squeeze, and Suen and Lui (1999), who develop an empirical model of spousal selection (based on optimal assignments) to explore efficiency in the marriage market.

[10] The model is a direct adoption of the assimilation model proposed in Wong (2002).

proportion of single agents who are race 1, which is endogenously determined in the model based on agents' selection criteria. Let u^k denote the fraction of race k agents who are single. All proportions are sex-neutral.

Output: The output of a single agent is his or her own type, x. The match output is the product of partners' types. Intermarriage is taboo. The simplest way to introduce the concept of taboo is to assume that all agents devalue the match output by the same amount τ, $\tau > 0$.[11] Thus, the mating taboo hurts low type agents more than high type agents. Of course, treating the taboo as a lump-sum tax in intermarriage output is not the only way to think about the concept.[12] Alternatively, the mating taboo can be generated by the degree of residential segregation. It could also be heterogeneous (observed and/or unobserved) or stochastic in nature. Given the complexity of the model and of estimation issues, these alternatives will not be pursued in this paper.

Utility: A single agent derives utility from his or her own type. Match utility is assumed to be non-transferable, so it is an equal split of the match output. The utility structure of a race k agent is

$$\begin{aligned} U_k &= x_k \text{ if single} \\ &= \frac{x_k x_{k'}}{2} \text{ if } k = k' \\ &= \frac{x_k x_{k'} - \tau}{2} \text{ if } k \neq k'. \end{aligned} \tag{1}$$

Within-Group Heterogeneity: Within-group heterogeneity represents agents who are *ex ante* different with respect to their types x, $x \in [\underline{x}, \overline{x}]$.[13] The lowest bound of an agent's type is at least as large as two to satisfy the incentive constraint for marriage: $\frac{x_k x_{k'}}{2} - x_k >= 0 \Rightarrow x_{k'} >= 2$. Let $F(.|x)$ denote the distribution of type among single potential partners who will propose to type x agents if they meet.[14] The corresponding probability density function is $f(.|x)$. F is continuous and twice differentiable, $F' > 0$, and $F'' < 0$, and standard Inada conditions hold.

Let subscripts i and j represent types for men and women respectively. Therefore, heterogeneity in men and women associated with their races and types is represented

[11] The mating taboo is assumed to be the same within and across races for the purpose of maintaining the tractability of the model.

[12] Note that the unfavorable aspect of the taboo tax hinges on assortativeness in the marriage market. Were matching negatively sorted, taxing match output would become favorable and it would only exacerbate the negative assortativeness of matching. A mating taboo in this environment is uninteresting. To restrict the unfavorable aspects of the mating taboo, I impose the assumption of productive complementarity and scale economy in match output, which leads to positive assortative matching.

[13] Types summarize agents' attributes into a one-dimensional quality measure (see section 4.1 for details).

[14] The content of F is discussed in section 4.1.

by x_{ki} and $x_{k'j}$ respectively. To further simplify for exposition, the distribution of types is assumed to be the same for men and women of the same race, $F_{ki} = F_{kj} = F_k$, so that matching outcomes are not due to differences in gender courtship opportunities. Assume for now that the distribution between the two races is also the same so that aversion to interracial marriage is not a consequence of differences in distribution, $F_1 = F_2 = F$.[15]

Match Formation: Only single agents search for marriage partners. Matching is random, so agents of different types have the same likelihood of meeting other agents. Let λ be the arrival rate of single agents of the opposite sex faced by a single agent of either sex. Let λ be governed by a Poisson process.[16] When two single agents meet, race and types are observed. If both agents agree to a marriage proposal, a match is formed. If one of the partners rejects a match proposal, the two single agents continue to look for partners.

Match Destruction: A match dissolves exogenously at rate δ.[17]

2.2 Marriage Decisions and Equilibrium

A marriage decision is made with the objective of maximizing agents' expected discounted value in the future utility stream. Given an arrival rate of partners, an agent has a probability π of contacting a race 1 potential partner and deciding whether or not the partner is acceptable. With probability $(1-\pi)$, an agent contacts a race 2 potential partner, and decides whether or not to accept the race 2 partner and to accept the agent's type. Therefore, the flow value of a type i agent of race 1 who is single, $V(x_{1i})$, is his instantaneous utility while single, and the weighted expected benefit of marriage following an optimal policy if partner type $Z_{k'}$ is realized, given that a potential partner has arrived, is

$$\begin{aligned} \beta V(x_{1i}) &= x_{1i} + \lambda\pi E \max\left[W(x_{1i}, Z_1), V(x_{1i})\right] \\ &\quad + \lambda(1-\pi) E \max\left[W(x_{1i}, Z_2), V(x_{1i})\right] - \lambda V(x_{1i}), \end{aligned} \tag{2}$$

where $W(x_{1i}, Z_{k'})$ is the expected discounted value of marriage with a race k' random partner of type $Z_{k'}$, and the expectation is taken using the conditional distribution $F(.|x_{1i})$.

The *ex post* flow value of marriage, $W(x_{1i}, x_{kj})$, is made up of the realized match utility and the net value of remaining single due to an exponential random separation δ,

[15] The estimation strategy is based on racial and gender differences in type distribution.

[16] The arrival rate is assumed to be independent of race to simplify the exposition and focus the essence of inter- and intra-marriage that is affected by the mating taboo, as well as individual and racial differences in type distribution.

[17] Using exogenous separation instead of a common specification of cloning removes the second infinity problem and brings the model closer to reality.

$$\beta W(x_{1i}, x_{1j}) = \frac{x_{1i}x_{1j}}{2} + \delta\left[V(x_{1i}) - W(x_{1i}, x_{1j})\right] \quad (3)$$

$$\beta W(x_{1i}, x_{2j}) = \frac{x_{1i}x_{2j} - \tau}{2} + \delta\left[V(x_{1i}) - W(x_{1i}, x_{2j})\right]. \quad (4)$$

The decision on the acceptance of a partner of a given race is determined by whether the partner's type exceeds the agents' reservation type. Let R_{1i} and R'_{1i} denote reservation types with race 1 and 2 partners respectively. Because intermarriage incurs an output loss, agents facing race 2 partners are more selective in order to equalize intermarriage and intramarriage output. Equalizing intermarriage and intramarriage output implies that race 1 agents must select race 2 agents by τ/x_{1i} units from intramarriage reservation type, so $R'_{1i} = R_{1i} + \tau/x_{1i}$.[18] Note that high type agents require less compensation for distaste when compared with low type agents primarily because high type agents gain more from increasing returns and complementary in match output.

