

The Relative Returns to Graduating from a Historically Black College/University: Propensity Score Matching Estimates from the National Survey of Black Americans

Gregory N. Price · William Spriggs ·
Omari H. Swinton

Published online: 24 March 2011
© Springer Science+Business Media, LLC 2011

Abstract This paper considers the returns to earning a baccalaureate degree from a Historically Black College/University (HBCU) relative to a non-HBCU for black Americans. With data from the National Survey of Black Americans, we use propensity score matching estimators to estimate the treatment effect of graduating from an HBCU on direct labor market outcomes, and on psychological outcomes that indirectly increase wages. We find that the treatment effect of graduating from an HBCU relative to a non-HBCU is positive with respect to labor market and psychological outcomes across three decades. As our direct labor market outcome measure reflects permanent earnings, our results suggest that as HBCUs afford graduates relatively superior long-run returns they continue to have a compelling educational justification, as the labor market outcomes of their graduates are superior to what they would have been had they graduated from a non-HBCU.

Keywords Black Colleges/Universities · Labor market outcomes · Matching estimators

JEL Classification I23 · J01 · J15

G. N. Price (✉)
Department of Economics, Morehouse College, 830 Westview Dr., Atlanta, GA 30314, USA
e-mail: gprice@morehouse.edu

W. Spriggs · O. H. Swinton
Department of Economics, Howard University, 2400 Sixth St. NW,
Washington DC 20054, USA

W. Spriggs
e-mail: wspriggs@howard.edu

O. H. Swinton
e-mail: oswinton@howard.edu

Introduction

Since their genesis in the aftermath of the emancipation of slaves, Historically Black Colleges and Universities (HBCUs) have been vehicles for social, political and economic progress for black Americans. Their historical efficacy is evidenced by the disproportionate number of HBCU graduates—well into the twentieth century—who are among the black business elite (Boyd 2007), university professors, congressmen, and judges (Fryer and Greenstone 2010; Wilson 2007); and among the clergy and activists who waged the successful battles for civil rights (Redd 1998; Roebuck and Murty 1993). HBCUs also appear to have a positive impact on the social capital—which has been found to be a crucial determinant of economic success (Sobel 2002)—of its graduates (Palmer and Gasman 2008), and on growth rates in rural counties (Mykerezzi and Mills 2004). Notwithstanding this evidence of being effective institutions, at least since Solnick (1990), HBCUs have been viewed analytically as labor market interventions that impact the wages of attendees and graduates. In general, the interest has been whether or not HBCU graduates fare better or worse in the labor market relative to black graduates of non-HBCUs. The results have been mixed, as relative to non-HBCUs, HBCU graduation has been found to have no impact on earnings (Ehrenberg and Rothstein 1994; Robinson and Albert 2008), a positive impact (Burnim 1980; Constantine 1995; Strayhorn 2008), or a negative impact (Fryer and Greenstone 2010). The mixed results are not surprising given the variety of data, estimators, and econometric/statistical approaches utilized to estimate the effects of HBCU graduation.

For educational policy purposes, the existence of mixed results on the effects of graduating from an HBCU are problematic. Given the historic role that HBCUs have had in effectively providing higher education opportunities for black Americans, their ongoing relevancy is meaningful and significant if there is clear evidence that the tuition and fees that attendees/graduates pay realize a return in the labor market. As HBCUs are no longer the sole option for black Americans, it may also be important for the returns to graduating from an HBCU exceed that of non-HBCUs, if they are to stay relatively competitive. In addition, the Supreme court in *U.S. v. Fordice* (505 U.S. 717 [1992]) required that state legislatures establish “educational justification” for the continued existence of public state-supported HBCUs. Surely, one dimension of “educational justification” is the extent to which HBCUs confer labor market advantages on its graduates. In this context, a preponderance of empirical evidence on the labor market effects of HBCU graduation—negative, neutral, or positive—could be an important input into legislative decision making on the future of public HBCUs.

In this paper, we add to the literature on the labor market consequences of HBCU graduation by estimating the effects of graduating from an HBCU with data from the National Survey of Black Americans (NSBA). As far as we know, the NSBA has not been previously utilized to explore the labor market consequences of graduating from an HBCU. Given that the NSBA is

a nationally representative sample of black Americans with respondents who graduated from a broad range of colleges, and reporting a wide range of labor market experience, it can be a source of parameter estimates that are unbiased, or with less bias relative to parameter estimates of the effects of HBCU graduation in the extant economics literature. Existing studies depend upon data such as the the National Longitudinal Survey of the High School Class of 1972 (NLS-72), Baccalaureate and Beyond Longitudinal Study (B&B), and the College and Beyond Database (C&B), that either restrict the labor market experience of respondents and/or the type of HBCU respondents attended or graduated from.¹

