Is Parental Love Colorblind? Allocation of Resources within Mixed-Race Families

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Comments welcome

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Abstract

Recent studies have shown that differences in wage-determinant skills between blacks and whites are likely to emerge during a child's infancy. These findings highlight the role of parental investment decisions and suggest that differences in labor income tend to persist across generations, either because minority parents are limited in their choices, or because they have relatively negative expectations regarding the rewards attached to investments in skills. Exploring the genetics of skin-color determination and the widespread incidence of mixed-race families in Brazil, I present evidence that, controlling for observed and unobserved parental characteristics, light-skinned children are more likely to receive investments in formal education than their dark-skinned siblings. Even though not denying the importance of borrowing constraints (or other ancestry effects), this suggests that parental expectations regarding differences in the return to human capital investments may play an *independent* role on the persistence of earnings differentials.

Keywords: interracial marriage, intrahousehold allocations, racial differentials, investments in children.**JEL codes:** D13, J13, J15, J24, J71.

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"My father was also belligerent toward all of the children, except me. (...) I've thought a lot about why. I actually believe that as anti-white as my father was, he was subconsciously so afflicted with the white man's brainwashing of Negroes that he inclined to favor the light ones, and I was the lightest child. Most Negro parents in those days would almost instinctively treat any lighter children better than they did the darker ones. It came directly from the slavery tradition that the mulatto, because he was visibly nearer to white, was therefore better.

(...) my mother was the one who whipped me. (...) Thinking about it now, I feel that just as my father favored me for being lighter than the other children, my mother gave me more hell for the same reason. She was very light herself and favored the ones who were darker. (...) She went out of her way never to let me become afflicted with a sense of color-superiority."

excerpt from The Autobiography of Malcom X as told to Alex Haley, Chapter 1.

1 Introduction

A number of studies detect significant association between individual characteristics used to infer ethnic-group membership and various measures of socioeconomic success.[1] In the United States, Brazil and South Africa, for example, the intense trade of African slaves by English and Portuguese colonizers, and the Dutch displacement of indigenous populations made the color of one's skin an indicator of European ancestry and play a key role in social stratification. This historically-rooted stratification remains stark in those three countries,

[1]Bertrand and Mullainathan (2004) provide experimental evidence that (randomly selected) firms in the United States are less likely to interview job-applicants with distinctively black names. Using cross-sectional observational data, Goldsmith et al (2005), Gyimah-Brempong and Price (2006), Hersch (2006), Hunter et al. (2001) and Keith and Herring (1991) all find suggestive evidence of a complexion gap in terms of wages, legal punishments, education and unemployment among African Americans. Hammermesh and Biddle (1994) and Biddle and Hammermesh (1998) find evidence of appearance premia. Their reasoning could also be applied to hair curliness, nose width, lip thickness, steatopygia, and to any of the physical traits that can be linked to membership in the black or white ethnic groups. In fact, when the Apartheid regime was introduced in South Africa, skin color and physical traits were used in combination to establish the classification system imposed by government officials.

particularly in the case of labor markets, despite the sharp differences in patterns of economic development and institutional arrangements regarding racial segregation.[2]

There are two factors that could explain skin-color differentials in the labor market context. It is possible that dark-skinned individuals receive lower wages, are less likely to be employed, or have limited access to certain jobs (relative to an equally able light-skinned individual) due to discrimination. Alternatively, observed differences may be the result of darker-skin individuals relatively lower investment in the accumulation of skills, what translates into a scarcity of economic opportunities. These are not mutually exclusive, however. If skills are not fairly rewarded, members of the group discriminated against have less incentives to invest in them.[3]

Findings from recent studies tend to emphasize the role of human capital investments, showing that differences in skills between blacks and whites emerge quite early (during infancy), affecting both cognitive and non-cognitive aspects of child development.[4] Since these early investment reflect the decision of parents, if knowledge about the interplay of achievement differences and differential investments in human capital is to be advanced, patterns of familial investments on young children need to be better understood. These findings also suggest that differences in labor market performance are likely to persist across generations, either because minority parents face constraints that non-minority parents do not, or because the former have, in relative terms, negative expectations regarding the usefulness of investments in human capital.

Policy prescriptions are likely to be different if racial differences are explained by family background, as borrowing constraints, or if they are explained by differences in expectations regarding returns to investment (Lazear, 1980). If the explanation of the relatively low levels of schooling rests on imperfect capital markets, subsidized loans for minority education should be prescribed. If the source is differential returns, subsidized loans would not be the adequate policy, and the government action should be concentrated on policies to curb labor market discrimination.

Empirical applications targeted at identifying the forces behind minority parents' underinvestment in human capital are plagued by the fact that predictions derived from different assumptions are, in general, observationally equivalent. Take the case of borrow-

[2]See Alexander et al. (2001) for a three-country perspective. Analysis of US historical data can be seen in Bodenhorn (2003), Bodenhorn and Ruebeck (2005), Dollard (1937), Freeman et al. (1966), Hill (2000), Ransford (1970), Reuter (1918) and Seeman (1946).

[3]See Carneiro et al. (2005), Heckman (1998) and Neal and Johnson (1996).

[4]See Carneiro et al. (2004) and Levitt and Fryer (2004).

ing constraints, for example. Minority parents may face borrowing constraints that limit their ability to invest in their children. Current racial differentials on income from labor are then transmitted across generations via under-accumulation of skills. If it is assumed that employers statistically discriminate (disadvantaged groups are considered less likely to have invested in skills), this equilibrium is self-reinforcing. Employers' beliefs regarding reduced productivity among minority workers are, on average, confirmed by draws from the respective population (as elegantly modeled by Antonovics, 2006 and Blume, 2006). Note, however, that the same implications can be derived from models in which, instead of borrowing constraints, the focus is on parental expectations of employers' discriminatory behavior, or even genetic transmission of tastes and cognitive ability. This is because in these models wage determination is related to ancestry, with family connections unambiguously determining membership in different ethnic groups. Hence, any empirical examination of differences in human capital investment *across* families is bound to capture the role of *all* family-level characteristics, be they observed or not.

In the present paper I attempt to untangle some of these effects by considering the following thought experiment. Employers are assumed to, at the time of a job interview, base their expectations on appearance (phenotype) and its connection to ancestry. In particular, skin color is used to infer family background. Of course, in the case of complete segregation in marriage markets and totally endogamic marital associations, skin color and race are expected be perfectly matched. In a contest of significant miscegenation in marriage markets, however, connections between ancestry and appearance are less straightforward. In particular, identical family backgrounds (genetic, social, or financial) are shared by siblings of different appearance. Therefore, mixed-race families offer an interesting laboratory for the examination of the persistence of skin-color-based differences in labor market outcomes.[5] Following this simple insight, I present evidence that, controlling for observed and unobserved parental characteristics, light-skinned children are more likely to receive investments in human capital than their dark-skinned siblings. Even though not denying the importance of borrowing constraints (or other ancestry effects), this novel result suggests that parental expectations regarding differences in the return to human capital investments (according to skin color) may play an *independent* role on the persistence of education and earnings differentials.

In essence, this paper is based on the examination of how mixed-race families, through parenting practices and decisions, mediate the impact of society-wide skin color differenti-

[5] See Campbell and Eggerling-Boeck (2006) and Lopez (2003) for a discussion on the rapid growth of mixed-race families in the United States. See also Fryer (2006) for a perspective in economics.

ation over their children. The analysis has to consider different conceptual ways by which welfare optimizing parents may generate systematic differences in the patterns of investment depending on skin color:[6] i) they may respond differences in expected returns to human capital investments; ii) they may respond to differences in the costs of those investments (including opportunity costs); iii) parents may simply prefer one skin color over another (evaluate identical outcomes differently). The interesting question here is: Do parents operate so as to maximize or minimize the effects of genetic endowment of "whiteness" on earnings?

The analysis is based on the combination of unique features of the Brazilian racial classification system and data collection with random aspects of the genetics of skin color.[7] Even though the high rate of interracial marriages and the consequent high proportion of mixed-race individuals in the population (*mulattoes* or *browns*) are frequently cited indicators of Brazilian racial tolerance, there is evidence that they coexist with pertinent differences between whites and non-whites in terms of wages and other measures of living standards (see Arias et al., 2004; Campante et al., 2004; and Telles, 2005). A recent publication by the World Bank (see Perry et al., 2006) extended that analysis and presents evidence that returns to schooling (in terms of wages) among dark-skin individuals are 1 to 3 percentage points lower than among whites.

These findings have put racial inequality on the forefront of the policy agenda. In fact, a recent Human Development Report (United Nations, 2005) states that skin-color differences in economic achievement is the main social challenge facing Brazil, suggesting that anti-discrimination policies should be a central component of any poverty reduction program implemented in that country. As with many governmental interventions, the effectiveness of these redistribution policies will ultimately depend on the variation of individual characteristics within and between families, and on intrafamilial rules regarding the allocation of resources (which may reinforce or attenuate their impact).[8] This is particularly relevant when mixed-race families represent a large fraction of the population, since they introduce intra-family variation in skin tones to the picture.[9]

[6] This reasoning follows the case of intrahousehold gender differentials. See Behrman et al. (1986).

[7] Since information on skin-tone variations within families is not available in major US-based data sets, I focus my analysis on evidence drawn from a developing country context. The intuition of the exercise is general enough to capture the North American case, however. A research proposal, based on preliminary versions of the present paper, suggesting the inclusion of measures of skin color on the NLSY data collection effort has been pre-approved by the Bureau of Labor Statistics (BLS). I am extremely thankful to Dan Black, the NLSY97 PI, for supporting that proposal. I am also working on a grant proposal based on the idea of electronic measurement of skin color differences within and across families.

[8] See Sheshinski and Weiss (1982) for an insightful exposition.

[9] Interest on the intrafamily impact of phenotypic differences goes beyond socioeconomic studies, however.

Using data from the Brazilian 1991 Census of Population, I find that light-skinned children (ages 5 to 14) are 0.6 to 0.7 percentage points more likely to be enrolled in school or pre-school during a particular year than their siblings of darker skin tones. This amounts to 50% of the raw difference between white and non-white kids in mixed-race families. Back of the envelope calculations suggest that the compound effect of this difference is that a child of light skin tone is approximately 2.8 to 3.3% more likely to have completed primary school than his/her darker skin sibling at age 15 (assuming no differential grade retention). Using an alternative data set, from the 1989 Brazilian Survey of Nutrition and Health, I also find evidence that (conditional on enrollment) light-skinned children are more likely to attend private schools. On the other hand, there is no evidence of differences in the health, nutrition and disability, in particular for birth outcomes that are determined before the child's skin color is "revealed" to parents.

Suggestive evidence on intrafamilial contracts that compensate darker kids for the underinvestment in human capital, as proposed by Becker and Tomes (1976), is found. Lighter skin individuals are more likely to host darker skin siblings later in life (age 28 and older), which I interpret as compensatory transfers denominated in housing services. Moreover, non-white 10 to 17 year-olds are more likely to coreside with their mothers than their white siblings, once again increasing darker children consumption of home and board (relative to their lighter siblings).

The paper is organized into five sections. In Section 2, I present a simple conceptual framework and discuss empirical implications. Section 3 discusses the genetics of skin color and describes the data set. Section 4 presents the econometric evidence and discusses the findings. Section 5 concludes and discusses extensions left for future research.

2 Conceptual framework

This section describes, in simple theoretical terms, major aspects of decision-making regarding intrahousehold allocations of investment in the human capital of children with different phenotype. I draw from the literature on intrahousehold allocation of resources and gender differentials, in particular from the seminal contributions of Becker and Tomes (1976), Behrman et al. (1982) and Rosenzweig and Schultz (1982).[10] I use the conceptual framework

Psychologists, for example, have shown that the sense of identity and group membership for children at young ages is a very important aspect of their non-cognitive development. In mixed-race families variations in skin color may directly impact children and their identification with respect to different cultures and peers. See Brunsma, D. L. (2005), Rockquemore and Laszloffy (2005), and Shih and Sanchez (2005).

[10]See also Berhman et al. (1986) and Behrman (1988).

to guide the empirical analysis that follows.

Consider the case in which parents are concerned with the distribution of earnings among their children. Parents may also consider the distribution of non-labor income, but this decision is (for now) assumed separable from the former. That is to say, decisions of investments that influence the accumulation of human capital (which affect earnings) are taken independently from the ones regarding the allocation of non-human capital. Investment decisions are taken exclusively by parents, and children are assumed not to have any decision-power within their families.

Parental consumption is also assumed separable from earnings maximization, so that the analysis can be focused on a parental preference's sub-function:

$$U^e = U(e_1, ..., e_n; \kappa) \tag{1}$$

where κ summarizes family characteristics that influence tastes, and e_i represents child-i's (potential) earnings.

Parents choose investments in schooling (s) in an attempt to maximize welfare subject to budget and human capital transformation constraints. The budget is given by:

$${}_{i=1}^{n} p_i s_i \leqslant Y^e \tag{2}$$

where Y^e represents the resources available to parents (after deducting consumption expenditures), and p is the price of schooling investments (which may include school fees or wages from the sale of child labor, for example). Human capital accumulation affects expected earnings according to the following convex technology:

$$G(e_i, s_i, d_i, x_i; \phi) = 0 \tag{3}$$

where x represents child characteristics, d is the phenotype and ϕ summarizes technical relations that may be family-specific or basically reflect genotype.

First order conditions for interior solutions to the maximization are:

$$\frac{\partial U}{\partial e_i}\frac{\partial e_i}{\partial s_i} - \lambda p_i = 0....\forall i \tag{4}$$

Therefore, the optimal allocation of investments between child i and child j should follow:

$$\frac{\frac{\partial U}{\partial e_i}}{\frac{\partial U}{\partial e_j}} = \frac{p_i}{p_j} \frac{\frac{\partial e_j}{\partial s_j}}{\frac{\partial e_i}{\partial s_i}}.$$

The outcome of the decision process ultimately depends on assumptions regarding the form of utility functions (in particular regarding the differential treatment of offspring), differences in costs/prices and technical relations (differences in returns to education). Diagrams 1A to 3A, represent possible outcomes regarding the distribution of earnings between child i and child j, for the case of identical net-returns. The diagrams depict an earnings possibilities frontier and the parental iso-utility curve. Diagram 1A represents parental utility that is symmetric, Diagram 2A represents parents that are inequality averse, and Diagram 3A depicts parents that happen to favor child i. In these three cases, investment will only be differential in case 3A, when child i will be more likely to receive investments in education than her/his sibling.