Thus, given the partner's race as k', the decision of whether to intermarry is based on whether the partner's type exceeds the augmented reservation type, $x_{k'j} >= R_{ki} + \tau/x_{ki}$, where $k' \neq k$. Rearranging terms, the intermarriage condition becomes $x_{ki}(x_{k'j} - R_{ki}) >= \tau$. That is to say, intermarriage occurs if the taboo is sufficiently small or the endowment difference between the partner's type and the minimum requirement is sufficiently large.

The optimal reservation-partner-type is given by equating the weighted value of a match at the reservation type with the value of being single,

$$\pi y_{11} W(x_{1i}, R_{1i}) + (1-\pi) y_{12} W(x_{1i}, R'_{1i}) = V(x_{1i}). \quad (5)$$

Equation (5) can be simplified to $\frac{x_{1i}R_{1i}}{2} = \beta V(x_{1i})$. Let M_{1i} be the maximum-attainable type of a race 1, type i agent, and $M'_{1i} = M_{1i} + \tau_1/x_{1i}$.[19] The agent's acceptance set is $\mathcal{A}_{11i} = \{j | R_{1i} <= x_{1j} <= M_{1i}\}$ if meeting a race 1 partner, and $\mathcal{A}_{12i} = \{j | R'_{1i} <= x_{2j} <= \min[\overline{x}_2, M'_{1i}]\}$ if meeting a race 2 partner. Given the realized race of the partner, if a marriage offer falls within the agent's acceptance set, the agent will accept the match proposal following the optimal policy; otherwise, the offer will be rejected. The decision problem of race 2 agents is structured analogously.

If $L(x)$ denotes the exogenous population distribution of types, steady state accounting implies,

[18] τ/x_{1i} is obtained from: $x_{1i}x_{2j} - \tau = x_{1i}x_{1j} \Rightarrow x_{1i}(x_{2j} - x_{1j}) = \tau \Rightarrow (x_{2j} - x_{1j}) = \tau/x_{1i}$.

[19] M_{1i} is endogenously determined in the equilibrium.

$$
\begin{aligned}
u^1 &= \int_{x_{1j}} \frac{\delta}{\delta+\lambda\left[\pi\int_{z\in\mathcal{A}_{11j}} dF\left(z|x_{1j}\right)+(1-\pi)\int_{z\in\mathcal{A}_{12j}} dF\left(z|x_{1j}\right)\right]}\,dL\left(x_{1j}\right), \\
u^2 &= \int_{x_{2j}} \frac{\delta}{\delta+\lambda\left[(1-\pi)\int_{z\in\mathcal{A}_{22j}} dF\left(z|x_{2j}\right)+\pi\int_{z\in\mathcal{A}_{21j}} dF\left(z|x_{2j}\right)\right]}\,dL\left(x_{2j}\right), \qquad (6) \\
\pi &= \frac{\varphi u^1}{\varphi u^1+(1-\varphi)u^2}.
\end{aligned}
$$

A steady state Nash equilibrium contains two acceptance sets $\{R_{ki}, M_{ki}\}, \{R_{kj}, M_{kj}\}$ such that $\beta V\left(x_{ki}\right), \beta V\left(x_{k'j}\right)$, $\beta W(x_{ki}, x_{k'j})$, and $\beta W(x_{kj}, x_{k'i})$ satisfy (2), (3), and (4) for $i, j = 1, ..., J$ and $k, k' = 1, 2$; the following conditions hold for all $i, j = 1, ..., J$: (i) the optimal reservation policy: for $k = 1, 2$, $\{R_{ki}, M_{ki}\}, \{R_{kj}, M_{kj}\}$ satisfying (5), (ii) the optimal matching agreement: for $k, k' = 1, 2$, $x_{k'j} \in A_{kk'i}$ and $x_{ki} \in A_{k'kj}$, and (iii) steady state accounting: u^1, u^2, π satisfying (6).

In a steady state, every single individual selects his (her) own partner type to (i) maximize the expected net benefit flow attributable to the choice of partner following (2), (3), and (4), given the optimal choices made by all other single individuals, and (ii) agreement decisions are optimal. Given the assumptions of the model, the equilibrium is characterized by positive assortative matching, which represents a positive relationship between agents' reservation types and their own types.

2.3 The Effects of the Mating Taboo

In what follows, I describe the comparative statics of the mating taboo on reservation type, the intermarriage rate, and the intermarriage premium. Let $\kappa = \frac{\lambda}{\beta+\delta}$. Combining equations (2), (3), (4), and (5), the reservation type of race 1 agents is the solution to the following equation

$$
\frac{x_{1i}R_{1i}}{2} = x_{1i} + \kappa\pi_a \int_{z\in\mathcal{A}_{11i}} \frac{x_{1i}\left(z-R_{1i}\right)}{2}\,dF\left(z|x_{1i}\right) + \kappa(1-\pi_a)\int_{z\in\mathcal{A}_{12i}} \frac{x_{1i}\left(z-R_{1i}\right)-\tau}{2}\,dF\left(z|x_{1i}\right). \qquad (7)
$$

(7) indicates that the reservation match output is the sum of the output while single and the weighted sum of the expected net match output. The solution R_{1i} is unique because the left-hand side of (7) is increasing in R_{1i} and the right-hand side decreasing. Appendix A proves the following lemma:

Lemma 1. $-1 < \frac{dR_{ki}}{d\tau} < 0$.

As the aversion to intermarriage becomes more severe, agents substitute partners within race for those outside race, and agents become less picky. So, lemma 1 is the consequence of the substitution effect. Note that a unit increase in the mating taboo reduces the reservation type by less than one unit. All acceptance sets for intramarriage move down along type scales, and the acceptance probability within race increases with the taboo.

Note further that there is a tension between τ and λ in affecting equilibrium matching outcomes. On the one hand, an increase in τ lowers the reservation type (lemma 1). On the other hand, an increase in λ speeds up the arrival rate of partners, so a match becomes more valuable and agents become more selective.