Our use of the NSBA allows us to extend the literature on the labor market effects of graduating from an HBCU in several dimensions. The NSBA does not report on labor market earnings for respondents across all survey waves for respondents. Neither does it provide the type of numeric data that is customarily utilized to estimate earnings equations. However, to the extent that the labor market effects of graduating from college affect permanent income, observed earnings over the early career paths of college graduates may be measuring short run transitory earnings and hence the short run effects of graduating from an HBCU. We estimate the effects of graduating from an HBCU on an individual's Duncan socioeconomic status index, which can be viewed as a measure of permanent income (Zimmerman 1992), and the long-run effects of attending/graduating from an HBCU. The NSBA also includes two measures of psychological well being for respondents—an index of black identity and self-esteem. To the extent that labor market earnings are a function of self-esteem (Goldsmith et al. 1997), and racial identity (Darity et al. 2006), we estimate the effects of graduating from an HBCU on both of these measures of psychological well being to consider how graduating from an HBCU can indirectly affect labor market outcomes. In this context, our analysis of the psychological outcomes associated with HBCU graduation extends the measures utilized in typical earnings equations to include factors that have indirect impacts on labor market outcomes.

Econometrically, we employ a potential outcomes approach to identify treatment effects associated with graduating from an HBCU. We exploit the NSBA categorical data by estimating the treatment effect of graduating from an HBCU by matching on the propensity score—defined as the conditional probability of receiving the treatment, for both a direct measure of labor market outcomes, and an indirect measure. As Brand and Halaby (2006) indicate in a recent application of this approach, matching estimators are

¹NLS-72 (Jones 1986) limits labor market experience to approximately 10 years, as it follows high school seniors—some of whom eventually attended and/or graduated from college—from 1972–1986. The B&B (Wine et al. 2005) limits the labor market experience of actual college graduates to 11 years with the initial survey in the 1992–1993 academic year, and the most recent follow-up survey in 2003. While the C&B (Bowen and Bok 1998) captures data on college attendees/graduates starting in 1951, it only includes 4 HBCUs.

attractive for estimating treatment effects as they are not dependent upon a linear functional form governing the effects of covariates and selection into the treatment. As such matching estimates of treatment effects are potentially superior to regression-type estimates (e.g., ordinary least squares, instrumental variables) given that linearity constitutes misspecification.

The remainder of this paper is organized as follows. In the second section below, we provide a labor market context for graduating from an HBCU. We provide a theoretical framework in which the racial characteristics of the HBCUs as institutions impact investments in a high confidence/self-esteem identity, which conditions the wage received in the labor market. The third section provides a discussion of the data and methodology. The results are reported in the fourth section, and the last section concludes.

A labor market context for HBCUs: the returns to identity/self-image

With the exception of Constantine (1995)—who models the decision of an individual to attend an HBCU within a random utility framework—the existing economics literature on the labor market effects of HBCUs provides little theoretical guidance as to why graduating from an HBCU should impact wages—a treatment effect. Even Constantine’s (1995) random utility framework fails to suggest a possible causal nexus by which HBCU graduation could impact wages, as it only explains the choice to attend an HBCU, and the wage effects are measured conditional on such a choice.

To motivate our empirical estimates of HBCU wage effects, we posit that HBCUs have likely treatment effects given their uniqueness—a product of their history, that favorably impacts upon the identity, self-image and self-esteem of their graduates which has labor market consequences. If, following Akerlof and Kranton (2002), one views schools as institutions with social goals including imparting to its attendees/graduates certain identities with behavioral traits, then HBCUs in particular can be viewed as imparting more than skills to black students. An identity of high confidence and self-esteem comes particularly to mind for the what HBCUs desire to impart upon its graduates. The overrepresentation of HBCU graduates in occupations that are perhaps positively correlated with high confidence/self-esteem such as congressman, court judges, university professors (Fryer and Greenstone 2010), and civil rights activists (Redd 1998; Roebuck and Murty 1993), suggests that HBCUs have a comparative advantage in cultivating high confidence/self-esteem identities and self-image among black college students.

Suppose that the typical black college student—and not necessarily at an HBCU—views college attendance and graduation as a human capital investment (Mincer 1958; Rosen 1977). The decision to enroll in college is on the basis of maximizing the value of income less the costs of attending. As in Akerlof and Kranton (2002), each black student produces marketable skills k_i according to $k_i = n_i e_i$ where n_i is ability, and e_i is effort. We assume n_i is exogenous and normalize it to unity, so that expected income associated with

graduating from college is $w_i k_i$, where w_i is the expected market wage after college graduation. The college is assumed to have a prescription for ideal student identity, that it attempts to impart on students, say through curricula, social events, or the provision of social capital. Call this a high confidence/self-esteem identity. A student who subscribes to and acquires this identity earns a payoff of $I_i - t(1 - b)$, where I_i is the student's self-image of being highly confident and possessing high self-esteem, b is the fraction of the college student body that is black, and t is measure of how difficult it is for black students to subscribe to a particular identity as a function of a college's racial demographics.