[Diagrams 1A to 3A go about here]

There is evidence, however, that net-returns may be different when siblings have different skin tones. Consider for example that child i is white and child j is non-white. Diagram 1B to 3B depict three cases considering the parental utility functions introduced in the examples above. These diagrams suggest that, except in the case of parents that exhibit inequality aversion (2B), families will end up with the white child earning more than the non-white, as observed in the general population. In this case, however, such an observation does not necessarily imply that parents prefer to treat children differently. It could imply that the same educational investments yield different earnings due to differences in returns. Parents face in this case an equity-efficiency trade-off. In Diagram 2B, for example, families averse to inequality are forced to invest more in the education of the non-white child in order to counterbalance the differential way in which labor markets treat their children. In the case of parents in Diagram 1B, efficiency considerations generate differential investments that favor the white child.

[Diagrams 1B to 3B go about here]

Consider alternatively that parents care about their children's living standards. Improvements in well-being can be reached either by increasing their earnings (via investment in human capital) or by transfers of non-human capital (see Becker and Tomes, 1976). In this case, parents may devise strategies to maximize the returns to their investments in human capital and target equity using non-human capital, bypassing the efficiency-equity trade-off seen in the previous case. These can either be achieved with transfers from parents to children or via implicit contracts between siblings.

The parental welfare function can be represented by:

$$U^w = U(e_1 + \delta t_1, ..., e_n + \delta t_n; \kappa) = U(w_1, ..., w_n; \kappa) \tag{5}$$

where t represents non-human capital transfers and δ represents its conversion into units of earnings. Maximization is subject to the same constraints as above.

Diagram 4 summarizes the result of the maximization process for parents with symmetric preferences.

[Diagram 4 goes about here]

The interesting implication in this case is that, independent of preferences, parents will maximize returns to investments in human capital. Equity considerations, or preferential treatment for that matter, are undertaken through transfers of non-human capital. The inclusion of transfers allow parents to operate beyond the autarkic solution derived in the separable case.

3 Data, genetics of skin color, and descriptive statistics

3.1 *Data*

The main data set used in the present study is the 1991 Brazilian Census of Population (*Censo Demográfico, Instituto Brasileiro de Geografia e Estatistica - IBGE*). The public use data, available for purchase from the IBGE web-site, consists of 10 percent samples of the population for localities with more than 15,000 inhabitants and 20 percent samples otherwise. The interviews were undertaken on private households, and collected information on the dwelling's construction, general living standard measures related to access to basic public services, and to the ownership of assets and durable goods. With respect to individual characteristics of each household member, a knowledgeable adult (most frequently the spouse of the household head) was asked to report basic demographics, migration, school enrollment and educational attainment, fertility history (for women 10 and older) and sources of income.

Considering the particular interest of the present study, the 1991 Census maintained the structure used in other editions and asked respondents to report individual members' "skin-color or race," reflecting the Brazilian social norm that skin-color and race are equivalent concepts.[11] For the skin color question, respondents were given five options: white, black, indigenous, yellow (Asian), and brown. Indigenous and Asians are a very small fraction of the overall population (0.6%), and geographically concentrated in the North and Sao Paulo regions, respectively. In the analysis that follows I have dropped any household in which at least one member was reported to be in either of these two groups. Moreover, in order to reduce confounding effects from individuals of mixed indigenous descent being classified as brown, I have dropped data collected from the Northern sector of the country. Finally, since individuals classified as blacks amount to 5% of the population, I include them in the non-white group and use this dichotomous classification in the empirical exercises below. The working samples used in the analysis are based on children of the household head between ages 5 and 14 and on adults 28 and older.

These data allow for two distinct definitions of mixed-race families. The first definition considers mixed families the ones that result from marriage of individuals of different skin-color groups (whites and non-whites), independent of the skin-color of their children. The second definition does not take into consideration the skin-color of parents and is solely based on the existence of siblings at different ends of the color classification spectrum. These two definitions are combined in some specific cases. For the main empirical strategy in this paper, the second definition is used

I have also examined data sets from alternative sources, as the 1989 Brazilian Survey of Nutrition and Health (BSNH), available for download from ICPSR-University of Michigan; the 1985, and 1992 to 2004 waves of the Brazilian Household Survey (PNAD, IBGE);[12] the 1995 Data Folha Pool on Skin Color and Race Issues (Pesquisa 300 Anos de Zumbi, Data Folha); and the socioeconomics questionnaire attached to the 2005 Brazilian National Middle School Examination (ENEM, INEP).

[11] In fact, until the 1990's, on both censuses and household surveys the question was literally phrased as "what is your skin-color?," without any explicit reference to race.

[12] As in the case of census data, PNAD is available for purchase from the IBGE web-site.

3.2 *Miscegenation and socioeconomic differentials*

One of the most striking features of the Brazilian racial context is that it is based on somewhat contradictory observations. On one hand, there is widespread miscegenation in marriage and housing markets. On the other hand, and in sharp contrast with the image of tolerance portrayed by miscegenation, there are stark and persistent inequalities in socioeconomic outcomes among skin-color groups. Telles (2005) provides a detailed description of this contradictory evidence. In this section I present some overall patterns based on the 1991 Census data.

Figure 1 and 2 present evidence that rates of literacy and completion of elementary school (4 years) still are, despite the slow process of convergence across cohorts, different for white and non-white females and males. In the case of high school completion the gap between whites and non-whites is widening among more recent cohorts, as shown in Figure 3. Figure 4 shows disparities in log-hourly-wages. Once again, differences are quite stark. The wage gap ranges from 50% to 60% for most of the cohorts. Finally, Figure 5 shows the difference in the distribution of raw hourly-wages among men and women of white and non-white skin. The non-white wage distribution clearly represents a shift to the left in relation to the white one. A remarkable feature of this evidence is that in pretty much all cases outcomes for browns and blacks seem indistinguishable (not shown). This suggests that the analysis of socioeconomic differences can be pretty much summarized in a dichotomous classification (white/non-white). This is, in fact, the standard procedure among labor economists and other social scientists studying racial differentials in Brazil.

Figures 6 and 7 turn to a slightly different aspect of wages and educational differentials. Both figures present naive estimates of returns to schooling using simple gender and skin-color specific regressions of log-wages and employment indicator on age dummies and educational attainment. Figure 6 presents the cumulative marginal returns to school year completion. Returns are relative to no-schooling whatsoever. Returns are in general higher among whites, in particular among males. Differences for men and women are further discussed below. In terms of employment probability the differences between men and women are even more striking. Additional years of education for men do not seem to help whites more than non-whites (except for the first year of education), while for women more education has a higher return among non-whites (possibly reflecting outcomes in the marriage market that may favor white women or the simple fact that the latter are less likely to participate in the labor force). These findings seem very much in line with results presented by Arias et al. (2004) and Perry et al. (2006). Using more sophisticated models and also controlling for parental education and school quality, they show that the returns to an additional year of education is 1 to 3 percentage points higher for white than for non-white males.

Table A1 turns to the data on miscegenation. Rates of marriage between individuals of different skin color is remarkably high. Quite different from the case of the United States and South Africa, mixed-race marriage corresponds to approximately 22% of all marriages listed in 1991 for women between ages 18 and 55. Since blacks correspond to a small fraction of the population I, once again, focus on a dichotomous classification that collapses blacks and browns into one category. Panel B summarizes the results in Panel A under this simplified classification. These data indicate that 18.5% of married white women were matched to non-white men, while 20.6% of non-white women were married to white men. These figures are approximately twenty times the ones observed in the United States.[13] Panels C and D use pooled data from PNAD to capture how mixed-race marriages evolve over time. In the 10 years between 1992-1993 and 2003-2004, the rate of mixing remained relatively stable among women between 18 and 25, except for the slight increase (1.5%) in incidence of white females married to non-white males. Haloing the same lines, Table A2 presents the results of miscegenation in terms of progeny color diversity. Looking at child-level observations in the working sample, around 12% of the non-white children have a white sibling. The corresponding figure for white children is 11%. It is this within-sibship mixing that allows the estimation of skin-color differences I discuss below.

3.3 *The genetics of skin color*

Skin color is determined by facultative and constitutive factors. The first have to do with variations in the environment and exposure to sunlight. These factors are mostly studied by anthropologists interested in the evolution of human populations at different parts of the globe and by medical researchers focusing on ethnic differences in patterns of skin cancer, and photo-chemical breakdown of folic acid in the blood or regulation of vitamin D storages.[14] Constitutive factors represent the genetic endowment but, even though they have intrigued biologists for centuries, the most significant knowledge about its workings have only been gathered in the past 15 years (see Barsh, 2003; Ress, 2003; and Sturm et al., 1998).

Skin color genetic make-up is the result of the concentration of three pigments:

[13] See Charles and Luoh (2006) and Fryer(2006).

[14] See Diamond (1994), Dunn and Dobzhansky (1958), King (1971), Parra et al. (2004), and Relethford (1997).

melanin (the brownish *eumelanin* and the yellowish *pheomelanin*), hemoglobin on red blood cells in superficial vasculature, and carotenoids (controlled by dietary intakes). Melanin is the most important of the three, particularly in the case of inferred association between skin color and European/African ancestry studied in the present paper. Melanin synthesis happens within cells named *malanocytes*, and in organellles called *melanosomes*, from where is secreted into the epidermis. The quantity of *malanocytes* is fairly constant across individuals of different ethnic origins, so that genetic variation in skin color is determined almost exclusively by type, size, shape and concentration of *melanosomes*. While type, shape and distribution of these elements are fully determined genetically, their size can be affected by environmental conditions (sunlight incidence in different geographic locations).

Most scientists believe that the synthesis of melanin is controlled by three to six genes with two alleles each.[15] This means that Mendelian notions of genetics do apply to skin color. Polygenic inheritance guarantees, however, that alleles are not truly dominant or recessive and may generate a large number of intermediate cases. Most interestingly, heterozygotic individuals when interbreeding may generate offspring that are either lighter or darker than themselves. As an example, I present in Diagram A1 possible skin-color outcomes when two parents of intermediate color procreate. In Diagrams A2 to A4 I extend the example to consider probability distributions of skin-color for children of parents at different points of the color spectrum (10,000 draws from the just-born population). Diagram A2 focuses on intra-color marriages, Diagram A3 examines the combination of an intermediate parent with others at different points of the spectrum. Finally, Diagram A4 considers inter-color couples formed by individuals that have different skin colors but are as similar as possible in terms of tonalities.

Diagram A2 indicates that, for example, the probability that two parents of same skin color having kids that are either darker or lighter than themselves ranges from 50% to 75%. Diagram A3 reveals that when mothers of different skin colors have children with fathers of intermediate skin tone, the probability that a child is of the same color as the mother ranges from 12.5% to 30%. Finally, Diagram A4 indicates that partners of different skin colors have children with 50% chance of being as light or lighter than their mothers in all cases (assuming that mothers are the lighter parent). These figures indicate that mixed-color marriages are likely to generate quite elaborate skin-color distributions among their children.

Of course, most of the variation predicted by the genetics of skin color is based

[15]Most recent breakthrough in this area was published in December 2005, see Lamason et al. (2005) - Science Vol 310, pp.1782-1786. The article presents evidence that the gene *SLC24A5* accounts for between 25 and 38 percent of the skin color differences between Europeans and Africans.

on correct assessment of skin color in first place. This is unlikely to be the case, since reports of skin tones in a survey context are also determined by social conventions. In fact, recent research based on Y-chromosome and mitochondrial DNA (mtDNA) of self-declared male whites in Brazil indicate that 60% of their matrilineal genes are from African origin.[16] In essence, Brazilian whites are expected to actually be, in genetic terms, very light mulattoes. In the analysis that follows, I assume that, since an individual respondent assesses all members of the household, skin color classifications reflect meaningful differences between children and/or parents. One should not expect, however, that distributions predicted by the genetic inheritance examples above be exactly observed in the data. Nonetheless, they are expected to provide reasonable guidance on the realm of possibilities.[17]

3.4 *Descriptive statistics*

Table A3 presents general observed characteristics of families of two or more children by sibship skin-color mix. It also reports individual characteristics of parents. In general the figures in the table reproduce the skin-color differences in living-standards suggested by previous education and wage differentials. In this case, however, mixed-color sibships can be considered a distinct group. In all variables considered, except ownership of dwelling,[18] all-white sibships have better housing conditions and more access to public services. All-non-white sibships lag far behind, while the mixed-color group is at intermediate levels. Non-white couples are also more likely to be concentrated in rural areas and in the Northeastern region of the country. For all four groups, husbands are on average 37 years old while wives are 34. In all cases except all-white, the average female education is higher than male's, reflecting a characteristic that distinguishes Brazil from other developing countries (in particular in Asia and Africa): women are more educated than men, and this difference in educational attainment has consistently widened since the 1980's (see Beltrao, 2002).[19] In the case of the progeny size, the expected negative correlation with income is not observed.[20]

Most importantly, in a significant number of cases, families have children classified as having different skin colors. This occurs more frequently among mixed-color couples,

[16]See Carvalho-Silva et al. (2001) and Pena et al. (2000).

[17]I discuss skin color missclassification in a companion paper, Rangel (2007).

[18]This most likely reflects the fact that non-white sibships are more likely to reside in rural areas, were housing ownership is more widespread (even if not legal).

[19]Notice that in the case of literacy rates women have advantage with respect to their husbands even amomg white-only couples. This suggests that the differences in average years of education among whites are affected by outliers.

[20]I return to this issue in the conclusion.

but also among same-color ones. This reflects the fact that skin-color information gathered through surveys does not correspond to genetic-based measures. Two white individuals can reproduce to have white and non-white children if they happen to be genetically non-white in first place. The data also shows that two non-white individuals are more likely to have children of different skin colors. This is the result of browns being the largest group within non-whites. Considering these facts, the numbers presented in Table A3 seem to conform with predictions from genetic endowments.

The characteristics of children in these different families are presented in Table A4. In general, the pattern observed for adults is reproduced in this case. Children in all-white sibships are more likely to be enrolled in school as well as to have more years of schooling than their counterparts in all-non-white sibships. Children in mixed-color sibships are in between these two groups in terms of the education outcomes. The figures in the table also reveal that white children in mixed-color sibships are not more likely to be enrolled and have less years of education than their non-white siblings. A word of caution on the interpretation of these numbers is necessary, however. Non-white children in these families are also more likely to be older, so that it is not clear if in a multiple-variable analysis these differences would be confirmed.[21] In fact, Telles (2005) presents evidence, also based on the 1991 Census, that in a sample of mixed-color sibships the average grade-for-age score is higher for whites than for non-whites.