Now, assign black men to race 1. Black men's intermarriage rate is

$$IMR = \frac{(1-\pi_a)\int_{z\in\mathcal{A}_{12i}} dF\left(z|x_{1i}\right)}{(1-\pi_a)\int_{z\in\mathcal{A}_{12i}} dF\left(z|x_{1i}\right) + \pi_a \int_{z\in\mathcal{A}_{11i}} dF\left(z|x_{1i}\right)}.$$

Because lemma 1 implies that an increase in the mating taboo raises R'_{ki}, the acceptance probability for race 2 partners falls and that for race 1 partners rises. Consequently, the intermarriage rate falls with the mating taboo.

Let $\triangle Q$ represent the ratio of intermarriage and intramarriage output.[20] An intermarriage premium, $\triangle Q > 1$, occurs if the relative expected intermarriage and intramarriage output exceeds the relative acceptance probability of marrying outside and within race. The driving force for the intermarriage premium is the selectivity that reduces the acceptance probability. An increase in the mating taboo that leads to a sufficient fall in acceptance probability would raise $\triangle Q$ to above unity.

3 Data

Given a model that describes agents' marriage transition, panel data with marriage histories are used for estimation. Specifically, data on age at first marriage, a couple's wages and education at first marriage, race, and the duration of first marriage are used.[21]

3.1 The Sample[22]

The PSID 1968-1997 consists of family, individual, marriage history, and income-plus samples. Interviews in the PSID have been conducted annually since 1968. The family files do not contain marriage histories of the respondents, and the marriage history file does not contain detailed demographic and employment data. To obtain a sample for the analysis, I first use marriage history and individual files to create an eligible sample population with a well-defined marriage history. Then I link the sample to family files to obtain for each household head, and spouse if married, corresponding

[20] $\triangle Q = E[x_{1i}Z_2 - \tau \mid Z_2 \in A_{12i}] \;/\; E[x_{1i}Z_1 \mid Z_1 \in A_{11i}]$.

[21] Although longer marriage histories are available, only the first marriage spell is utilized.

[22] The data appendix contains detailed descriptions of the data selection process.

demographic and employment data. The 1968-97 individual file contains 59,888 spells, and the 1985-1997 marriage history file contains 41,267 spells of respondents ever interviewed. For marriage histories prior to 1985, I use the individual file to track individuals' marriage behavior year by year. I use income-plus samples to obtain income variables from 1994-1997.[23]

The marriage history file contains information on when first marriages started and ended (if this occurred). I follow each individual before they marry, through their first marriage and/or separation, or if they do not marry or married but not divorce, through their last interview. Only household heads (and spouses if married) are selected because the PSID only records household heads and their spouses' demographic and employment data, not subfamilies.

Marital search duration can only be partially observed because the elapsed singlehood duration T_{0b} is unknown.[24] In what follows, I use 15 as an index for spousal search starting time.[25] Therefore, if T^* is the stopping time of being single, C is the censoring time, and T_{of} is the residual singlehood duration (the duration of search after the interview date), the completed spell of search duration is $T_0 = T_{ob} + T_{of} = \min\{T^*, C\} - 15$. The duration of marriage is defined as the number of years a couple stays married before or until the censored time, whichever comes first. Zero durations are dropped because they may induce spurious duration dependence. This leaves 483 married and 201 single households.[26]

Data concerning wages and education of respondents (and their spouses if married) are taken as of the year of their marriages. I assume that these characteristics are time invariant. Annual salary in 1997 dollars is used as the wage variable for the entire sample. 12.96 percent of wives in the sample had zero wages. Instead of dropping these cases, which may contain valuable marriage data, I impute a potential wage for them. Early release data 1994-1997 contain little information on respondents' education levels: After deleting missing education and wage data, the full-sample

[23] One disadvantage of using the PSID (1994-97) is that income data from family files 1994-1997 are preliminary. One can technically obtain family income data, for example, by adding certain variables. However, 99 percent of responses on those variables are zero.

[24] The initial condition problem is solved by Chamberlain (1979) using a bayesian technique, in which the random effect distribution is conditioned on forward recurrence information. Ondrich (1985) controls for heterogeneity assuming that both unemployment and employment spells have Weibull Distribution with parametric unobserved heterogeneity. Results from an exponential model and Cox's Proportional hazard model reveal that there is significant heterogeneity in the duration of being single in my sample. Heterogeneity in my model is captured by the acceptance selection of each individual type, assuming that $\lambda > 0$.

[25] First, age 15 is the official Census definition for the marriageable age (see Statistical Abstract 1996 for details.) Second, evidence from the Census reveals that in 1970, 99 percent of women were married at or after age 18 and men at or after age 20. In 1990 the corresponding ages were 20 and 22 for women and men respectively. Moreover, my sample does not contain respondents who married at ages younger than 15, and only 2 cases of zero single duration spells, so the choice of 15 as starting age does not seem unreasonable.

[26] The early release data contain many missing observations and so the pool of single respondents is reduced sharply.

contains 435 married and 153 single households. Among these households, there are five groups: whites, blacks, Chinese, Japanese, and American Indians. I keep this full-sample for the purpose of generating the marriage index distribution (see subsection 4.1). I choose the subset of black men for the estimation; total married and single households headed by black men are 160 and 20, respectively.[27]

3.2 Descriptive Statistics[28]

Table 1 contains sample characteristics of intermarried and intramarried black men's and spouses' family incomes, wages, and education levels. Mean family incomes for intermarried black men were 6.3 percent higher than their intramarried cohorts. Mean wages of intermarried black men were 14 percent higher than intramarried black men. Black men who intermarried had 0.4 years more (or 3 percent higher) education than intramarried cohorts. Spouses of intermarried and intramarried black men had similar mean wages and education levels, with white spouses having slightly higher mean levels. The fact that intermarried blacks tended to have higher wages (and education) may reflect that those agents self-selected into intermarriage, or that white women were more selective than black women, or that fixed costs in terms of the mating taboo existed. The magnitude of the wage premium for intermarried black men exceeds that of the education premium in this sample.

Table 1. Sample Characteristics of Black Men, PSID, 1968-97

	Sample Mean	Standard Deviation
Intermarriage		
family incomes	35828.44	18736
wage	23727.15	17246
education	12.81	1.30
wife's wage	11469.02	6965
wife's education	12.50	1.31
Intramarriage		
family incomes	33693.25	22251
wage	20877.68	14632
education	12.41	1.96
wife's wage	11440.87	10617
wife's education	12.30	1.94

Descriptive statistics on singlehood and marriage durations are given in table 2. In this sample, many respondents ended up marrying: the proportion of black men

[27] Two cases of intermarriage of black men occured with other ethnic groups. Because the size is small, I dropped these observations in the sample. The total number of marriages is thus reduced to 160.