The specification of the identity pay-off captures a key characteristic of HBCU graduates—their overrepresentation in occupations that presumably require high confidence/self-esteem. It also captures what is plausibly driving such an outcome for HBCU graduates. For black college students a particular self-image is easier to subscribe to the higher the percentage of blacks in a college's student population. As b increases, it becomes easier to fit in a group that subscribes to a particular self-image, and the total return to a particular self-image increases. Akerlof and Kranton (2002) provide additional evidence that the racial composition of a college's student body could matter for the returns to identity. There is evidence that black and white students do not differ in their expectation for educational attainment, levels of effort in school, or attainment (Cook and Ludwig 1997). However, Akerlof and Kranton (2002) find that when one considers attitudes among black and white students in the High School and Beyond sample, attitudes towards academics change when a student is a minority in a school. In particular, blacks in majority white schools are significantly more likely to dread math and english—which runs counter to the findings of Cook and Ludwig (1997). This suggests that for black students the fraction of a college's student population that is black can condition the extent to which they adopt and adhere to the ideal identity the college is attempting to impart on students.

Let the utility function of a typical black college student be $U = (we)^\alpha I^\beta$, where we is expected post-college income, and I is identity/self-image.² Suppose further that the cost of effort and the cost of subscribing to the identity a

²The specification of the utility function incorporates the idea that as institutions, colleges have economic (e.g. imparting skills that have a return in the labor market) and sociological (e.g. imparting on students particular identities corresponding to social ideals) functions (Akerlof and Kranton 2002). Allowing earnings to be embodied directly in effort recognizes the economic and human capital dimension of college. The sociological dimension of college—particularly its role in shaping social ideals, is captured by allowing identity/self-image to indirectly and multiplicatively affect expected post-college earnings. In this context, the model differs from Akerlof and Kranton (2002) as investments in identity/self-image can have an indirect tangible economic return. This is similar to the approach of Darity et al. (2006). Our theoretical framework treats I as identity and self-image. Another interpretation of I —particularly in a context where it corresponds to an identity of high confidence/self-esteem is that it is a measure of psychological capital. Thus, our model also embodies the effects of psychological capital on earnings as considered by Goldsmith et al. (1997).

college desires for its student are given by $C = c(e) + c(I)$ with both $\partial c(e)/\partial e$ and $\partial c(I)/\partial I > 0$. A student maximizes utility by choosing the extent to which to adopt the identity the college aims for, and an effort level or:

$$\underset{e, I}{\operatorname{argmax}} \left[U = (we)^\alpha [I - t(1 - b)]^\beta \mid C = c(e) + c(I) \right]$$

The solutions for e and I provide an optimal wage condition, and establishes:

Proposition (Wage Effect of a College's Black Student Population) *Given optimal student effort, the expected market wage is an increasing function of optimal identity adoption and the fraction of a college's student population that is black.*

The proof of this proposition follows from the first-order condition for optimal identity adoption. Utility maximization requires that the marginal utility of identity equal its cost, and the optimal wage (w^*) must satisfy:

$$w^* = \frac{c'(I)^{1/\alpha} [I - t(1 - b)]^{(1-\beta)/\alpha}}{\beta^{1/\alpha} e}$$

where $c'(I) = \partial c(I)/\partial c$. If $0 < \beta < 1$, and $c''(I) > 0$, then $\partial w^*/\partial b > 0$, and the expected post-college wage for a black student is proportional to the ratio of black to non-black students enrolled in the college he attended and/or graduated from.

For two identical black college graduates/attendees who differ only in the racial composition of the college they graduated from or attended, $U_1(e, I \mid b_1) > U_2(e, I \mid b_2)$ if $b_1 > b_2$, where $U_i(\cdot)$ is utility for the i th black college graduate/attendee. As HBCUs differ from non-HBCUs in the fraction of its student population that is black, an implication of the proposition above is:

Corollary (Labor Market Treatment Effect of HBCU Graduation) *Let b_1 and b_2 be the fraction of the student population that is black at an HBCU and non-HBCU respectively, then for $b_1 > b_2$, $E[(w^* \mid b_1) - (w^* \mid b_2)] = \tau > 0$.*

Our theory provides a labor market context for attending/graduating from an HBCU. Relative to non-HBCUs, if HBCUs are more successful in encouraging black students to invest in and adopt a high confidence/self-esteem identity, then the relative wages of HBCU attendees/graduates will be higher as wages are increasing in optimal identity investment. In general, our theory suggests a "treatment effect" (τ) for HBCU graduation. For identical black college students who differ only in whether or not they attended/graduated from an HBCU, the wage outcome for the HBCU attendee/graduate is higher—and this difference measures a causal effect.