4 Econometric results

4.1 *Basic setup*

I explore reduced-form demands for schooling of children motivated by the conceptual framework presented in section 2. Consider the following linearized version in the case of child i in household h:

$$s_{ih} = \alpha_0 + \alpha_1 d_{ih} + \alpha_2 X_{ih} + \mu_{ih} \tag{6}$$

[21] Some biology studies suggest that female and younger children are more likely to be lighter than males and older children. This may very well reflect conscious decisions by parents, using specific stopping rules and targeting a particular color composition of their progeny (I further discuss this in the conclusion and in a companion paper). There is also evidence that only after the 6th month of age children will have their adult-life skin color defined. See Sturm et al. (1998) and Park and Lee (2005). Although mothers reporting skin color for their children would most likely report and "average" tone against a common standard, in the empirical exercises below, when comparing children of white and non-white skin, I always control for age and gender in order to net out the impact of the latter on skin color classification.

where d is the skin-color (1 is white), and X is a vector of individual characteristics (gender and age).

In this formulation, the indicator of child skin color captures all the impact from returns or costs of investments in schooling, as well as confounding factors originated by the omission of parental and familial characteristics that have a direct impact on schooling decisions and are correlated with one's skin color. The specification is then augmented to include observed household-locality factors such as income, parental characteristics and regional prices (Z_h):

$$s_{ih} = \alpha_0 + \alpha_1 d_{ih} + \alpha_2 X_{ih} + \alpha_3 Z_h + \xi_{ih} \tag{7}$$

I finally turn to a more elaborate model including controls for unobserved parental characteristics, which may include better measures of permanent income (and borrowing constraints), parental tastes and parenting ability. In order to implement this formulation I assume that unobserved characteristics can be decomposed in two parts: $\xi_{ih} = \eta_h + \varepsilon_{ih}$. The first represents ancestry effects that are common for all siblings, the second is an idiosyncractic term specific to each child (although possibly correlated within the sisbship). Therefore, exploiting the fact that some families report children with different skin color one can estimate the models including a family fixed-effect:

$$(s_{ih} - \overline{s}_h) = \alpha_1 \left(d_{ih} - \overline{d}_h\right) + \alpha_2 \left(X_{ih} - \overline{X}_h\right) + (\varepsilon_{ih} - \overline{\varepsilon}_h) \tag{8}$$

where only the within-household variation is explored, with variables being expressed in deviations from family-level averages.

These models employ a binary enrollment indicator as dependent variable (linear probability models). Child-level controls are included semi-parametrically using age, gender and birth order (first and lastborn) dummies. Household-level controls include husband and wife indicators for skin-color (indicator is one if white), completed education (less than elementary, elementary and some middle, middle and some high, and high school or more), a second-order polynomial on age, geographic location of household (region, urban sector, and metropolitan area indicators), measures of living standards (material on walls and roof, sewer system, water pipes, exclusive-use lavatory, ownership of dwelling), and logarithm of number of household members.

4.2 *Main findings*

Table 1 presents standard measures of differences in enrollment rates between white and non-white children after controlling for child-level demographics (column [b]) with and without sample weights. The results indicate that whites are 10 percentage points more likely to be enrolled than non-whites in the overall sample of sibships of two children or more (Panel A). This difference is still significant when comparing children for a sample of mixed-color progeny families (Panel B). The magnitude is dramatically reduced (now 1 percentage point), reflecting the fact that, along a myriad of factors, mixed-color families are more similar to each other than families in the general sample.[22]

These differences are dramatically reduced when controls for family characteristics are included in column [c], but differences remain significant. In columns [d] and [e], family fixed-effects are included. The results indicate that family-level characteristics (even when not observed) cannot entirely account for the differences between white and non-white children. That is to say, even when comparing siblings, the probability of a white child being enrolled in school is 0.4 to 0.7 percentage points higher than for a non-white child. This corresponds to 50% of the raw skin-color difference in enrollment rates observed among children of mixed-color families.[23] Therefore, based on this evidence, one should consider that parents may be choosing to invest less in the non-white offspring.[24] I investigate the possibility that this reflects an income maximization strategy, following the differences in returns to schooling according to skin color. Before delving into this reasoning, I consider alternative reasons for why differential enrollment is observed within the family.

It is possible that skin-color differences captured in the Census data are correlated with unobserved measures of relationship to the household head. This may happen if children are incorrectly coded as offspring of the head, even if not biologically attached to him/her, for example. In this case, differences according to skin color would be reflecting the fact that stepchildren receive less investments, a hypotheses backed up by many studies (see Case et

[22]I examine changes in the working sample and its impact on the estimates on Table A5. The results presented here are robust to inclusion and exclusion of different regions covered by the census.

[23]In Table A6 I estimate a similar regression using adult siblings (ages 28 to 71) of different skin-colors that happen to co-reside. The results regarding long-term school attainment corroborate the findings in terms of current enrollment.

[24]For the sake of comparison I have examined the case of gender differentials using the same data. In this case, for families with boys and girls, the difference in enrollment rates is 2.28% in favor of girls (with or without family controls). Family fixed effects only reduce this difference to 2.18%, indicating that 96% of the original difference is accounted for intra-family discrimination in schooling investments. Studies of gender differentials in Brazil have consistently pointed to differences in opportunity costs as an explanation for these findings (active child-labor market induces boys to drop-out of school to work). See Psacharopoulos and Arriagada (1989).

al., 1999; Daly and Wilson, 1998; McLanahan and Sandefur, 1994; and Zvoch, 1999). To address this concern I have re-estimated the original model including children known to be stepchildren of the head in the sample. In Table 2 the results of the model show that the inclusion of these observations does not have an impact on the estimated differentials. I have performed the same exercise for white and non-white fathers separately (columns [c] to [f]), since biases are expected to go in opposite directions. A white father would have a stepchild coded as non-white while a non-white dad would have a white stepchild. For the former, skin-color differences would be reinforced by the biological disconnect, while for the latter they would be counterbalanced. In both cases no differences between models estimated with or without stepchildren are found.

A second alternative explanation rests on the possibility that the costs of sending dark-skin children to school is higher because of school-level discrimination. Social norms in place at schools may imply relative discomfort to dark skin children. Parents would then respond by being relatively less likely to enroll their dark-skin children. These social costs would imply that non-whites fall behind in school due to grade repetition, school changes, or unsuccessful school experiences in general. If that is the case, controls for total education attainment (holding age constant) should have large impact on currently observed differences in enrollment.[25] In Table 3, columns [b] and [c], I replicate the estimates of the basic models with fixed effects including dummies for years of education completed before the current school year. Point estimates are virtually unchanged by the education controls, supporting the idea that differential social costs of enrollment are not the main driving force behind the results.

Moreover, it is important to take into consideration that these social costs may be counterbalanced by the effect of opportunity costs. If stigmatization is a reality within schools, it is most probably also significant in the market for child labor (which is quite large in developing countries, particularly in Brazil). Therefore white children should be, all else equal, less likely to attend school because the opportunity costs of not selling labor at the market is higher for them than for their darker skin siblings. It is likely, therefore, that social costs and opportunity costs balance each other out.

A final piece of evidence contrary to the hypothesis of school discrimination as the main source of differences is the fact that the results are different for boys and girls, even though schools are not segregated by gender. Table 4 indicates that skin color differentiation among siblings is only observed for boys (Panel A) and adult men (Panels B and C). These

[25] This strategy is similar to the inclusion of the lagged dependent variable in cross-sectional analyses as a proxy for unobservable characteristics.

results conform with differences in the rates of return to education discussed on Section 3.4 above, which indicate that returns are relatively higher for white males but not for white females.[26]

Since one cannot guarantee that even in mixed-gender school system school-level social networks are not gender specific, it is important to investigate if these differences in relative returns to education depending on gender do not coexist with gender differences in reports of discrimination episodes by students and adults. Using data from the 2005 Brazilian National Middle School Examination (ENEM, INEP), I find that non-white boys are the ones more likely to report being victims of racism (difference of 2.6 percentage points or 10%) and are more likely to list racial differences as an important issue in their lives (difference of 0.6 percentage points with respect to girls or 33%). Data from the 1995 Data Folha Pool on Skin Color and Race Issues (Pesquisa 300 Anos de Zumbi, Data Folha) corroborates this finding, suggesting that 25% of non-white males younger than 21 declared being victims of racism, compared to 19% among non-white women. Among the ones being victims of racism, 66% (males) and 59% (females) declare victimization at the school level. These numbers indicate that school-level discrimination, and its potential social costs imposed over enrollment may be pertinent for schooling decisions, but they seem incompatible with the gender differences in skin-color differentials observed in the Census data.

Finally, there is the possibility that estimated skin color differences reflect reverse causality. Since mothers are the ones reporting the skin color of children, it may be the case that their reasoning for skin color classification is based on measures of child success. Therefore, unsuccessful children (i.e., the ones with poor performance at school) are the ones more likely to be coded as non-white. The fact that educational attainment controls did not affect the current enrollment difference yields little support for the reverse causality argument, however.

In order to further examine this issue, I have focused on the Census measures on the incidence of genetically determined disability, at-birth and long term health measures from the Brazilian Survey of Nutrition and Health (BSNH-1989). The idea is that these variables indicate the quality of a child and directly impact school enrolment, but should only be impacted by the skin color measure if mothers adapt their reports to reflect a ranking of child

[26]It may also reflect differences in marriage market competitiveness that tend to favor non-white women rather than non-white men (i.e., non-white women have more sex-appeal in Brazil). Data from the 1995 Data Folha Pool on Skin Color and Race Issues (Pesquisa 300 Anos de Zumbi, Data Folha) indicates for example that 40% of male whites report non-white women as more desirable sexual partners (versus 44% indiferent) while the corresponding numbers for female whites are 22% and 64%. The corresponing numbers for the overall population (including non-white choices) are 52%/41% among men and 38%/55% among women.

quality. In particular I estimated models as the ones used for enrollment having blindness, deafness, prematurity, low birth weight indicators and height (which is believed to already be fully determined at the time kids enter school at ages 5 or 6) as the dependent variables. The results in Table A7 indicate that no significant differences were found between white and non-white siblings.

I have also used BSNH data to examine other aspects of human capital investment estimating models having weight-for-age, body mass index, and morbidity indicators (diarrhea, fever, etc.) as the dependent variables. Again, no differences were found between white and non-white siblings (results not shown). One may consider, therefore, that differences in enrollment are not exclusively reflecting parental preferences. Moreover, they also indicate that parents do not use investments in these other aspects of human capital to compensate dark-skin children for the lower investments in their education.

Finally I have investigated BSNH information on enrollment in private and public schools. There is a well know disparity between the quality of education provided by the two systems in Brazil (favoring private). It is also well know that the private school population has lighter skin on average than the public one, reflecting differences in income and costs of admission. When I estimate the intra-family regressions using data on 549 siblings ages 7 to 14 enrolled in school, I find that lighter kids are 1.91 percentage points more likely to attend a private institution than their darker siblings (significant at the 10% level). When estimating using 173 brothers, that difference is estimated to be 5.7 percentage points, significant at the 5% level. The corresponding number for sisters is not available due to insufficient sample. I conclude that this reinforces the argument for differential investment by parents according to returns to education, specially considering that returns are most likely a function of the quality of schooling provided.

4.3 *Further aspects*

4.3.1 *Compensatory transfers*

As discussed by Becker and Tomes (1976), and in Section 2 above, an interesting aspect of parental decision-making is the possibility of addressing equality concerns by utilizing non-human capital transfers to compensate children that received less education. Compensatory transfers can either be directly implemented by parents or via schemes ensuring that children transfer resources among themselves. That is to say; either parents offer non-human capital transfers to dark skin children or they devise implicit contracts in which white children transfer accumulated resources to their non-white siblings.

Data on inter-vivos transfers between parents and children or between siblings are not available in this case, nor is information on inheritance patterns. As an alternative way of exploring this compensatory transfers idea, I examine the parental supply of housing to their children. I employ data from the 1985 wave of the Brazilian Household Survey (PNAD). This wave contains a special module in which mothers were asked about all the children ever born. They were instructed to determine skin color, age and gender of each one of the children, including the ones not currently coresiding. The age interval is limited to children under 17, however. I conjecture that mothers attempt to compensate dark skin children by offering shelter for longer than in the case of white children. In practical terms this would mean that non-white children in mixed-race sibships are more likely to be found within the mothers's household than their white siblings. Results from a sample of 1,558 children between 10 and 17 years of age is compatible with such hypothesis. Non-white children are 1.80 percentage points less likely to have left the mothers' household (significant at 10%).

In a second exercise, the 1991 Census stratum of coresiding adult siblings is further explored. The hypothesis to be tested here is that white individuals compensate their non-white siblings by offering them a chance to coreside. This is not an estimation of the probability of a white individual offering shelter to a non-white sibling relatively more often than to a white one (since such information is not available). Instead this means that, conditional on coresidence, the white sibling is more likely to be the head of the household in which I observed the coresidence status (i.e., the white sibling is the major household provider). Table 5 presents the results of this exercise. The figures indicate that, when two siblings of different skin color coreside, the white person is 2.04 percentage points more likely to be the host than his/her non-white sibling (Panel A). Notice however that, as in the enrollment differentials case, all the difference is coming from the comparison among brothers (6.4 percentage points) and not among sisters (Panels B and C, respectively).

4.3.2 *Parental characteristics*

Estimations based on family fixed effects models do not allow for the examination of the impact of household-level characteristics on enrollment. However, it is still possible to investigate if they differentially impact white and non-white children. This corresponds to the interaction of the skin-color dummy and other observed characteristics in the empirical model. The model to be estimated is therefore:

$$s_{ih} = \alpha_0 + \alpha_1 d_{ih} + \alpha_2 X_{ih} + \widetilde{\alpha}_2 d_{ih} X_{ih} + \widetilde{\alpha}_3 d_{ih} Z_h + \eta_h + \varepsilon_{ih} \tag{9}$$

There is a growing interest on heterogeneity in preferences within households in the current literature on family economics. Motivated by the passage of Malcom X's autobiography cited in the introduction, I examined if parents of different color influence the treatment of white and non-white children in any particular way. That is to say; I examine if an increase in the education of a white parent has the same impact on the difference in enrollment rate between white and non-white siblings than the increase in the education of a non-white parent (holding all else constant).