[28] To check how representative the PSID sample is, I compare it with 1990 Census data (see Data Appendix).

transiting to marriage is 88.89 percent (row 2, column 2). The sample shows that black men who intermarry had less difficulty in staying married than their intramarried cohorts: the duration of marriage was slightly longer for intermarried than intramarried black men. All intermarriages remained censored. The proportion of the interrupted marriage spell for the intramarried families exceeded that for the intermarried by 16.2 percent.

Table 2. Sample Durations

	Singlehood	Intermarriage	Intramarriage
Fraction Censored	.111	1	.838
Mean Duration	11.967	8.667	8.357
Standard Deviation	5.984	5.538	6.458

3.3 The Intermarriage Rate

The black/white intermarriage rate of black men is 3.75. To quantify whether the intermarriage rate is low or not, I compare the sample intermarriage rate with a “random” intermarriage rate for black men. The random intermarriage rate was 85.4 percent in the 1990 Census. A comparison of the actual and “random” intermarriage rates indicates that the former is remarkably low.

One explanation for the low intermarriage rate is group mean differences in characteristics such as group size, wages, and educational attainment. Differences in these variables affect courtship opportunities. Alternatively, individual differences in characteristics may affect the propensity to intermarry. To this end, I fit a probit model to the sample.[29] Results indicate that higher educated and older individuals, and those who reside in states with a higher percentage of white single women, tend to intermarry. The last result from the Probit estimation suggests that data support the notion that individual exposure to ethnicity has a positive effect on intermarriage. After controlling for various individual characteristics, the constant from the probit estimation has a large negative effect on intermarriage for black men. This indicates that racial differences in the form of mean characteristics and fixed costs such as distaste have a negative effect on intermarriage.

In sum, the PSID sample reveals preliminary conditions on the black male marriage market that indicate the existence of an intermarriage premium and compensation for intermarriage in terms of higher mean wages and education. In particular, agents’ characteristics affect their intermarriage behavior, and intermarriage may be negatively influenced by the fixed-effects of racial distaste or racial differences in mean characteristics.

[29] The dependent variable equals one if a marriage is an intermarriage. The independent variables are husband’s age, age squared, education, percentage of single white women in the residential state, regional dummies, and city dummies.

4 Estimation Strategy

The object of interest is to estimate the likelihood of a type i agent marrying a type j agent. The model does not admit analytical solutions, but can be numerically solved in a straight-forward manner. The estimation strategy involves ranking agents, solving the matching model for agents' acceptance sets, and then maximizing a likelihood function given the numerical solutions of the marriage model.

4.1 The Marriage Index

To estimate the model, it is necessary to know the distribution of types. In what follows, I adopt an explicit formulation for agents' marriage index. Agents' logarithms of wage w and education e are ranked in discrete categories.[30] I first generate $z = \exp\left[\alpha w + (1-\alpha)\, e\right]$, where α is a scaler parameter that measures the sensitivity of spousal demand of a change in wages.[31] Then I take the range of the corresponding order statistics of z and discretize it into 10 equal partitions. The set of z within each interval is mapped to x_i following the mapping $x_i = median\left[z_{Li} < z <= z_{Hi}\right]$, where z_{Li} indicates the lowest z that makes a type i individual, and z_{Hi} indicates the highest z that makes a type i individual. The real-valued x_i represents a type i individual, which is a piece-wise constant within the corresponding $i-th$ interval of z. Thus, given α, w, and e, $x_i(\alpha)$ and the corresponding empirical type distribution, $F(x;\alpha)$, are generated. This procedure is implemented separately for men and women of each race.

4.2 The Likelihood Function

The structural parameters in the model are $< \lambda,\ \delta,\ \alpha,\ \tau >$. The model is identified from data that consist of a panel where some individuals are single with duration T_0, married with duration T_1, intermarried with indicator y, as well as the couple's wage and education at first marriage, w and e, respectively. Assuming the parameters of males and females across blacks and whites to be the same, data on singlehood duration identify λ, marriage duration identify δ, intermarriage identify τ, and the couple's wage and education identify α.

Consider a type i man (of race 1) who is single at the first interview. Let T_{ob} be the elapsed singlehood duration and T_{of} the residual singlehood duration so that $T_0 = T_{0b} + T_{0f}$. T_{ob} and T_{of} be i.i.d. and have an exponential distribution with parameter $\lambda\left\{(1-\pi)\left[F_2(M'|x_i) - F_2(R'|x_i)\right] + \pi\left[F_1(M|x_i) - F_1(R|x_i)\right]\right\} = \lambda h_0$, which represents the hazard rate of marriage. Let D_{ob} (D_{of}) denote a binary variable that equals one, if it is known that the elapsed (residual) duration exceeds a certain value,

[30] I consider a discret type distribution because it gives me a flexible class of error structures. See subsection 4.3.

[31] Since the procedures of constructing "type" for each sex is the same, I drop the gender subscript.

i.e., left-censored (right-censored), and equal to zero otherwise. Conditioned on being type i, the individual contribution of singlehood duration until and including the time of exit into marriage or censoring is

$$L_{0i} = (\lambda h_0)^{1-D_{ob}+1-D_{of}} \exp\left[-\lambda h_0 \left(T_{ob} + T_{of}\right)\right], \tag{8}$$

where $T_{0f} > 0$ and $T_{0b} > 0$.