Data and methodology

Our data is the National Survey of Black Americans (Jackson and Gurin 1997). The National Survey of Black Americans (NSBA) is a full probability household survey of 2,107 black Americans, 18 years of age and older, conducted in four waves: 1979–1980, 1987–1988, 1988–1989, and 1992.³ The sample for the initial wave is based upon the 1970 census, and subsequent updates, of the distribution of the black population. Every black American household in the continental United States had the same probability of being selected. In general the NSBA is an omnibus social survey, and it captures data measuring for example community life, religion, racial identity, political attitudes, informal and formal help resources, and job and employment history. Relative to our inquiry, the NSBA also includes measures of HBCU graduation, labor market outcomes, and a large number of individual personal characteristics that are potentially correlated with the decision to attend and/or graduate from college.

Relative to existing survey data that have been used to examine the labor market consequences of HBCU graduation, the NSBA has several virtues. First, unlike standard population surveys, it recognizes that the geographical distribution of black Americans is different from that of Americans in general (Jackson and Gurin 1997). To the extent that the NSBA is more representative of the U.S. black population than say the black sub-samples in NLS-72, B&B, and C&B; inferences about the labor market effects of HBCU graduation from NSBA are potentially less biased. Finally, the NSBA measures labor market outcomes for black college attendees/graduates over a wider range of labor market experience, and from a larger set of HBCUs than either NLS-72, B&B, or C&B. As earnings are sensitive to experience (Chiswick 2003) and unobserved school quality (Brewer et al. 1999); the relatively more extensive experience and college profiles for black Americans captured in the NSBA can permit estimates of the labor market effects of HBCUs that are potentially less biased than estimates based on black sub-samples in NLS-72, B&B, and C&B.

A limitation of the NSBA is that other than the first survey wave, no numeric data are reported for individual earnings.⁴ However, the NSBA does report across all four waves the Duncan Socioeconomic Status Index –or

³Wave 1 of the NSBA was administered to 2,107 individuals, Wave 2 was administered to 951 individuals (including 935 from Wave 1), Wave 3 to 793 individuals (including 779 individuals from wave 2), and Wave 4 to 659 individuals (including 1 individual from Wave1, 28 individuals from Wave 2, and 623 individuals from Wave 4).

⁴The first wave of the NSBA is the only one that reports numeric values of income for individuals, and it is top-coded. The last three waves do not report any individual measures of income, providing only categorical measures of total family/household income.

Duncan Index—for respondents.⁵ The availability of the Duncan Index for individual NSBA respondents across all four waves is a potential virtue. To the extent that the Duncan Index as a measure of occupational and socioeconomic status has little or no variance due to transitory and life-cycle dynamics, it could be a more reliable measure of an individual's permanent labor market status (Zimmerman 1992). In this context, existing studies that use actual measured wages/earnings to estimate the labor market effect of HBCU graduation are probably estimating a short-run effect. Our approach of estimating treatment effects of HBCU graduation on an individual's Duncan index provides an estimate of the long-run labor market effects of HBCU graduation.

To parameterize the treatment effect of graduating from an HBCU we adopt the potential outcomes approach (Imbens 2004). Given random observations on HBCU attendees/graduates indexed by $i = 1, \dots, N$, each observation is characterized by a pair of potential outcomes, $Y_i(0)$ for the outcome under the control treatment, and $Y_i(1)$ for the outcome under the treatment. Each unit is exposed to a single treatment W such that:

$$Y_i = Y_i(W_i) = \begin{cases} Y_i(0) & \text{if } W_i = 0 \\ Y_i(1) & \text{if } W_i = 1 \end{cases}$$

To estimate the treatment effect of graduating from an HBCU, we utilize a matching estimator, which imputes the missing counterfactual outcomes by comparing treated units with those who are comparable, but did not receive the treatment.⁶ In general, matching estimators have advantages relative to other estimators in enabling identification of causal effects. For example, matching estimators do not require arbitrary functional form (e.g. linearity) assumptions, which reduce the likelihood of biased parameter estimates due to functional form misspecification—both in the conditioning covariates, and in the process governing selection into the treatment. Comparability of control units is measured by similarity in characteristics—ideally pretreatment characteristics—as captured in a general distance metric. Following Imbens (2004) for a sample characterized by (Y_i, X_i, W_i) , where X_i is a covariate measuring a characteristic, the imputed potential outcomes can be expressed as:

$$\hat{Y}_i(0) = \begin{cases} Y_i & \text{if } W_i = 0 \\ \frac{1}{M} \sum_{j \in I_m(i)} Y_j & \text{if } W_i = 1 \end{cases}$$

⁵The Duncan index is measured on a numeric scale from 0 to 96, and the numeric value is proportional to the prestige of an occupation. A two-stage procedure is utilized to generate a Duncan Index. In the first stage, prestige rankings for a few occupations are regressed on a measure of education and earnings for an occupation. In the second stage, estimated parameters from the first stage are used to rank a broader set of occupations, then scaled to formulate an index. For a more detailed description see Duncan (1961) and Duncan et al. (1972).