Using a subsample of the families above, restricting to mixed-race couples (white/non-white), I estimate the differential impact of parental education on school investments. Results of this estimation are presented in Table 6. Parental education is found to have positive effects on the enrollment of children. These effects are different for white and non-white siblings, however. A white parent's education increases the investment in white children by less than for their non-white siblings. The reverse is observed for the non-white parent's education attainment. Most importantly, the diference-in-diferences parameter is shown to be significant. There are three potential explanations for these findings: i) technology of childrearing imply that in mixed-race couples a non-white child is mostly raised mostly by a white parent, what determines the bigger importance of his/her education for the non-white child; ii) preferences of parents of different skin color are also different. If education is an indicator of bargaining power and influence over household allocation of resources, this results may indicate that parents prefer children at the opposite end of the color spectrum (which follows the same pattern observed in the marriage market), and; iii) darker parents have superior knowledge of discrimination in labor markets and invest based on such perceptions once they have more say over the allocation of resources.

5 Conclusion

This paper examines how mixed-race families, through parenting practices and decisions, mediate the impact of society-wide skin color differentiation over their children. Data from Brazilian surveys are used and indicate that parents reinforce phenotype-based differences within their progeny. That is to say, investments in human capital follow an efficiency maximization principle, with skin colors favored by employers also being favored by parents. I find that light-skinned children (ages 5 to 14) are 0.6 to 0.7 percentage points more likely to be enrolled in school or pre-school during a particular year than their siblings of darker skin tones. I also find evidence that (conditional on enrollment) light-skinned children are 1.9% more likely to attend private schools. These results are particularly prevalent among brothers.

Families seem to undertake compensatory actions, however. Parents use non-human capital resources to (at least partially) address differences in well-being between their light- and dark-skinned children, corroborating notions of intrafamilial contracts suggested by Becker and Tomes (1976). Evidence presented above suggests that lighter skin individuals are more likely to host darker skin siblings later in life (age 28 and older). Moreover, non-white 10 to 17 year-olds are more likely to coreside with their mothers than their white siblings. Home and board may be used as the currency for compensation.

The evidence presented, even though not denying the importance of borrowing constraints (or other ancestry effects), suggests that parental expectations regarding differences in the return to human capital investments (according to skin color) may play an *independent* role on the persistence of earnings differentials. As Rosenzweig and Schultz (1982) discuss in the case of gender differentials, a clear implication of my findings is that an intervention that reduces the white advantage in differential returns to schooling will have multiplier effects as minority parents use extra income to explore increased returns to investment in the education of their children.

The analysis presented in this paper is based on the impact on investments in the quality for children for a given quantity. Of course, if lighter skin individuals are considered more valuable in the labor market, parents may adjust their fertility behavior in response to those incentives. Presumably, families will target a bigger number of white children if these are more valuable. Of course selective abortion is useless in this case, since skin color cannot be predict using such technology. This does not rule out color-oriented marriage market search or differential stopping rules, however. A particular difference between the present case and stopping rules and sex preferences is that parents may update their beliefs regarding the probability of having light children as they procreate (since the exact racial mix is not perfectly know by all parts involved). I leave for future research the investigation of these marriage market and fertility issues.

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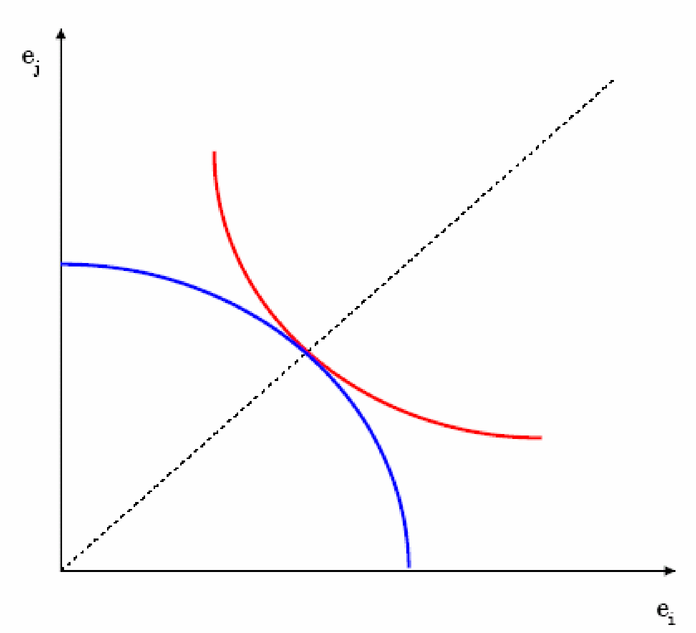


DIAGRAM 1A: No differential net-returns to education investments and symmetrical preferences

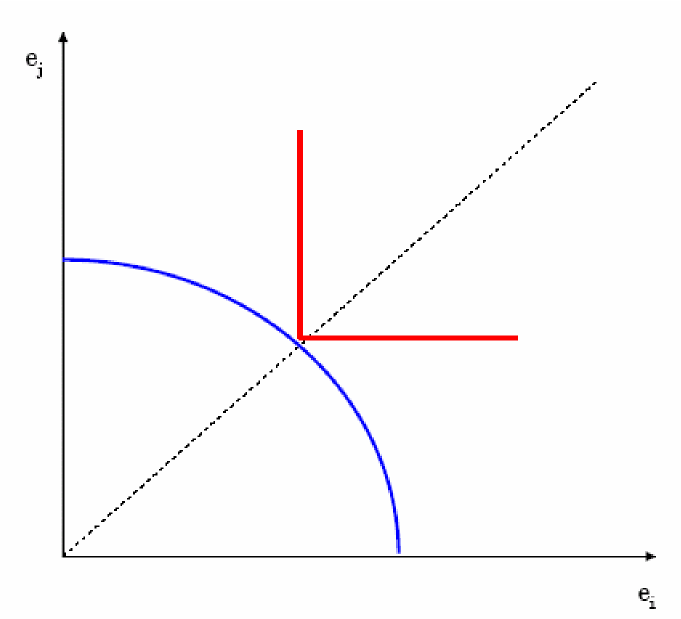


DIAGRAM 2A: No differential net-returns to education investments and inequality aversion

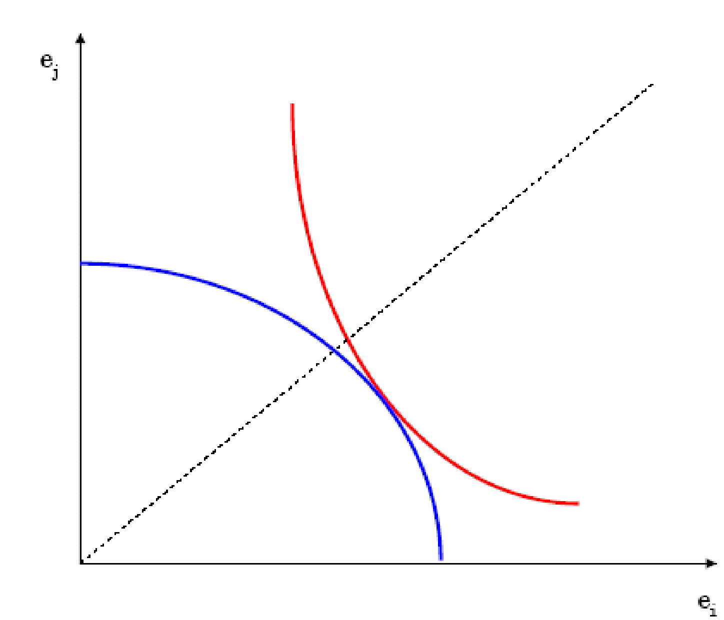


DIAGRAM 3A: No differential net-returns to education investments and preferences shifted towards child *i*

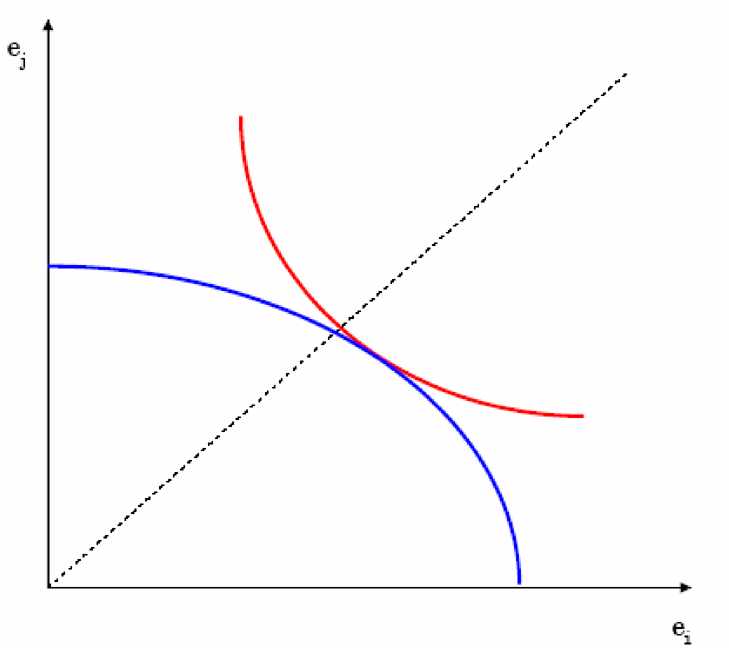


DIAGRAM 1B: Differential net-returns to education investments favoring child *i* and symmetrical preferences

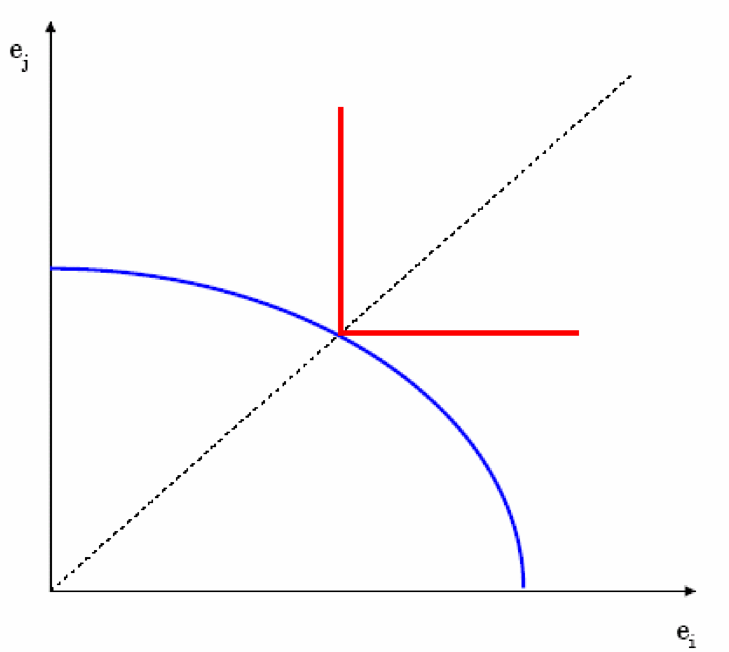


DIAGRAM 2B: Differential net-returns to education investments favoring child *i* and inequality aversion

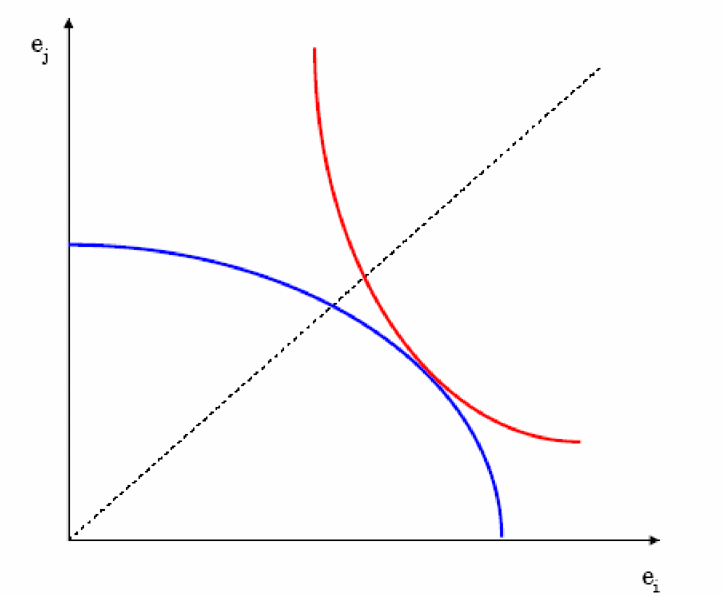


DIAGRAM 3B: Differential net-returns to education investments favoring child *i* and preferences shifted towards child *i*

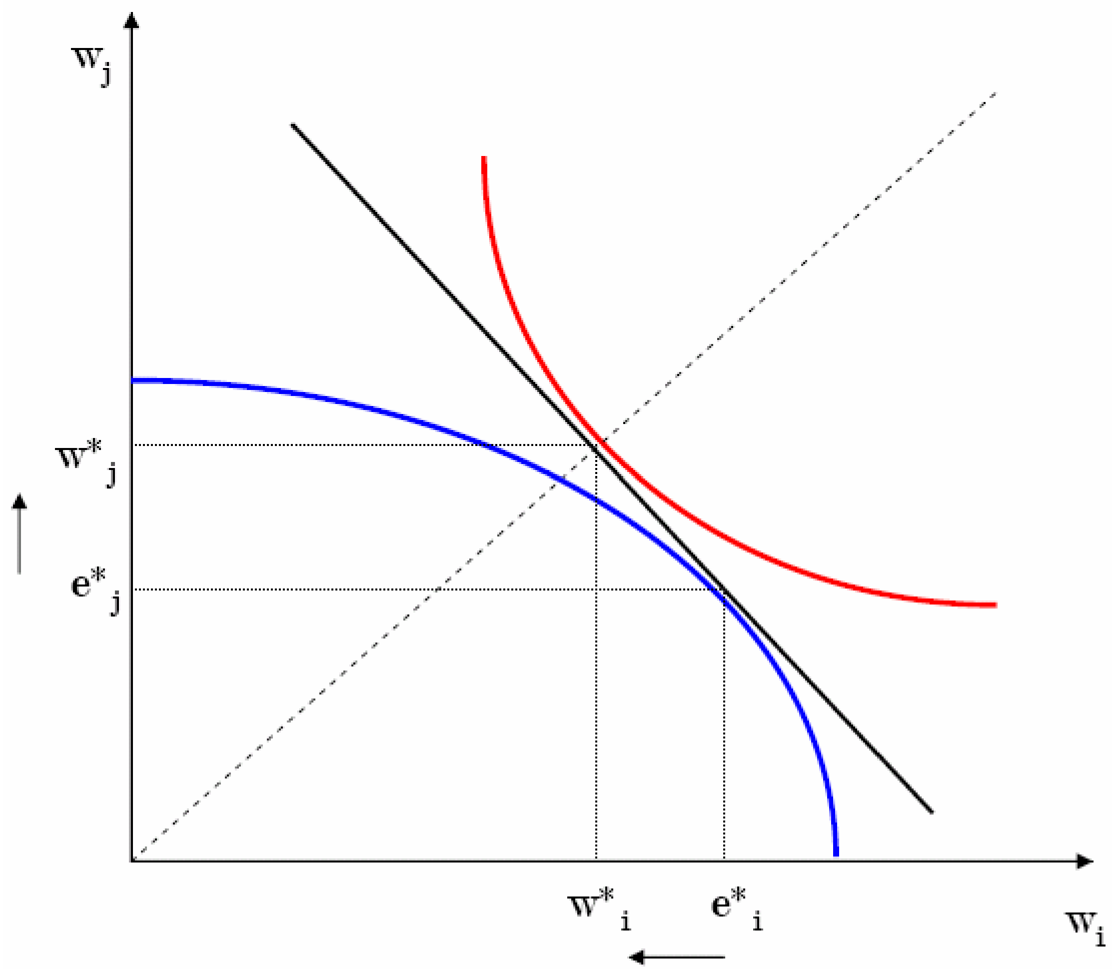


DIAGRAM 4: Non-separable model and the equalizing role of transfers.