Events occurring after exit from singlehood are independent of events up to exit. Therefore, their probability is independent of the likelihood of being single. The event immediately following type i's singlehood duration is the realization of what race and what type of partner type i matches with. This event is made up of two parts. First, it consists of the probability of the realized marriage type y of a type i agent (whether intermarried or not), which is given by

$$\Pr(Y = y|x_i) = \left(\frac{(1-\pi)\left[F_2(M'|x_i) - F_2(R'|x_i)\right]}{h_0}\right)^{y} \left(\frac{\pi\left[F_1(M|x_i) - F_1(R|x_i)\right]}{h_0}\right)^{(1-y)}. \tag{9}$$

An intermarriage occurs if $y = 1$. Second, it includes the density of the accepted type conditional on i's marriage type, $f(x_{kj}|x_i, y)$. The density is given by the number of race k and type j women out of all types of women acceptable to a type i man. Let N_{kj} be the number of race k and type j agents and $\sum_j N_{kj} I(x_{kj} \in A_i)$ be the number of potential partners acceptable to a type i man, where $I(x_{kj} \in A_i)$ is an indicator function equaling one if a woman is acceptable. Then

$$f(x_{kj}|x_i, y) = \left[\frac{N_{kj} I(x_{kj} \in \mathcal{A}_i)}{\sum_{j=1}^{J} N_{kj} I(x_{kj} \in \mathcal{A}_i)}\right]_y \left[\frac{N_{kj} I(x_{kj} \in \mathcal{A}_i)}{\sum_{j=1}^{J} N_{kj} I(x_{kj} \in \mathcal{A}_i)}\right]_{(1-y)}. \tag{10}$$

Conditional on the marriage type and realized partner type, marriage duration T_1 has an exponential distribution with parameter δ. If $D_{0f} = 1$, I do not follow the individual any longer. Let $D_2 = 1$ if T_1 is right-censored, and equal zero otherwise. If $D_{0f} = 0$, then a type i individual's likelihood contribution to events between entering marriage and separation equals

$$L_{1i,kj} = \Pr(Y = y|x_i) f(x_{kj}|x_i, y) \delta^{1-D_2} \exp(-\delta T_1), \tag{11}$$

where $T_1 > 0$. The total type i individual likelihood contribution for a respondent who is single at the time of the first interview equals the product of (8) and (11), which describes the odds of each type i man who initially is single, matching with a partner with a marriage offer, and followed by the marriage dissolving exogenously:

$$L_{i,kj} = L_{0i} L_{1i,kj}^{(1-D_{0f})}, \tag{12}$$

where $i = 1, ..., 10$ and $j = ., 1, 2, ..., 10$.

4.3 Classification Errors[32]

It is well known that search models are sensitive to measurement errors. The matching model is also sensitive to classification errors because agents' types may be incorrectly specified using only observable characteristics. To resolve the problem, I consider a classification error model, assuming 10 types of agents.

Denote b and l to be and true types for type i and j agents respectively. Let the classification errors for type i and j agents, v_1 and v_2, be independently and identically distributed, where $i = b + v_1$ and $j = l + v_2$. Because the supports of v_1 and v_2 are known, only their distributions need to be estimated. Further, the classification error probabilities are assumed to be symmetric and to be the same between men and women. Let the density of classification error for type i and j agents be $q(|v_1|)$ and $q(|v_2|)$ respectively. Symmetry means that the probability of misclassifying an individual is the same for any i and b with the same error, $q(|b - i|) = q(|b' - i'|)$ for any $|b - i| = |b' - i'|$, where $b \neq b'$ and $i \neq i'$.

For all samples of men, the likelihood function adjusted for classification errors is

$$L_c = \prod_{n \in (i,kj)} \sum_{v_1 = i-10}^{i-1} \sum_{v_2 = j-10}^{j-1} L_{0(i-v_1)} \left[L_{1(i-v_1),k(j-v_2)} q(|v_2|) \right]^{(1-D_{0f})} q(|v_1|), \qquad (13)$$

where n represents the $n-th$ observation of type i agents, $i = 1, ..., 10$, and $j = ., 1, 2, ..., 10$.

5 Estimation Results

The logarithm of the likelihood function (13) is maximized using a simulated annealing algorithm.[33] Standard errors are bootstrap standard errors.[34] The likelihood is estimated setting the discount rate and the exogenous fraction of black women at 0.05 and 0.14 respectively. The exogenous fraction of black women of 0.14 is chosen to match the national representative fraction.

5.1 Parameter Estimates

The parameter estimates for the (baseline) model are in table 3.[35] Row 1 shows that education constitutes almost all observable marriageability. Alternatively, as

[32] Details in solving the classification error model can be found in Wong (2003).

[33] Various initial parameter values are used to ensure a global optimum.

[34] I use standard bootstrap drawing N observations with replacement.

[35] I also estimate the model using standized earning (by mean age) and the present value of an individual's expected income; I find no qualitative difference in results. The present value of an

wage represents temporal income and education represents permanent income, α can be interpreted as the time rate of preference. The low α implies that agents are patient. Estimated classification error distribution shows the likelihood that wage and education correctly classify agents' types to be 16 percent ($q(0) = 0.1625$).[36]

Table 3. Estimates of the Matching Model of Black Men

α	0.0078 (.002)
λ	0.6925 (.050)
δ	0.0098 (.002)
τ	64.00 (5.64)
$q(1)$	0.1250 (.001)
$q(2)$	0.1124 (.002)
$q(3)$	0.1028 (.002)
$q(4)$	0.0583 (.003)
$q(5)$	0.0405 (.003)
$q(0)$	0.1625
$\log L$	-1125.06

Notes: $q(0) = 1 - 2q(1) - 2q(2) - 2q(3) - 2q(4) - q(5)$

To see how the marriage market of black men is stratified from the model prediction, I plot estimated acceptance sets for black men and black women and those for black men and white women in figures 1 and 2, respectively. Figure 1 shows that there are overlapping marriage sets for the black intramarriage market. Men of type six and above demand women of type six and above; while these women are less selective, they are willing to match with men of type four and above. The reason for the asymmetry is the gender distribution differential: there are more high type black women than men. Men become more selective because they face more high type women, while on the other hand, women face more low type men and become less selective. Similar to higher type men, type four and five men are accepted by type ten women, but they are willing to match with type four women, unlike higher type men. The bottom three types of men are not married because they are not eligible to be marriage partners of the same type or higher. This result is consistent with extensive facts that support the notion that underclass black men tend to be single.[37]

individuals's expected income is computed assuming earning terminates at age 65: $\sum_{t=a}^{65} w(t)\, e^{-r(t-a)}$, where $w(t)$ is predicted earning at age t, r is the discount rate, and a is the individual's age at marriage or the censored time.

[36] I also estimate the model with a discrete unobserved heterogeneity on types and on the mating taboo. The deep parameters of the model are robust and the probability of zero classification error jumps to 0.73.

[37] See, for example, Wilson (1990).