⁶Matching estimators are becoming popular in applied economics/sociology research—including estimating the returns to attending/graduating from college as in the recent analysis of Brand and Halaby (2006).

and

$$\hat{Y}_i(1) = \begin{cases} \frac{1}{M} \sum_{j \in l_{m(i)}} Y_j & \text{if } W_i = 0 \\ Y_i & \text{if } W_i = 1 \end{cases}$$

where l_{mi} is an index l for $W_l \neq W_i$ that satisfies:

$$\sum_{j|W_j \neq W_i} 1 [\| X_j - X_i \| \leq \| X_l - X_i \|] = m$$

The indicator function $l(\cdot)$ equals 1 if the expression above is true and 0 otherwise. In general, the index chooses an observation in the opposite treatment group that is the m th closest with respect to the distance norm $\| \cdot \|$.

For a sample of N observations with N_1 treated and N_0 controls, matching estimator for the population average treatment effect (Abadie et al. 2001) is:

$$\tau^P = \frac{1}{N} \sum_{i=1}^N [\hat{Y}_i(1) - \hat{Y}_i(0)]$$

τ^P is the treatment effect for a randomly assigned member of the population. To the extent that treatments are policy interventions targeted at particular subpopulations, some of whom selected into it, and others who did not, the effect of the treatment on the subpopulation of treated and control observations may be of interest. As such, the population treatment effect on those actually treated and not treated respectively is:

$$\tau_T^P = \frac{1}{N_1} \sum_{i:W_i=1} [\hat{Y}_i(1) - \hat{Y}_i(0)]$$

$$\tau_C^P = \frac{1}{N_0} \sum_{i:W_i=0} [\hat{Y}_i(1) - \hat{Y}_i(0)]$$

If assignment to the treatment is independent of the outcomes, then conditional on the X_i , τ^P , τ^T , and τ^C are identified. If we further assume that conditional on the covariates, the probability of assignment to the treatment is bounded away from zero and one (Abadie et al. 2001), then it is feasible to define the matching index on the probability of receiving the treatment—or the propensity score. We follow this approach, and estimate the treatment effects of graduating from an HBCU with propensity score matching estimators. Our use of a propensity score matching estimator, while defensible as a strategy for identifying treatment effects conditioned on observables, is also motivated on practical grounds. The NSBA does not provide a sufficient number of covariates measured numerically that are traditionally used in regression models to estimate the causal effects of graduating from college (e.g. parents education/income, years of schooling) on earnings/wages.

Results

Identification of treatment effects with a matching estimator requires imputing the missing potential outcomes ($Y_i(0)$). We impute the missing potential outcomes with a matching algorithm that uses the outcomes of nearest observations in the opposite treatment group (Abadie et al. 2001). As there is evidence that the efficacy of propensity score matching increases with sample size (Zhao 2004), our matching algorithm is based on a distance metric that optimizes the number of observations in the NSBA data. In particular for a vector of covariates \mathbf{X} , define the propensity score—the conditional probability of receiving the treatment—for treated and control observations as $p(\mathbf{X}^t)$ and $p(\mathbf{X}^c)$ respectively. Let \mathbf{I}^c be a binary indicator vector indicating whether or not an observation represents a college graduate, graduated from an HBCU, and let \mathbf{I}^{nc} be the corresponding vector for observations that did not graduate from college, our distance measure, which specifies the index l_{mi} for the estimators $\hat{Y}_i(1)$ and $\hat{Y}_i(0)$ is:

$$d(\mathbf{X}^t, \mathbf{X}^c) = \| [\mathbf{I}^c + p(\mathbf{X}^t)] - [\mathbf{I}^{nc} + p(\mathbf{X}^c)] \|$$

$$= \begin{cases} \| p(\mathbf{X}^t) - p(\mathbf{X}^c) \| = m_i & \text{if } \mathbf{I}^c = \mathbf{I}^{nc} = 1 \\ \| \mathbf{I}^c + (p(\mathbf{X}^t) - p(\mathbf{X}^c)) \| = m'_i & \text{if } \mathbf{I}^c = 1, \mathbf{I}^{nc} = 0 \end{cases}$$

Our matching algorithm selects control observations on the basis of the difference in propensity scores between treated and control observations.⁷ When $\mathbf{I}^c = \mathbf{I}^{nc} = 1$, the distance between the treated and control groups—individuals who graduated from a non-HBCU—is minimized across the sample, as $m_i < m'_i$. This distance metric ensures that for matches in the sample, HBCU graduates are compared only with individuals who actually, and were most likely to have graduated from non-HBCUs.⁸ We implement this minimum distance algorithm with the Stata enabled matching with replacement program of Abadie et al. (2001).