Figure 1:
Literacy Rate by Gender, Skin Color and Birth Year

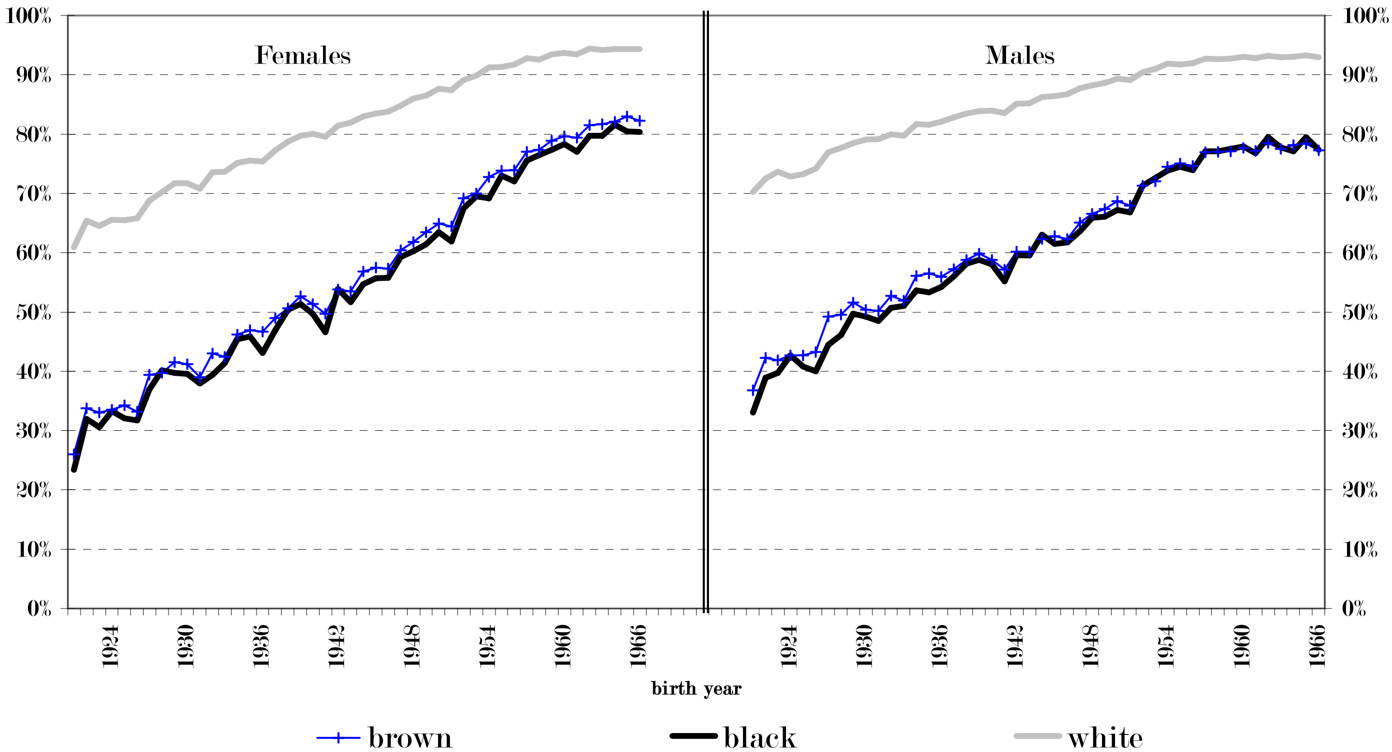
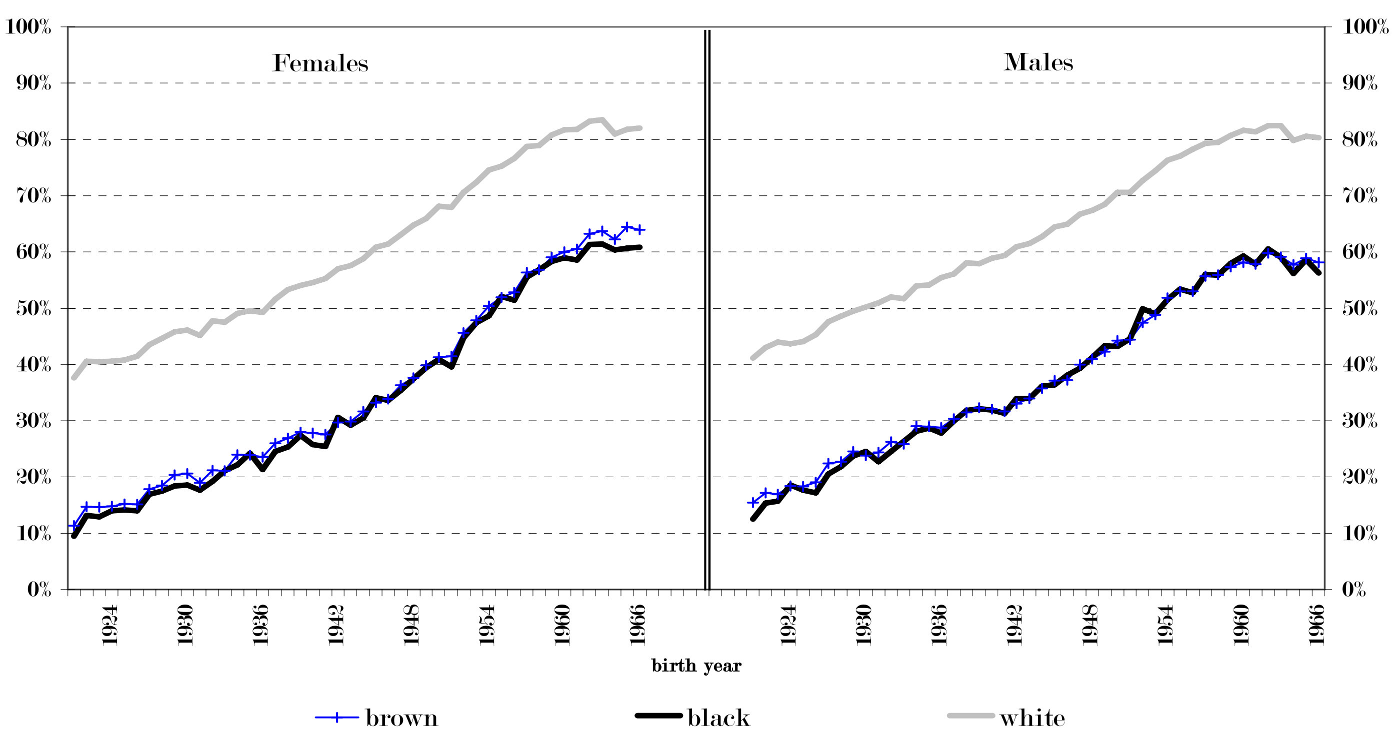
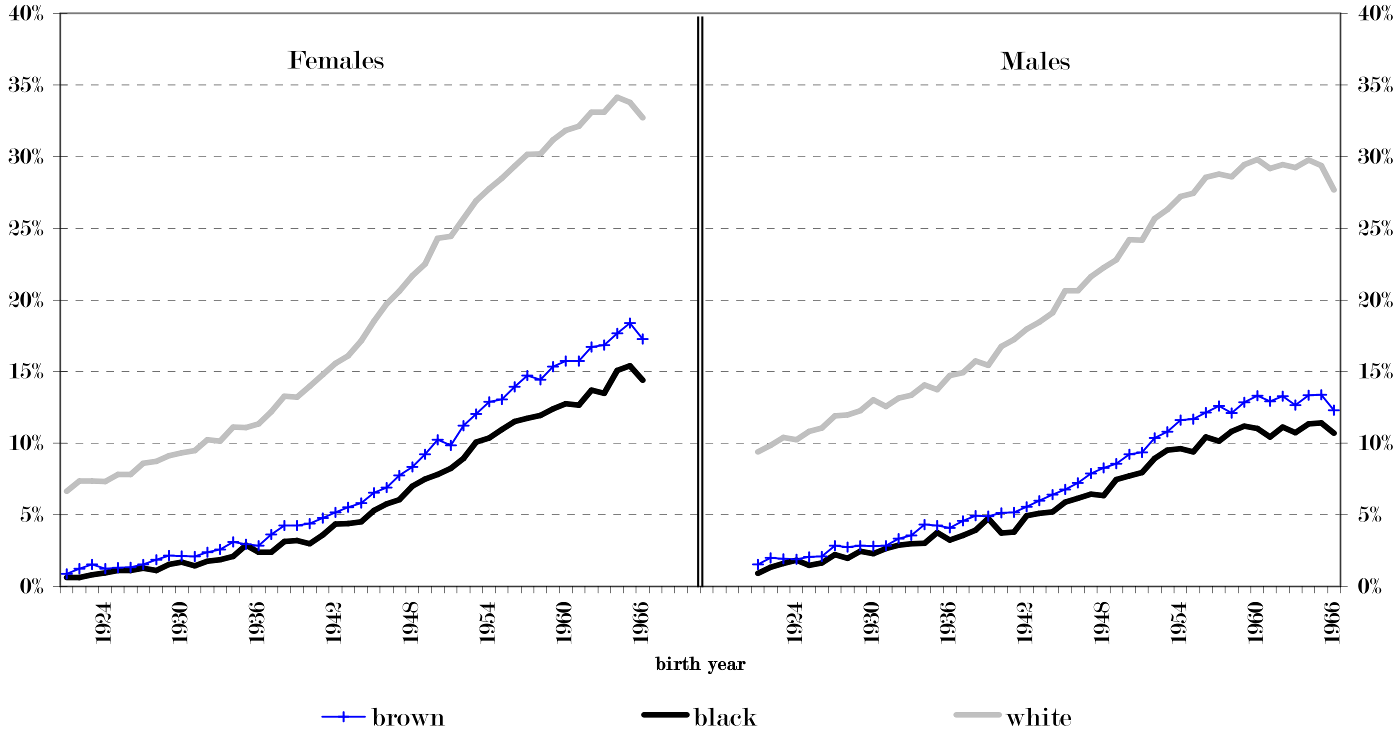


Figure 2:
Elementary School Completion Rate by Gender, Skin Color and Birth Year



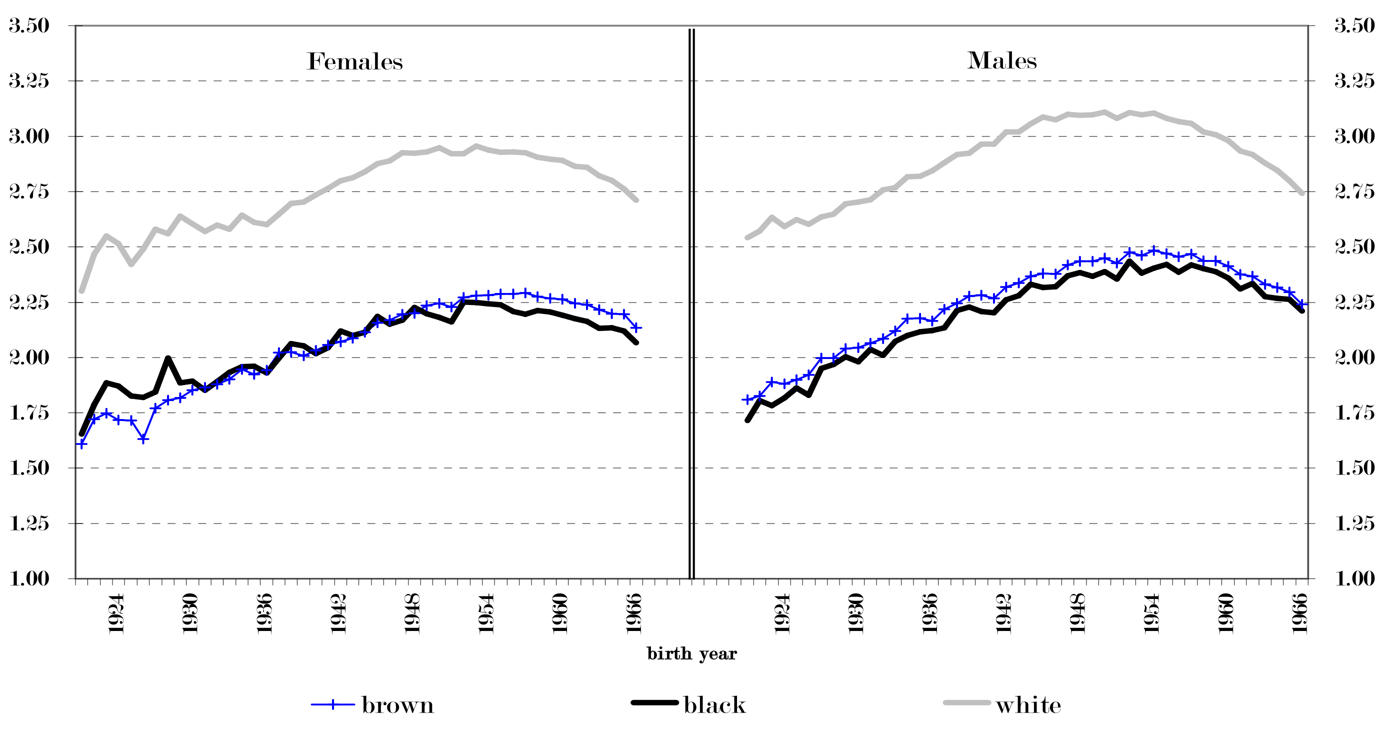
Source: 1991 Census (10-20% Sample), Adults between 25 and 70 years of age. Excludes Northern region (except state of Tocantins).