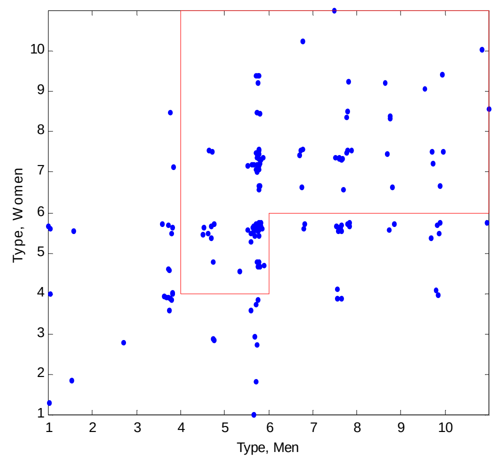

Figure 1. The Black Male Intramarriage Acceptance Set

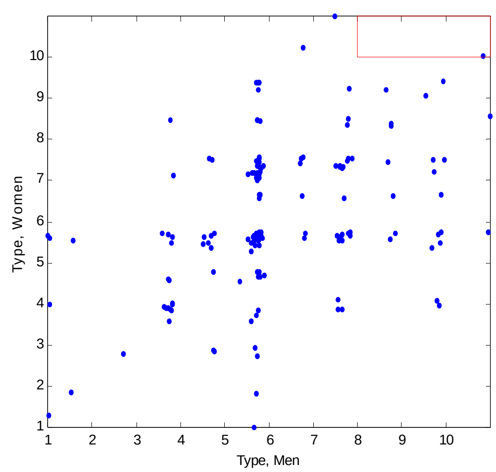

Figure 2. The Black Male Intermarriage Acceptance Set

The estimated mating taboo is 64.0. What does it say about compensating racial distaste? Due to the fixed-cost property of the taboo, each type of black men chooses white women whose types are at least as high as the sum of the reservation type for black women and the taste shifter τ/x_i. That is to say, higher type men require lower reservation types than lower type men to compensate for intermarriage.[38] Figure 2 shows that the intermarriage market is sorted by type eight through type ten men with only type ten white women. Lower type (type 7 and below) men are even pickier. Unfortunately, there are no higher type white women to compensate for their taboo,

[38] For example, $\tau/x_1 = 6.39$ and $\tau/x_{10} = 3.06$, type one men require more than twice as high attributes of white women as type ten men for marriages to take place.

and so they only marry within race.

Given parameter estimates, the model can predict the equilibrium fraction of single women who are black (π), the intermarriage rate (IMR), and the intermarriage output premium ($\triangle Q$). The predicted π is 0.290, exceeding the exogenous fraction of black women of 0.14. Using (6), this implies that the steady state fraction of black women who are single is higher than that of white women who are single, which is supported by Census data. The predicted intermarriage rate is 0.0356. The predicted intermarriage and intramarriage output is 207.31 and 196.88 respectively, giving an intermarriage premium of 5.3 percent.

5.2 Model Fit

The model does a reasonably good job of matching the intermarriage rate. The estimated unconditional intermarriage rate is 0.0356, which is close to the actual rate of 0.0375 in the data. While predicted means are useful as guides to how well the model captures certain features of data, it is constructive to conduct formal tests of model fit. To test the intermarriage rate, I construct the null hypothesis as $H_0 : IMR = 0.0375$. The test statistic is $|Z| = |\frac{\overline{IMR}-0.0375}{\sigma/\sqrt{N}}|$, where σ represents the standard error of the predicted mean intermarriage rate $\overline{IMR}$, and N is the sample size. I test whether $|\overline{IMR}|$ is $2.6 * \sigma/\sqrt{N}$ greater than 0.0375 at the 0.01 significance level. Because 0.0375 lies within the confidence interval for the predicted mean intermarriage rate, the null hypothesis is not rejected.[39]

The assumptions of Poisson arrival rates imply that singlehood and marriage durations should be distributed with intensity parameters $\lambda\{(1-\pi)[F(M_i) - F(R_i)] + \pi_a [G(M_i') - G(R_i')]\}$ and δ respectively, where i represents a type i agent.[40] To check how well the exponential model fits the data, I perform a formal test by fitting a Weibull model to the duration data. Under the null hypothesis of an exponential model, the slope of the shape parameter $\rho = 1$. The shape parameter of spousal search is estimated to be 0.9270 (table 4, row 2), which is quite close to one. The asymptotic confidence interval is right on the line. So, the assumption of exponential spousal search times is not rejected by the data. Note that this result is a direct consequence of taking classification error in the hazard rate into account (and subsequently integrating it out). The estimate without conditioning out classification error is $\rho = 0.6908$.

Table 4. Specification Tests For Exponential Search Times

[39] Although there is no benchmark to check for the fitness of the intermarriage premium, the predicted premium of 1.053 is close to the mean family income premium in the PSID, which is 1.063 (see table 1, section 3.2).

[40] The transition rate to marriage is obtained after conditioning out unobserved heterogeneity in types.

	ρ	95% lower limit	95% upper limit
Singlehood	0.9270	0.8064	1.0413
Marriage	0.9894	0.7561	1.2227

The exponential model seems to fit marriage spell data as well. However, the enormous standard error of ρ raises suspicion about the model's fitness even though the estimate is close to one. Because the estimate is smaller than one, it exhibits a decreasing hazard, that is to say, marriage tenure is negatively associated with the separation hazard. Such duration dependence may be spurious, and unobserved heterogeneity may be required to improve the fit of the model. Another way to achieve improvement is to discard the assumption of exogenous separation as the only match termination mechanism. Exogenous separation can underestimate the transition rate from marriage to separation. To obtain a reasonable estimate of the transition rate of separation, one may need to extend the model and introduce endogenous separation that can be derived from one of three sources: (1) the learning effect in marriage, so that agents discover each others' types after marriage, (2) shocks in match output that sufficiently reduce the flow payoffs of matches, and (3) shocks to agents' outside options. But such attempts are out of the scope of this paper. In sum, the model fits the spousal search data well and raises suspicion about marriage duration data. The result indicates that further investigation is necessary. In particular, including unobserved heterogeneity in the marriage hazard, or endogenous match destruction, would seem to be necessary.

5.3 The Causes of the Low Intermarriage Rate

Why do so few black men marry white women? If the mating taboo plays an important role in black men's low intermarriage rates and individual and racial differences in characteristics do not, then the low intermarriage rate is mainly due to taste. However, if human capital or opportunities have important effects on the intermarriage rate and its premium, policy instruments would be effective in targeting agents' intermarriage behavior.