Our estimate of the propensity score—the conditional probability of receiving the treatment—is based on a binary Probit specification of attending and graduating from an HBCU as a function of pre-treatment covariates. We selected the covariates from the NSBA based on those variables that have traditionally been found to explain the college enrollment decision (Brand and

⁷See Augurzky and Kluve (2007) for a consideration of propensity score distance matching.

⁸In general, this is the basic approach to capturing the missing counterfactual outcomes for those receiving the treatment in propensity score matching. Our distance metric imputes the missing potential outcome and counterfactual for HBCU graduates (e.g. graduating from a non-HBCU) by finding non-HBCU graduates in the sample with similar conditional probabilities of receiving the treatment, but were not exposed to the treatment under consideration—graduating from an HBCU. The indicator \mathbf{I} ensures that the matched unobserved outcomes are the average outcomes of the most similar individuals who actually, or based on their propensity score—could have received/chosen the control treatment of graduating from a non-HBCU.

Halaby 2006) such as the educational attainment of parents. To the extent that peer effects affect educational choices and attainment (Gaviria and Raphael 2001) we condition selection into the treatment on the racial background of the respondents grammar, middle and high school. We use respondent birth order as a measure of ability (Sulloway 1996) as it has been found to determine educational attainment (Black et al. 2005). As such, our propensity score accounts for the effects of unobserved ability on college attendance and graduation. As skin tone has been found to determine educational attainment among blacks (Loury 2009) we allow the respondents skin tone to be a determinant of selection into the treatment

Table 1 reports, for the entire sample and the subgroups of interest, the descriptions and mean/standard deviation of the variables upon which our propensity scores are estimated, along with the dependent variables for which we estimate the treatment effect associated with graduating from an HBCU relative to a non-HBCU. In addition to graduating from an HBCU, we also estimate the treatment effect of graduating from an elite HBCU relative to a non-HBCU—elite HBCUs being those included in the sample of selective colleges in the C&B Database (Fryer and Greenstone 2010).⁹ We also estimate the treatment effect of graduating from an HBCU on two psychological outcomes for which the NSBA reports on respondents—black identity and self-esteem. The simple group-specific means suggest that relative to non-HBCU graduates, HBCU graduates have higher permanent earnings, as indicated by a simple comparison of average Duncan Socioeconomic indexes across the three decades it is measured. This suggests that graduating from an HBCU relative to a non-HBCU is associated with a superior long-run labor market advantage. With respect to our psychological measures, a relative HBCU advantage is only present in the 1979–1980 period for Self-Esteem, and for the 1979–1980, and 1992 period for Black Identity. This suggests that any relative advantages that HBCU graduation had on self-esteem erode across time, but persisted for Black Identity.

We specify and estimate the propensity score as a function of the pre-treatment characteristics in Table 1, plus the square cross products of the non-binary pre-treatment characteristics.¹⁰ Use of a propensity score to identify causal effects requires sufficient overlap between treated and control units. If there is insufficient overlap identification of the causal effect of treatment is undermined as to do so requires comparing the outcomes of individuals with similar probabilities of receiving treatment.

Figure 1 depicts as a histogram, the density/distribution of the propensity scores, estimated from a Probit specification, for the treated and non-treated observations in the sample. For values of the propensity score between 0 and 0.58 approximately, there is sufficient overlap between treated and non-treated observations. There are no non-treated observations for which the propensity

⁹These HBCUs include Xavier, Morehouse, Spelman, and Howard.

¹⁰For the cross product term, at least one of the pre-treatment characteristics is non-binary.