Figure 3:
High School Completion Rate by Gender, Skin Color and Birth Year

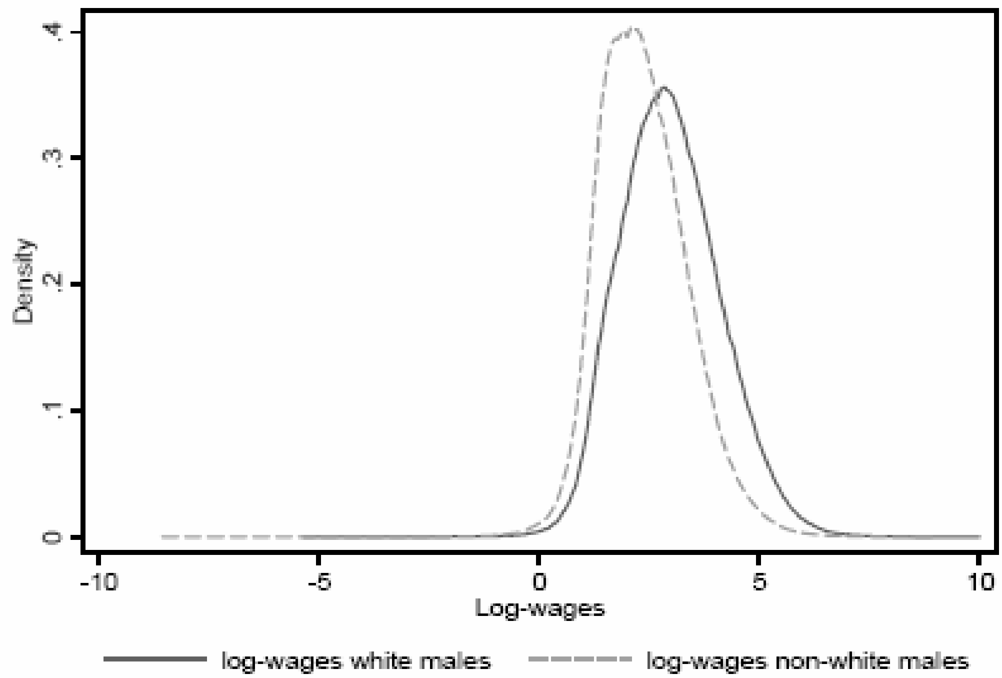


Source: 1991 Census (10-20% Sample), Adults between 25 and 70 years of age. Excludes Northern region (except state of Tocantins).

Figure 4:
Log-Hourly Wage Rate by Gender, Skin Color and Birth Year



Source: 1991 Census (10-20% Sample), Working adults between 25 and 70 years of age.. Excludes North region (except state of Tocantins).



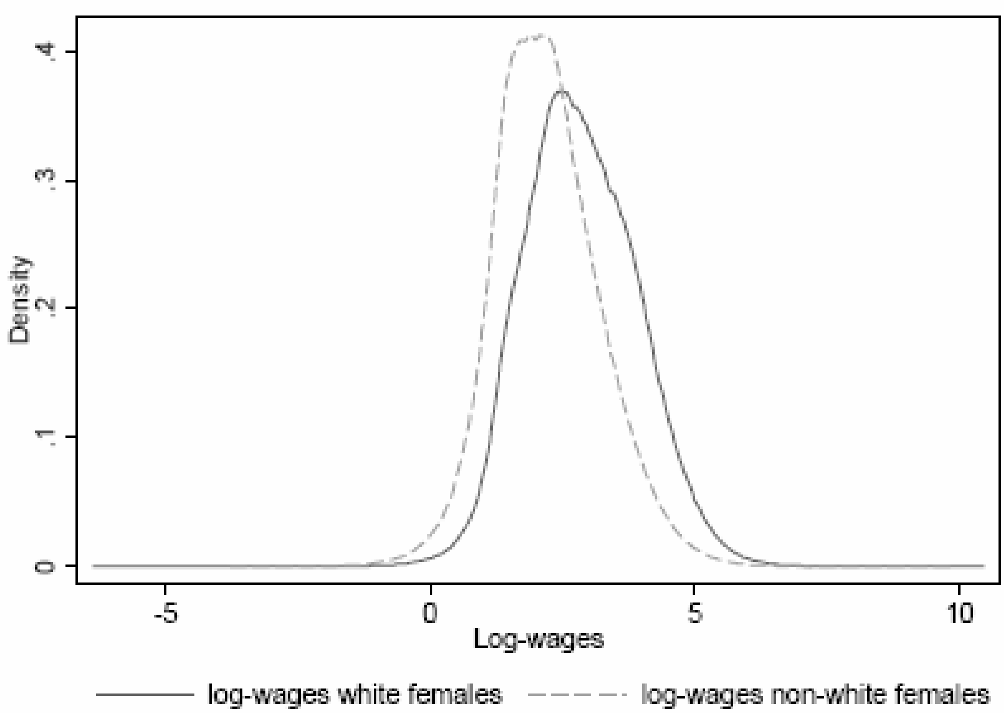
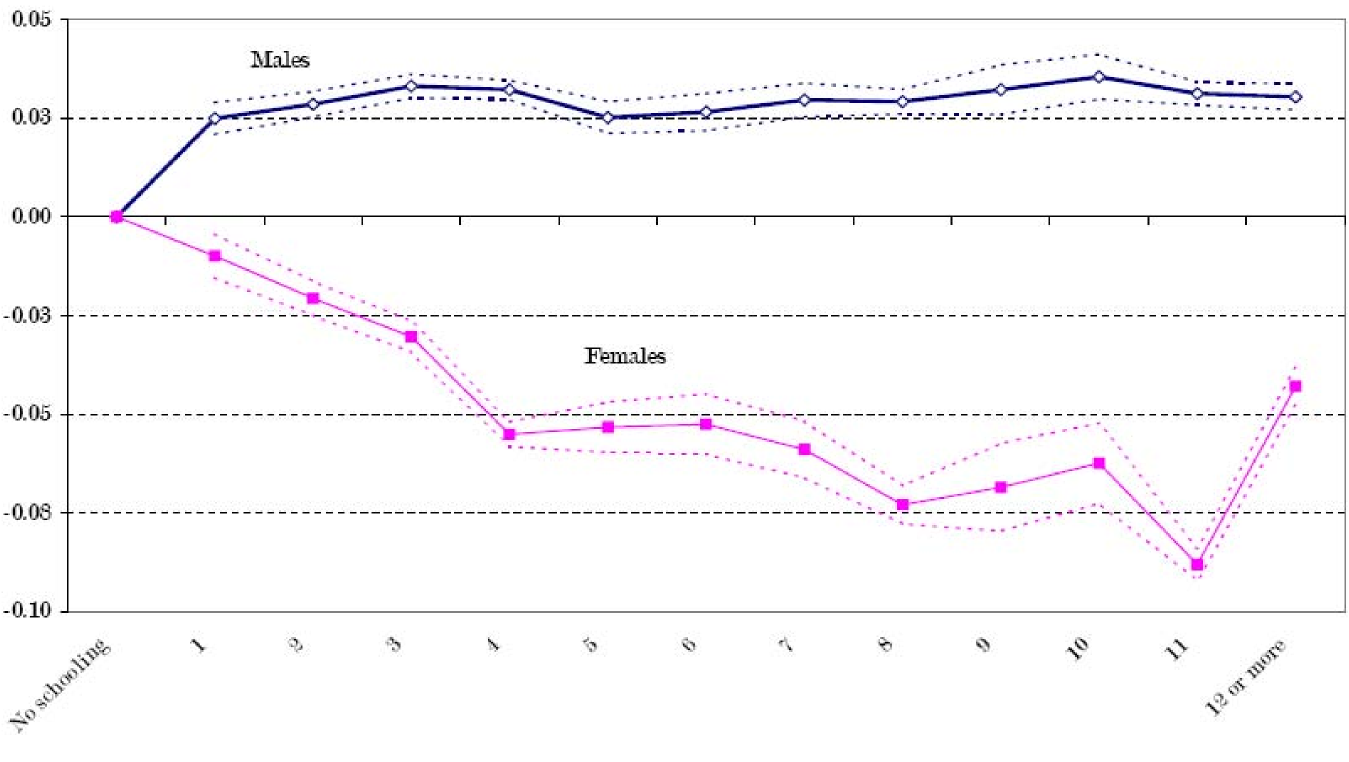


Figure 5:
Log-wage distributions by skin color group

Source: 1991 Census (10-20% Sample), Working adults between 25 and 70 years of age.. Excludes North region (except state of Tocantins).

Figure 6:
Cummmulative Differential Wage Returns to Education
(whites versus non-whites)

Figure 7:
Cummmulative Differential Employment Probability Returns to Education
(whites versus non-whites)



Source: 1991 Census (10-20% Sample), Children ages 5 to 14. Excludes North region (except state of Tocantins).

TABLE 1: Skin-Color Differentials in School or Pre-School Enrollment (percentage points), Children ages 5 to 14

	Average enrollment rate, non-whites [a]	OLS with child-level controls [b]	OLS + family-level controls [c]	Within-estimator family fixed-effects [d]	Within-estimator family fixed-effects parameterized age [e]
Panel A: All children					
White *versus* non-white [unweighted]	66.0	10.0 ***	0.3 ***	0.5 ***	0.5 ***
		(0.09)	(0.13)	(0.16)	(0.16)
White *versus* non-white [w/ sample weights]	68.1	9.5 ***	0.4 ***	0.7 ***	0.7 ***
		(0.09)	(0.13)	(0.17)	(0.17)
Panel B: Children in mixed-skin-color sibship only					
White *versus* non-white [unweighted]	73.6	1.0 ***	0.3 **	0.4 **	0.4 **
		(0.18)	(0.17)	(0.16)	(0.16)
White *versus* non-white [w/ sample weights]	75.1	1.2 ***	0.5 ***	0.6 ***	0.6 ***
		(0.19)	(0.18)	(0.17)	(0.17)

Notes: Sample is restricted to couple-headed households with at least 2 children in the 5 to 14 (inclusive) age range. White, brown or black wives and husbands between ages 21 and 45 (inclusive). Robust standard-errors clustered at household level in parentheses. Number of children in the regressions amount to 1,537,276 (PANEL A), and 170,029 (PANEL B). Child-level controls included semi-parametrically using age, gender and birth order (first and lastborn) dummies. Household-level controls include husband and wife indicators for skin-color (indicator is one if white), completed education (less than elementary, elementary, middle, and high school or more), second-order polynomial on age, geographic location of household (region, urban sector, and metropolitan area indicators), living standard measures (material on walls and roof, sewer system, water pipes, exclusive-se lavatory, ownership of dwelling), logarithm of number of household members and share of members between ages 5 and 14. The parameterized version substitutes child-age dummies for a second-order polynomial. Significance levels are 1% (***), 5% (**) and 10% (*).

TABLE 2: Skin-Color Differentials in School or Pre-School Enrollment (percentage points), Children ages 5 to 14
Within-sibship estimates in samples including stepchildren of male head of household

	Base sample	Non-bio children included	Base sample		Non-bio children included	
			White Fathers	Non-White Fathers	White Fathers	Non-White Fathers
	[a]	[b]	[c]	[d]	[e]	[f]
Panel A: All children						
White *versus* non-white [unweighted]	0.5 ***	0.5 ***	0.5 **	0.5 **	0.5 **	0.5 **
	(0.16)	(0.15)	(0.25)	(0.20)	(0.25)	(0.20)
White *versus* non-white [w/ sample weights]	0.7 ***	0.7 ***	0.8 ***	0.6 ***	0.8 ***	0.6 ***
	(0.17)	(0.17)	(0.27)	(0.22)	(0.26)	(0.22)
Sample	*1,537,276*	*1,581,358*	*736,296*	*800,980*	*754,077*	*827,281*
Panel B: Children in mixed-skin-color sibship only						
White *versus* non-white [unweighted]	0.4 **	0.4 **	0.4	0.4 **	0.4	0.4 **
	(0.16)	(0.15)	(0.25)	(0.20)	(0.25)	(0.20)
White *versus* non-white [w/ sample weights]	0.6 ***	0.6 ***	0.6 **	0.6 **	0.6 **	0.6 ***
	(0.17)	(0.17)	(0.27)	(0.22)	(0.27)	(0.22)
Sample	*170,029*	*177,643*	*64,883*	*105,146*	*67,654*	*109,984*

Notes: See Table 1. Significance levels are 1% (***), 5% (**) and 10% (*).

TABLE 3: Skin-Color Differentials in School or Pre-School Enrollment (percentage points), Children ages 5 to 14
Within-sibship estimates including controls for completed education as of past year

	Base sample	Base sample + completed education dummies	Base sample parameterized educ. and age
	[a]	[b]	[b]
Panel A: All children			
White *versus* non-white [unweighted]	**0.5** ***	**0.5** ***	**0.5** ***
	(0.16)	**(0.15)**	**(0.16)**
White *versus* non-white [w/sample weights]	**0.7** ***	**0.7** ***	**0.7** ***
	(0.17)	**(0.17)**	**(0.17)**
Panel B: Children in mixed-skin-color sibship only			
White *versus* non-white [unweighted]	**0.4** **	**0.4** **	**0.4** **
	(0.16)	**(0.16)**	**(0.16)**
White *versus* non-white [w/sample weights]	**0.6** ***	**0.6** ***	**0.6** ***
	(0.17)	**(0.17)**	**(0.17)**

Notes: See Table 1. Parameterized version includes second-order polynomials for a child's age and education, instead of dummies. Significance levels are 1% (***), 5% (**) and 10% (*).