Table 5 shows what would happen, according to the model's prediction, to the intermarriage rate and its premium, if endowments and opportunities to court were equalized, and if society were color-blind. To examine how low the predicted intermarriage rate is, I need to have a basis for comparison. I use a random intermarriage rate, predicted by the steady state fraction of single white women (0.71) as the basis. The second row presents the baseline situation. The gap between the random intermarriage rate and the predicted intermarriage rate is $(1-\pi)$-IMR = 0.71-0.0356 = 0.6744.

Table 5. Predicted Effects of Endowment and Opportunity Equalization on the Intermarriage Rate and its Premium

	IMR	Intermarriage Output	Intramarriage Output	$\triangle Q$
Baseline	0.0356	207.31	196.88	1.0530
Same E	0.0382	219.49	199.68	1.0992
Same O	0.0296	207.31	202.02	1.0262
Same O1	0.0082	207.31	196.88	1.0530
Same E and O	0.0329	204.0	189.76	1.0749
Same E and O1	0.0088	219.49	199.68	1.0992
$\tau = 0$	0.4173	202.95	201.59	1.0067

E=Endowment, O=Opportunity where black women took on the type distribution of white women, O1=Opportunity where white women took on the type distribution of black women.

5.3.1 Equal Endowments

Row 3 in table 5 reports an experiment in which black men had the same human capital endowments as white men, but in which courtship opportunities and taboos were the same as the baseline. That is, if all heterogeneity were because of initial observable endowment differences and were remediated entirely through government policies, for instance, the intermarriage rate would increase from 3.56 to 3.82. An explanation for the rise is that with black men as attractive as white men, black men would be more desirable as marriage partners. However, due to taboos, the increase in the intermarriage rate accounts for only a 0.4 percent fall in the intermarriage rate gap ((0.0382-0.0356)/0.6744 = 0.004).

5.3.2 Equal Opportunities

The next experiment equalizes courtship opportunities so that black women would take on the type distribution of white women (case O). The result (row 4) shows that if black men met high type black women as often as they did white women, the intermarriage rate would be reduced to 2.96. Of course, if black women's distribution first-order stochastically dominated that of white women, a large drop in the intermarriage rate would be expected.

If the type distribution of white women were equal to that of black women, intermarriage would be nearly eliminated (case O1, row 5). Selective matching would yield the same acceptance set as the baseline, that is, only type ten white women would be accepted. But there are many fewer type ten black women than white women (the density is 0.011 and 0.0535 respectively).

5.3.3 Equal Endowments and Opportunities

The next two experiments combine the experiments with equal endowments and courtship opportunities. The predicted intermarriage rate would be reduced to 3.29 and 0.88 for case O and case O1 respectively. These results further demonstrate that equalizing opportunities would reduce the intermarriage rate, and a change in black men's endowments would be of little use.

5.3.4 Color-Blind

In contrast to altering endowments and opportunities, the next experiment eliminates the mating taboo. If all heterogeneity were because of taboo, the intermarriage rate would jump to 41.73 percent (row 6), which is a stunning 11.72 fold increase from the rate of 3.56 in the baseline. This result is consistent with a remark in section 2.3 that predicts that the intermarriage rate rises with a lower mating taboo. Eliminating the mating taboo explains 56.6 percent of the low intermarriage rate. Because selection is due to interdependence among taboo, opportunities, and endowments, a change in opportunities and endowments tends to have small impact on the intermarriage rate, unless at the same time there is a change in taste. Obviously, eliminating all differences would completely erase the intermarriage rate gap.

Because the mating taboo plays an important role in the low intermarriage rate, I use the PSID simulation result to predict a Census intermarriage rate were the mating taboo eliminated. An 11.72 fold increase in the intermarriage rate would raise the 1990 intermarriage rate to 64 percent had there been no mating taboo (5.48*11.72 = 64.23). In other words, the mating taboo explains 74 percent of the low national intermarriage rate ((0.6423-0.0537)/(0.854-.0537) = 0.735).

5.4 The Intermarriage Premium

Table 5 also reports predicted effects on the intermarriage premium. Column 5 row 3 shows that an improvement in black men's endowments would raise the intermarriage premium by 4.6 percent. The second experiment shows that if black women took on the same distribution as white women, intramarriage would yield higher match output than in the baseline case, which is predictable because black women had a higher mean type. At the same time, black men would become more selective, and intramarriage output would increase. Thus, with intermarriage output unchanged, the intermarriage premium would be cut by half. The next experiment shows that if white women had the same distribution as black women, there would be no effect on intermarriage or intramarriage output. In the next two experiments, both endowments and opportunities were equalized (rows 6 and 7). The results show that this would raise the intermarriage premium about 2.2 to 4.6 percent.

If the only heterogeneity were from the taboo, while endowments and opportunities are the same as predicted in the baseline, the intermarriage premium would be eliminated. A decline in taboo (from 64 to 0) reduces mean intermarriage output, conditional on selection (see section 2.3). At the same time, according to lemma 1, agents would become more selective, thus raises mean intramarriage output. These two forces work against each other to compress the mean marriage output differential.

6 Conclusion

In this paper, I formulated and empirically implemented a random matching model within and across racial lines. The model is estimated on longitudinal data that included information about age of first marriage, wage, education, race, and marriage duration. The estimates of the model were used to quantify the importance of alternative reasons for the low intermarriage rate.

The results can be summarized as follows: (i) Education has a greater impact on desirability as marriage partners when compared with wage. But together, they only account for 16 percent of agents' marriageable traits. (ii) If the mating taboo were eliminated without altering opportunities and endowments, the intermarriage rate would rise to 64 percent, which would explain 74 percent of the low intermarriage rate, and the intermarriage premium would be eliminated. (iii) Equalizing courtship opportunities for black and white women would by itself reduce the intermarriage rate. In particular, if black men met white women as frequently as black women, almost no intermarriage would occur because there would be too few high type white women to compensate for the taboo. Equalizing opportunities in the sense of having black women's type distribution the same as white women's would close the marriage output gap by about half. (iv) Raising black men's endowments would be ineffective in affecting the intermarriage rate and would raise the intermarriage premium.

7 Appendix

7.1 Data Appendix

7.1.1 Sample Selection

To obtain a sample for the analysis, I first use marriage history and individual files to create an eligible sample population with well-defined marriage histories, and then link the sample to family files to obtain for each household head, and spouse if married, their corresponding demographic and employment data.