Table 1 Covariate summary

Variable	NSBA variable code ^a	Mean	Standard deviation	Number of observations
Graduated from a College/University with a Baccalaureate	3,364	0.089	0.285	976
Graduated from an HBCU with a Baccalaureate	1,436, 1,439	0.035	0.183	876
Graduated from an elite HBCU with a Baccalaureate	1,436, 1,439	0.003	0.055	976
Duncan socioeconomic status index: 1992	5,512	45.47	22.39	249
Duncan socioeconomic status index: 1988–1989	4,512	43.98	22.83	308
Duncan socioeconomic status index: 1987–1988	3,512	21.74	28.11	976
Duncan socioeconomic status index: 1979–1980	2,062	37.78	25.63	976
Self-esteem index: 1992	5,520	7.04	2.63	976
Self-esteem index: 1988–1989	4,520	6.71	2.69	976
Self-esteem index: 1987–1988	3,520	6.24	2.78	876
Self-esteem index: 1979–1980	2,135	3.64	0.840	976
Black identity index: 1992	5,513	3.34	0.494	346
Black identity index: 1988–1989	4,513	3.33	0.515	410
Black identity index: 1987–1988	3,513	3.36	0.491	484
Black identity index: 1979–1980	2,136	3.33	0.511	955
Pre-treatment characteristics				
Year of birth	1,403	1,941.39	15.47	958
Birth order	1,571	10.75	17.61	976
Female	1,586	0.599	0.490	976
Mother's years of education	1,475	8.98	3.79	976
Father's years of education	1,470	7.97	4.18	976
Went to a high school that was mostly or all black	1,488	0.377	0.485	976
Went to a junior high school that was mostly or all black	1,487	0.621	0.485	976
Went to a grammar school that was mostly or all black	1,486	0.773	0.419	976
Skin color:				
Very dark brown = 1	1,639	2.72	0.967	976
Dark brown = 2				
Medium brown = 3				
Light brown = 4				
Very light brown = 5				

score exceed 0.57 approximately, and there are approximately 200 non-treated observations for which there is a zero propensity score. This introduces the possibility that, at least for the full sample, there some treated observations which are not adequate for comparison with the non-treated observations. As this may introduce some bias, below we provide estimates that exclude these possibly non-comparable treated observations.

Tables 2, 3, 4, 5, 6, 7, 8 and 9 report estimates of three population treatment effects associated with graduating from HBCUS and elite HBCUs on our

Table 1 (continued)

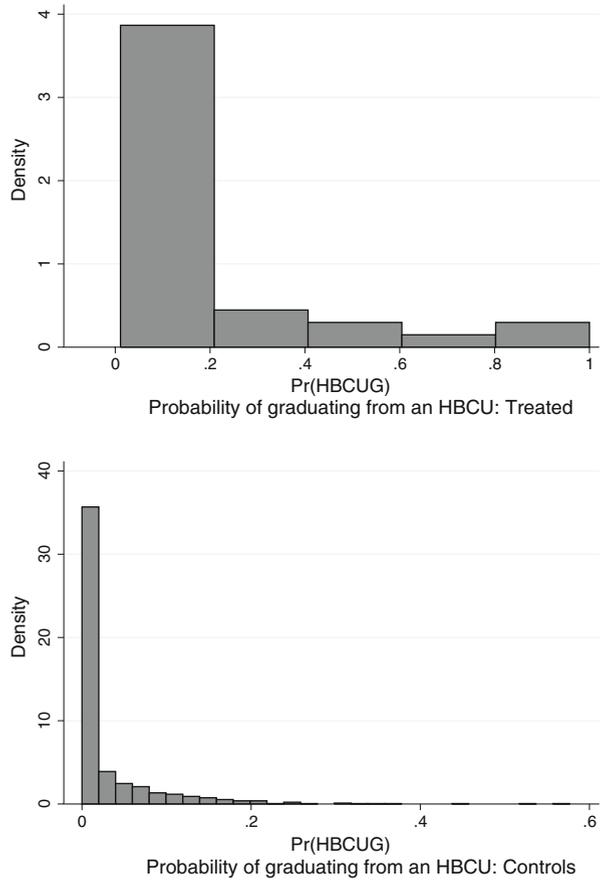
Variable	Mean	Standard deviation	Number of observations
Group-specific outcome measures			
Black HBCU graduates			
Duncan socioeconomic status index: 1992	66.92	11.33	19
Duncan socioeconomic status index: 1988–1989	69.42	6.48	20
Duncan socioeconomic status index: 1987–1988	48.79	31.17	34
Duncan socioeconomic status index: 1979–1980	64.5	13.50	34
Self-esteem index: 1992	5.5	2.63	34
Self-esteem index: 1988–1989	5.38	2.55	34
Self-esteem index: 1987–1988	5.02	2.44	34
Self-esteem index: 1979–1980	3.64	0.259	34
Black identity index: 1992	3.37	0.472	22
Black identity index: 1988–1989	3.19	0.495	23
Black identity index: 1987–1988	3.35	0.398	25
Black identity index: 1979–1980	3.29	0.415	33
Black non-HBCU graduates			
Duncan socioeconomic status index: 1992	60.45	20.88	18
Duncan socioeconomic status index: 1988–1989	62.42	19.49	24
Duncan socioeconomic status index: 1987–1988	39.92	36.09	53
Duncan socioeconomic status index: 1979–1980	57.74	20.36	53
Self-esteem index: 1992	6.57	2.71	53
Self-esteem index: 1988–1989	5.93	2.74	53
Self-esteem index: 1987–1988	5.65	2.65	53
Self-esteem index: 1979–1980	3.61	0.408	53
Black identity index: 1992	3.26	0.527	24
Black identity index: 1988–1989	3.19	0.562	30
Black identity index: 1987–1988	3.18	0.524	33
Black identity index: 1979–1980	3.14	0.529	53

^aMore than one variable code is included if the variable in question was derived from several questions

measure of labor market and psychological outcomes for the full sample.¹¹ For each outcome, we provide an estimate of the population average treatment effect (τ^P), the population average treatment effect on the treated (τ_T^P)—those individuals who actually received the treatment, and the population average treatment effect on the controls (τ_C^P)—a estimate of how the treatment would have affected the non-treated individuals had they received the treatment.