TABLE 4: Skin-Color Differentials in School or Pre-School Enrollment and Education Attainment (percentage points)
Within-household estimates, differential effects by gender

		All sibships, partial interactions		All sibships, stratified samples		Same-sex sibships, stratified samples	
	Males and females	Males	Females	Males	Females	Brothers only	Sisters only
	[a]	[b]	[c]	[d]	[e]	[f]	[g]
Panel A: School and Pre-School enrollment, Children ages 5 to 14 in mixed-skin-color sibship only							
White *versus* non-white [unweighted]	0.4 **	0.9 ***	-0.1	0.5 *	-0.1	0.5 *	-0.1
	(0.16)	(0.25)	(0.24)	(0.29)	(0.28)	(0.29)	(0.28)
White *versus* non-white [w/ sample weights]	0.6 ***	1.0 ***	0.2	0.6 *	0.3	0.5 *	0.3
	(0.17)	(0.27)	(0.26)	(0.31)	(0.30)	(0.31)	(0.30)
Sample	*170,029*	*170,029*		*85,248*	*84,781*	*48,784*	*50,049*
Panel B: Completed Primary Education, Adults ages 28 to 75 in mixed-skin-color sibship only							
White *versus* non-white [unweighted]	1.0 ***	1.7 ***	0.5	1.6 **	0.5	1.6 **	0.5
	(0.37)	(0.61)	(0.58)	(0.72)	(0.66)	(0.72)	(0.66)
White *versus* non-white [w/ sample weights]	1.1 **	2.0 ***	0.3	1.6 *	-0.1	1.6 *	-0.1
	(0.42)	(0.73)	(0.65)	(0.86)	(0.73)	(0.86)	(0.73)
Sample	*33,450*	*33,450*		*15,412*	*18,048*	*7,839*	*10,569*
Panel C: Completed High-School Education, Adults ages 28 to 75 in mixed-skin-color sibship only							
White *versus* non-white [unweighted]	1.2 ***	2.0 ***	0.6	2.8 ***	1.1 *	2.9 ***	1.1 *
	(0.33)	(0.53)	(0.54)	(0.61)	(0.63)	(0.61)	(0.63)
White *versus* non-white [w/ sample weights]	1.2 **	2.2 ***	0.3	3.0 ***	0.8	3.1 ***	0.8
	(0.38)	(0.63)	(0.63)	(0.73)	(0.71)	(0.73)	(0.71)
Sample	*33,450*	*33,450*		*15,412*	*18,048*	*7,839*	*10,569*

Notes: See Table 1. Significance levels are 1% (***), 5% (**) and 10% (*).

TABLE 5: Skin-Color Differentials in Sibling Compensatory "Transfers"
Individuals 28 and older

	Within-estimator sibling fixed-effects
Panel A: Probability of hosting sibling (%) - males and females	
White *versus* non-white	2.04 *
	(1.12)
Panel B: Probability of hosting sibling (%) - males only	
White *versus* non-white	6.41 **
	(2.51)
Panel C: Probability of hosting sibling (%) - females only	
White *versus* non-white	1.83
	(1.87)

Notes: Hosting a sibling implies that an idividual co-resides with a sibling and has a headship position within the household. Robust standard-errors clustered at household level in parenteheses. Sample consists of 17,757 individuals (PANEL A), 3,375 (PANEL B) and 6,067 (PANEL C). Controls include age and gender dummies.
Significance levels are 1% (***), 5% (**) and 10% (*).

TABLE 6: Mixed color sibship, Differential Impact of Parental Education, by Parental Skin-Color
Mixed color sibships only, mixed-color couples only, weighted regressions

	White children	Non-White children	Difference OLS	Difference FE	
White parent's education					
less than elementary	7.59 (0.71)	8.63 (0.71)	-1.04 (0.78)	-1.15 (0.75)	
elementary and some middle	10.21 (0.68)	11.03 (0.69)	-0.81 (0.77)	-0.50 (0.74)	
middle and some high	11.00 (0.83)	12.97 (0.84)	-1.96 (0.97)	-2.13 (0.94)	**
high school or more	12.33 (0.84)	13.27 (0.87)	-0.94 (1.01)	-1.00 (0.99)	
Non-White parent's education					
less than elementary	8.50 (0.71)	8.43 (0.71)	0.07 (0.77)	0.32 (0.73)	
elementary and some middle	10.55 (0.70)	10.93 (0.70)	-0.38 (0.77)	-0.07 (0.73)	
middle and some high	12.52 (0.85)	11.89 (0.86)	0.63 (0.99)	0.68 (0.96)	
high school or more	14.45 (0.82)	12.60 (0.85)	1.86 (1.00)	2.05 (0.98)	**
Difference-in-Differences					
less than elementary			-1.11 (1.20)	-1.48 (1.15)	
elementary and some middle			-0.44 (1.22)	-0.43 (1.17)	
middle and some high			-2.60 (1.57)	-2.82 (1.53)	*
high school or more			-2.79 (1.70)	-3.06 (1.67)	*
Sample		*103,191*			

Notes: Sample is restricted to couple-headed households with at least 2 children in the 5 to 14 (inclusive). White, brown or black wives and husbands between ages 20 and 45 (inclusive). Robust standard-errors clustered at household level in parentheses. p-values for F-tests in brackets. Models are fully interacted. Significance levels are 1% (***), 5% (**) and 10% (*).

TABLE A1: Marriage across the skin-color line

PANEL A: Overall sample

Census 1991, Females 18 to 55

	Males white	brown	black
Females			
white	81.48	16.79	1.72
	48.66	*10.03*	*1.03*
brown	21.30	73.84	4.86
	7.59	*26.33*	*1.73*
black	15.59	23.10	61.31
	0.72	*1.07*	*2.83*

PANEL B: Working sample

Census 1991, Females and males 21 to 45 with two children in 5 to 14 interval

	Males white	brown	black
Females			
white	83.17	15.62	1.21
	42.65	*8.01*	*0.62*
brown	24.57	72.98	2.45
	10.60	*31.50*	*1.06*
black	17.21	32.24	50.55
	0.96	*1.79*	*2.81*

Census 1991, Females 18 to 55

	Males Non-white	White
Females		
Non-white	79.60	20.64
White	18.52	81.48

Census 1991, Females and Males 21 to 45 with two children in 5 to 14 interval

	Males Non-white	White
Females		
Non-white	76.27	23.73
White	16.83	83.17

PNAD 1992-1993, Females 18 to 25

	Males Non-white	White
Females		
Non-white	75.53	24.47
White	23.83	76.17

PNAD 2003-2004, Females 18 to 25

	Males Non-white	White
Females		
Non-white	75.71	24.29
White	25.38	74.62

TABLE A2: Mixed-color sibship by children's color

Working sample

Census 1991, children 5 to 14

	same-color	mixed
white	89.44	10.56
	45.03	*5.32*
brown	87.77	12.23
	40.07	*5.58*
black	96.02	3.98
	3.84	*0.16*

Census 1991, children 5 to 14

	same-color	mixed
Non-white	88.43	11.57
White	89.44	10.56

TABLE A3: Descriptive statistics, household-level characteristics by progeny's skin-color mix

	All-white progeny mean (se)	Mixed-color progeny mean (se)	All-non-white progeny mean (se)
Living standards and asset holdings			
Rustic-material walls (%)	2.18 (0.03)	7.31 (0.11)	13.60 (0.07)
Rustic-material roof (%)	1.34 (0.02)	3.26 (0.07)	6.53 (0.05)
Water pipes (%)	85.18 (0.07)	64.39 (0.20)	52.29 (0.10)
Sewer pipes (%)	38.61 (0.09)	24.23 (0.18)	17.62 (0.08)
No sewer system (%)	7.99 (0.05)	21.17 (0.17)	31.53 (0.10)
No exclusive-use lavatory (%)	14.24 (0.07)	27.61 (0.19)	39.30 (0.10)
Two or more exclusive-use lav. (%)	20.84 (0.08)	10.37 (0.13)	5.65 (0.05)
Own dwelling (%)	70.61 (0.09)	71.29 (0.19)	71.07 (0.09)
Geographic location			
Urban sector (%)	73.41 (0.08)	69.72 (0.19)	60.66 (0.10)
Metropolitan area (%)	25.03 (0.08)	22.68 (0.17)	20.80 (0.08)
Mid-West region (%)	6.84 (0.05)	12.88 (0.14)	10.00 (0.06)
Northeast region (%)	12.17 (0.06)	43.31 (0.21)	51.87 (0.10)
Southeast region (%)	51.35 (0.09)	36.78 (0.20)	32.34 (0.10)
South region (%)	29.64 (0.09)	7.02 (0.11)	5.79 (0.05)
Characteristics of parents			
Husband age (in years)	37.24 (0.01)	37.16 (0.02)	36.92 (0.01)
Wife age (in years)	34.14 (0.01)	33.92 (0.02)	33.72 (0.01)
Husband literate (%)	89.75 (0.06)	74.99 (0.18)	64.84 (0.10)
Wife literate (%)	90.99 (0.05)	79.14 (0.17)	68.73 (0.10)
Husband completed education (in years)	5.98 (0.01)	4.06 (0.02)	3.10 (0.01)
Wife completed education (in years)	5.94 (0.01)	4.32 (0.02)	3.36 (0.01)
Husband has non-labor income source (%)	15.32 (0.07)	11.37 (0.13)	9.51 (0.06)
Wife has non-labor income source (%)	3.29 (0.03)	2.73 (0.07)	2.10 (0.03)
White couple (%)	84.05 (0.07)	10.78 (0.13)	0.72 (0.02)
White husband, non-white wife (%)	4.97 (0.04)	27.69 (0.19)	8.32 (0.06)
Non-white husband, white wife (%)	9.46 (0.06)	33.95 (0.20)	8.55 (0.06)
Non-white couple (%)	1.52 (0.02)	27.58 (0.19)	82.41 (0.08)
Characteristics of progeny			
Number of children in age range	2.45 (0.00)	2.92 (0.00)	2.87 (0.00)
Mixed-gender progeny (% of hh's with)	59.56 (0.09)	69.29 (0.19)	66.67 (0.10)
All-male progeny (% of hh's with)	21.00 (0.08)	15.47 (0.15)	17.71 (0.08)
Sample (HH's)	*282,830*	*58,131*	*235,123*

Notes: Sample of 576,084 couples with at least two children in the 5 to 14 age interval. Males and females ages 21 to 45 only. Jacknifed standar-errors in parentheses next to estimated means. Source: Brazilian 1991 Census 10-20% sample.

TABLE A4: Descriptive statistics, child-level characteristics by couple's and progeny's skin-color mix

	All families		All-white progeny	Mixed-color progeny		All-non-white progeny
	White child	Non-white child		White child	Non-white child	
	mean (se)	mean (se)	mean (se)	mean (se)	mean (se)	mean (se)
All children						
Age (in years)	9.26 (0.00)	9.16 (0.00)	9.27 (0.00)	9.17 (0.01)	9.41 (0.01)	9.13 (0.00)
Completed education (years)	1.85 (0.00)	1.12 (0.00)	1.91 (0.00)	1.36 (0.01)	1.42 (0.01)	1.08 (0.00)
Enrollment (proportion)	0.79 (0.00)	0.66 (0.00)	0.79 (0.00)	0.74 (0.00)	0.74 (0.00)	0.65 (0.00)
Sample	*1,537,276*		*692,215*	*170,029*		*675,032*
Boys only						
Age (in years)	9.26 (0.00)	9.17 (0.00)	9.27 (0.00)	9.17 (0.01)	9.40 (0.01)	9.14 (0.00)
Completed education (years)	1.77 (0.00)	1.02 (0.00)	1.83 (0.00)	1.25 (0.01)	1.29 (0.01)	0.99 (0.00)
Enrollment (proportion)	0.78 (0.00)	0.64 (0.00)	0.79 (0.00)	0.73 (0.00)	0.72 (0.00)	0.63 (0.00)
Sample	*782,960*		*351,381*	*85,248*		*346,331*
Girls only						
Age (in years)	9.26 (0.00)	9.15 (0.00)	9.27 (0.00)	9.18 (0.01)	9.43 (0.01)	9.12 (0.00)
Completed education (years)	1.93 (0.00)	1.22 (0.00)	2.00 (0.00)	1.46 (0.01)	1.56 (0.01)	1.18 (0.00)
Enrollment (proportion)	0.79 (0.00)	0.68 (0.00)	0.79 (0.00)	0.75 (0.00)	0.76 (0.00)	0.67 (0.00)
Sample	*754,316*		*340,834*	*84,781*		*328,701*

See Notes in Table A3.

TABLE A5: Skin-Color Differentials in School or Pre-School Enrollment (percentage points), Children ages 5 to 14
Within-sibship estimates sensitivity to inclusion/exclusion of regional data

	Base Sample	Including North	Excluding South
	[a]	[b]	[c]
Panel A: All children			
White *versus* non-white [unweighted]	**0.5** ***	**0.4** ***	**0.5** ***
	(0.16)	**(0.15)**	**(0.16)**
White *versus* non-white [w/ sample weights]	**0.7** ***	**0.6** ***	**0.7** ***
	(0.17)	**(0.16)**	**(0.17)**
Sample	*1,537,276*	*1,645,795*	*1,288,526*
Panel B: Children in mixed-skin-color sibship only			
White *versus* non-white [unweighted]	**0.4** **	**0.4** **	**0.4** **
	(0.16)	**(0.15)**	**(0.16)**
White *versus* non-white [w/ sample weights]	**0.6** ***	**0.6** ***	**0.6** ***
	(0.17)	**(0.16)**	**(0.18)**
Sample	*170,029*	*185,127*	*158,704*

Notes: See Table 1. Significance levels are 1% (***), 5% (**) and 10% (*).

TABLE A6: Skin-Color Differentials in Education Attainment (percentage points), Co-residing siblings ages 28 to 75
Within-sibship estimates

	Average school attainment, non-whites	Any formal schooling	Completed primary school (8 years or more)	Completed high school (11 years or more)
	[a]	[b]	[c]	[d]
Adults in mixed-skin-color sibship only				
White *versus* non-white [unweighted]	78.4 / 30.3 / 19.2	0.7 *	1.0 ***	1.2 ***
		(0.34)	(0.37)	(0.33)
White *versus* non-white [w/sample weights]	80.5 / 32.7 / 21.0	0.7 *	1.1 **	1.2 **
		(0.37)	(0.42)	(0.38)

Notes: Controls included are age and gender dummies. Sample is 33,460 individuals, corresponding to 14448 sibships. Significance levels are 1% (***), 5% (**) and 10% (*).