The 1968-97 individual file contains 59,888 spells, and the 1985-1997 marriage history file contains 41,267 spells of respondents ever interviewed. The marriage history file contains data from 1985-1997. For marriage history prior to 1985, I use the individual file to track individuals' marriage histories year by year. The individual file is also used to link marriage history data to the yearly family file. The marriage history file contains information on when first marriages started and ended if this occurred. I exclude individuals with inconsistent marriage histories, e.g., those with uncertain marriage years or marriage termination years, or those who ended the marriage before their marriage started. A substantial fraction of the original sample is not present after 29 years of survey.[41] Observations are not used for single

[41] Attrition occurred as a result of loss of contact as families moved, maturing children could not

respondents if their marriage histories were last updated before 1997. For married couples, observations are not used when marriages were not updated in 1997 but first marriages lasted after 1997. Imposing this restriction, only 28,956 spells are left.

I keep individuals whose first marriages began in or after 1968 and lasted until or after 1985. For those individuals whose marriages began before 1968, there was no information on the age at marriage or corresponding marriageable characteristics. The races of household wives were not available in the PSID before 1985. Thus, for couples whose marriages dissolved before 1985, there was no race information. The PSID oversamples Hispanics. After excluding the Latino sample, 23,541 spells are left.

To create data linking members of a couple, I use information on the household head and spouse because each family file only contains demographic and employment data for household heads (and spouses), not respondents from subfamilies. Thus, I restrict the marriage sample so that both household heads and spouses are present. Also, as mentioned earlier, only first marriages and their spells are considered. This leaves a total of 2,602 households, of which 1,289 are single and 1,313 married.

After deleting samples with uncertain and inconsistent race and age records, and respondents who have been institutionalized, I have 483 married and 201 single households. The pool of single respondents is reduced sharply because the early release data contain many missing observations.

Data concerning wages and education of respondents (and their spouses if married) are taken as of the year of their marriages.[42] Samples from 1994-1997 contain data only on annual wages and salaries, and no data on weeks worked or hours worked per week. Thus, annual salary is used as the wage variable for the entire sample. Non-working married women are given imputed wages.[43]

7.1.2 Comparisons Between the PSID (1968-1997) and the 1990 Census Data

To check how representative the PSID sample is, I compare it with 1990 Census data. I use the Census data as an economy-wide baseline. The sample contains non-institutional respondents with positive male wage.

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be traced, or respondents refused to continue to be interviewed. Ducan et al. (1991) document the representativeness of the PSID after 17 years from 1968. They find that there is a serious problem of attrition and most original households are not represented by respondents in 1968. However, samples still have comparable mean charactersitics to those in 1968.

[42] I decode the interval data of education in 1968-1974 and 1985-1990, using auxillary relations with the 1980 Annual Demographic March CPS data.

[43] To correct for income effects in the female labor supply, I impute potential wages for women (by race) who do not work using Heckman's two-step procedure. To correct for selectivity bias, I estimate a participation probit using a standard Heckman procedure. The probit equation contains all variables in the wage equation and the number of children. The wage equation is controlled by husbands' and wives' ages, ages squared, education, and husbands' wages.

The census sample characteristics are presented in table A1. The census sample shows similar intermarriage patterns as the PSID: intermarried black men (with white spouses) had higher family incomes, wages, and education levels than intramarried blacks. The sample means on earnings in the full-sample are higher than that in the PSID mainly because of the life-cycle effect from earnings.

The intermarriage rate from the Census is 5.5 percent (1225/22357=0.0548). The rate is so much lower in the PSID (3.75 percent) because the PSID oversamples poor blacks for the study of poverty. As blacks who intermarry have higher mean wages and education level (table A1), poor blacks are unlikely to intermarry. Another reason for the lower intermarriage rate in the PSID is that the sample does not include members from subfamilies, as opposed to the Census data. So there may be problems of undercounting in the PSID.

Table A1. The Sample Characteristics of Black Men, 1990 Census

Intermarriage	Sample Mean	Standard Deviation
family incomes	49054.51	34784.53
wage	28768.66	23245.2
education	13.80	2.63
wife's wage	15469.66	17785.06
wife's education	13.74	2.63
N	1225	
Intramarriage		
family incomes	45869.81	28608.36
wage	25638.94	17823.87
education	12.70	3.08
wife's wage	13918.98	13393.59
wife's education	13.14	2.79
N	20893	

7.2 Appendix A

Proof of Lemma 1. Equation 7 can be expressed as

$$0 = R_i - 2 - \kappa \left\{ \pi_a \int_{z \in A_i} (z - R_i)\, dF(z|x_{1i}) + (1 - \pi_a) \int_{z \in A_{2i}} (z - R_i - \tau/x_i)\, dF(z|x_{1i}) \right\}.$$

Implicit differentiation indicates that

$$\frac{\partial R_i}{\partial \tau} = \frac{-\frac{\kappa}{x_i}(1 - \pi_a) \int_{z \in A_{2i}} dF(z|x_{1i})}{1 + \kappa \left\{ \pi_a \int_{z \in A_i} dF(z|x_{1i}) + (1 - \pi_a) \int_{z \in A_{2i}} dF(z|x_{1i}) \right\}} < 0,$$

and

$$\frac{\partial R_i}{\partial M} = \frac{\kappa \left\{ \pi_a \left(M - R\right) f(m|x_{1i}) + (1 - \pi_a) \left[(M + \tau) - (R + \tau)\right] f(m + \tau|x_{1i}) \right\}}{1 + \kappa \left\{ \pi_a \int_{z \in A_i} dF\left(z|x_{1i}\right) + (1 - \pi_a) \int_{z \in A_{2i}} dF\left(z|x_{1i}\right) \right\}} >= 0.$$

For the acceptance set of the highest type agents, $x_{i=J}$, $\frac{\partial R_J}{\partial \tau} < 0$. For any $x < x_J$,

$$\frac{dR_i}{d\tau} = \frac{\partial R_i}{\partial \tau} + \frac{\partial R_i}{\partial M}\frac{\partial M_i}{\partial \tau}.$$

Following $\frac{\partial R_i}{\partial \tau} < 0$, an inductive argument implies that $\frac{\partial M_i}{\partial \tau} < 0$. Therefore, $\frac{dR_i}{d\tau} < 0$.

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