TABLE A7: Skin-Color Differentials in Genetically Inherited Disabilities, Birth and Early Infancy Outcomes

Within-household estimates, mixed-color sibships only

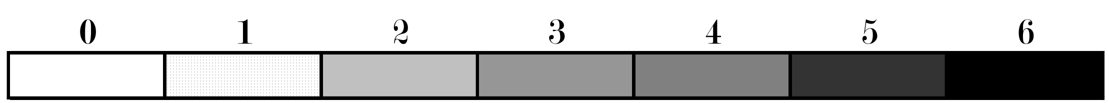
	Children 5 to 14		Children 0 to 5		Children 5 to 14	
	Deaf (per 10,000)	Blind (per 10,000)	Underweight at birth (%)	Premature Birth (%)	Height for age (z-scores)	Height (log centimeters x 100)
Panel A: Census						
Average in population	0.82	0.25				
White *versus* non-white	0.41	0.10	-	-	-	-
	(1.43)	(0.91)				
Sample	*170,029*					
Panel B: Brazilian Survey of Nutrition and Health						
Average in population			16.58	4.45	-0.86	483.93
White *versus* non-white	-	-	-0.80	-0.26	-0.04	-0.02
			(9.35)	(0.93)	(0.08)	(0.38)
Sample			*200*	*393*	*901*	*901*

Notes: The American Academy of Otolaryngology indicates that around 60% of deafness ocurring in infants and children are caused by inherited genetic effects. The same rate was recently reported for the case of blindness by the Research Institute of the McGill University Health Centre (American Journal of Ophtamology). Height is include as early outcomes due to relative consensus in the medical literature that main determinants are set between ages 0 and 4. See notes on Table 1. Significance levels are 1% (***), 5% (**) and 10% (*).

DIAGRAM A1: Punnett square with possible offspring of a intermediate skin-color parentage combination
(Assuming 3 genes as determinants of skin color)
Capitalized: Dark-skin alleles
Non-capitalized: Ligh-skin alleles
Numbers are counts of dark-skin alleles from combination of maternal and paternal gametes.

	Male gametes (skin-color 3)							
Female gametes (skin-color 3)	ABC	ABc	AbC	Abc	aBC	aBc	abC	abc
ABC	6	5	5	4	5	4	4	3
ABc	5	4	4	3	4	3	3	2
AbC	5	4	4	3	4	3	3	2
Abc	4	3	3	2	3	2	2	1
aBC	5	4	4	3	4	3	3	2
aBc	4	3	3	2	3	2	2	1
abC	4	3	3	2	3	2	2	1
abc	3	2	2	1	2	1	1	0

Color spectrum:



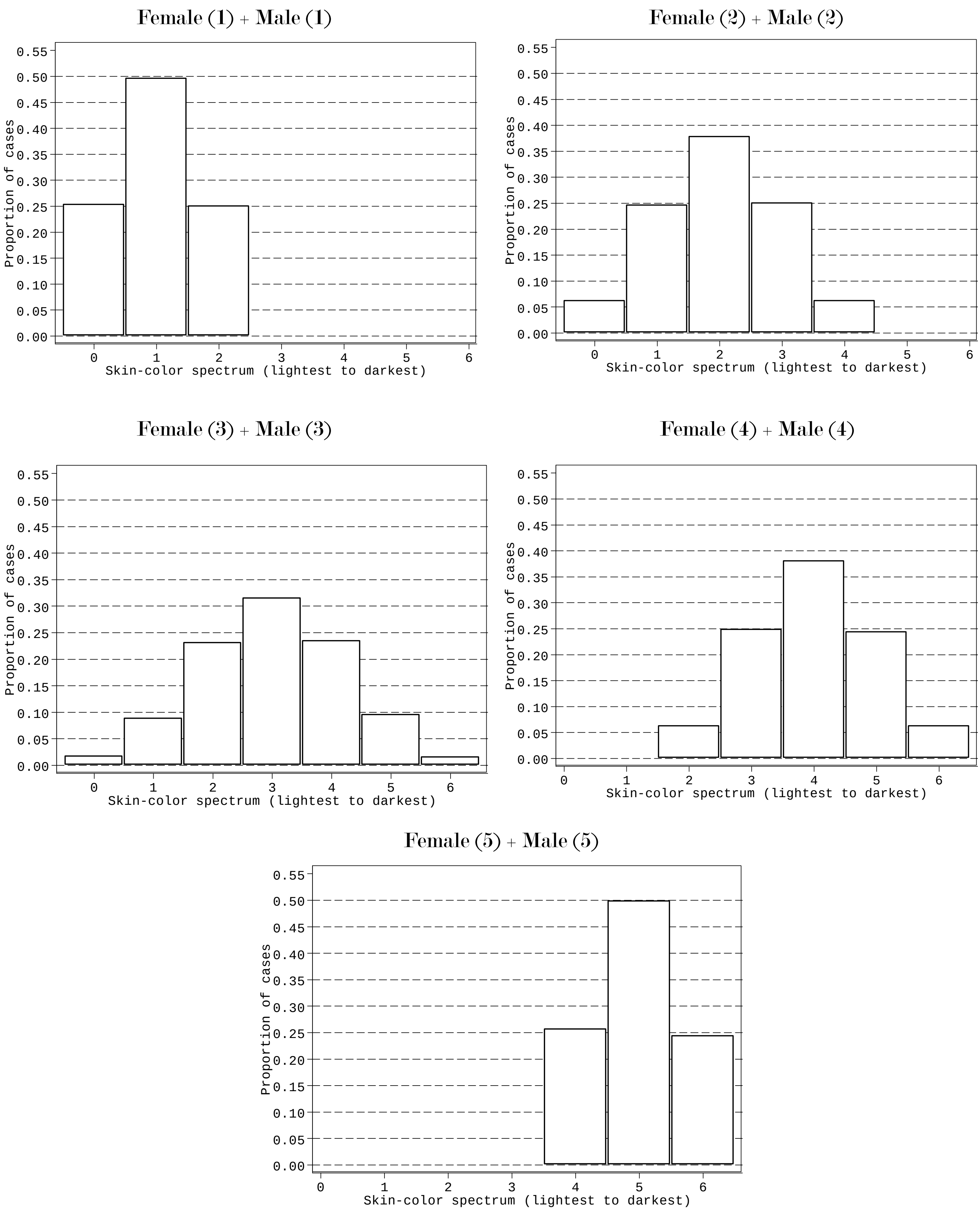


DIAGRAM A2: Intra-color matching and progeny skin-color distribution (10,000 draws)

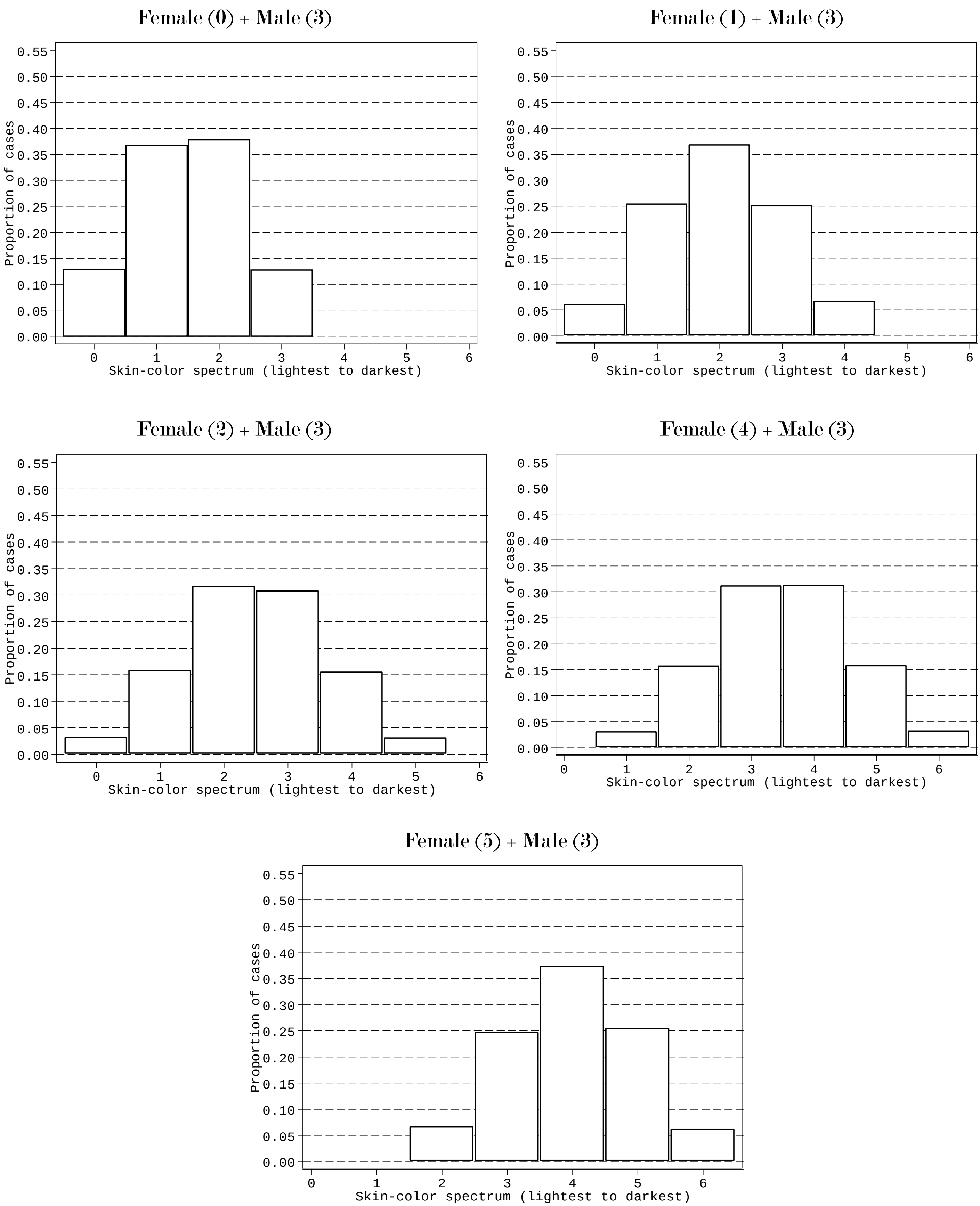


DIAGRAM A3: Mixed-color matching and progeny skin-color distribution (10,000 draws)

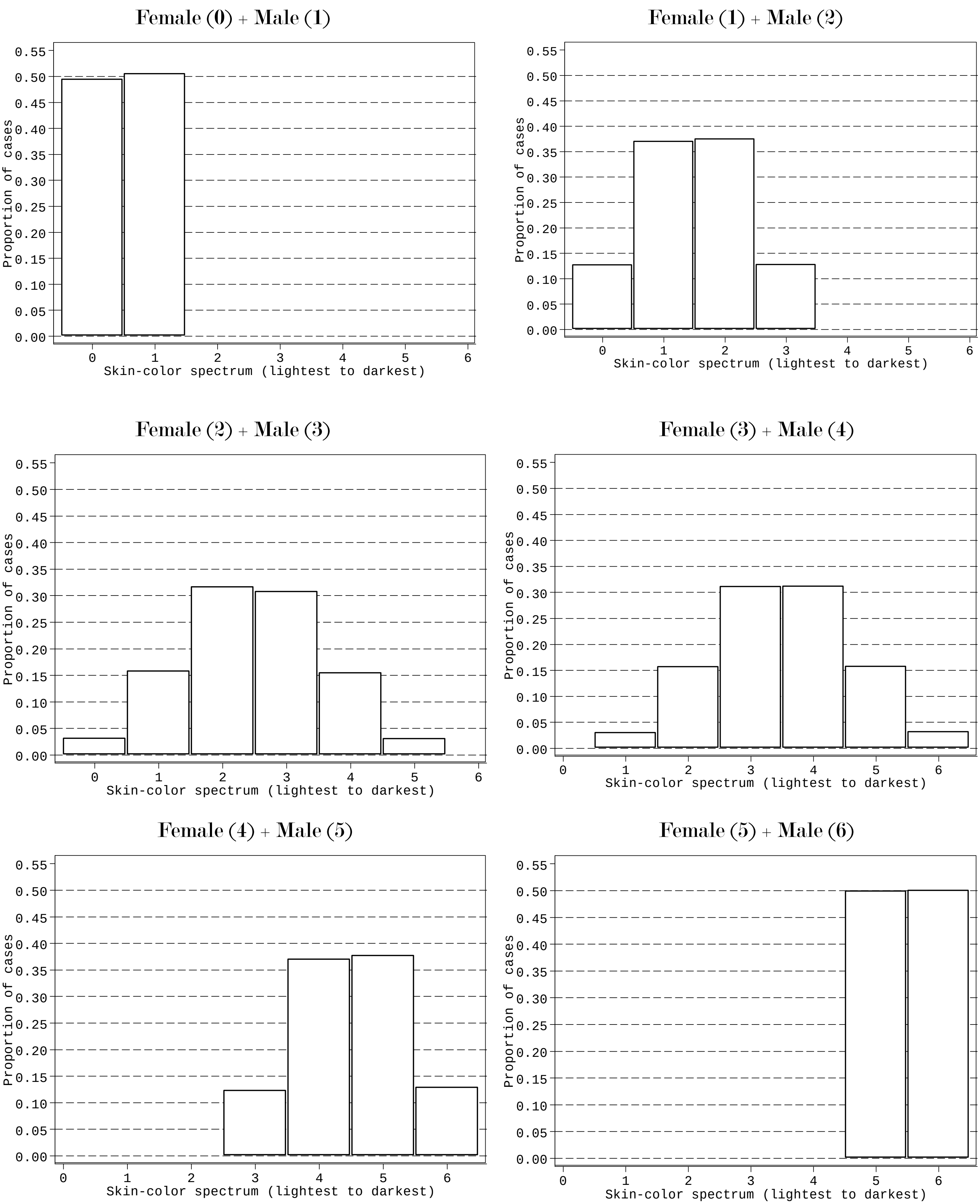


DIAGRAM A4: Nearest neighbor mixed-color matching and progeny skin-color distribution (10,000 draws)