¹¹We were unable to estimate a propensity score for graduating from an elite HBCU, as there was simply not enough observations on these HBCUs to get meaningful Probit parameter estimates. As such, in our treatment effect specifications of elite HBCUs, we use the estimated propensity score for graduating from HBCUs in general.

Fig. 1 Distribution of propensity scores. Notes: $\text{Pr}(\text{HBCU})$ denotes the probability of graduating from an HBCU—the estimated propensity score



The disaggregation of the treatment effect constitutes a departure from standard treatments of the effect of HBCU graduation on individuals, which have historically only estimated the population average treatment effect. As the population average treatment effect is relevant for a randomly assigned member into the treatment, it may obscure the effects the treatment has on particular subpopulations, and providing a misleading inference about treatment effects in general.

Our estimates of the psychological treatment effects of HBCU graduation are motivated by the implications of our theory of how HBCUs attempt to favorably condition the identity/self-image of its students and graduates. The proposition above shows that directly, the post-graduation wage (w^*) of individuals is an increasing function of the identity/self-image acquired in college. Indirectly, the net pay-off of identity/self-image increases with the fraction of a college's student body that is black. Thus, our theory suggests that HBCU graduation has a treatment effect on identity/self-image.

Table 2 The effects of graduating from a Historically Black College/University on labor market earnings propensity score matching parameter estimates treatment: HBCU graduation (full sample)

Time period:	1992	1988–1989	1987–1988	1979–1980
Treatment effect				
τ^P :	0.933 (0.294) ^a	2.91 (0.471) ^a	0.713 (0.233) ^a	−2.03 (0.323) ^b
τ_T^P :	−0.734 (1.46)	−0.393 (0.250)	−0.433 (0.241) ^b	−0.551 (0.396)
τ_C^P :	1.07 (0.237) ^a	3.14 (0.395) ^a	0.778 (0.222) ^a	−2.09 (0.310) ^a
Number of observations:	249	308	461	881
Number of matches:	4	4	4	4

Sample size varies as a result of attrition and missing variables

Standard errors are in parentheses

^aSignificant at the 0.01 level

^bSignificant at the 0.05 level

^cSignificant at the 0.10 level

With respect to labor market outcomes, the parameter estimates reported in Table 2 show that the population average treatment effect of HBCU graduation on our labor market outcome measure—the Duncan Score—is positive and significant in every decade except for that of the late seventies—for which it was negative and significant.¹² The Duncan Score can be viewed as a measure of permanent income (Zimmerman 1992), this suggests that for a randomly selected member of the population, the relative long-run wage returns to graduating from an HBCU is positive in every decade except for the late seventies.

For those that actually received the treatment, the parameter estimates for the population average treatment effect on the treated show that this effect was negative across all three decades, and significant in only the 1987–1988 time period. Comparing the estimates of τ_T^P with the estimates of τ_C^P —the population average treatment effect on the controls—suggests that in general, HBCUs did not optimally recruit students across the three decades. That the controls would have had positive treatment effects in every decade except for the late seventies relative to those that actually received the treatment is an indication of sub-optimal student recruiting by HBCUs—they represent a student population that could have benefited from an HBCU education, but graduated from a non-HBCU and realized a relatively lower labor market return. In contrast, those that actually graduated from an HBCU, realized either no net return, or a negative one in the 1987–1989 time period.

¹²For estimating the treatment effect of HBCU graduation, our matching estimators are based on four matches with replacement, as there is evidence that matching parameter estimates are robust when selecting between one and four matches with replacement (Imbens 2004).

Table 3 The effects of graduating from a Historically Black College/University on labor market earnings propensity score matching parameter estimates treatment: elite HBCU graduation (full sample)

Time period	1992	1988–1989	1987–1988	1979–1980
Treatment effect				
τ^P :	1.20 (0.499) ^a		1.33 (0.497) ^a	−0.610 (0.471)
τ_T^P :	0.230 (0.035) ^a		0.189 (0.076) ^a	0.191 (0.084) ^a
τ_C^P :	1.21 (0.500) ^a		1.34 (0.497) ^a	−.613 (0.472)
Number of observations:	249		461	881
Number of matches:	1		1	1

Sample size varies as a result of attrition and missing variables

No valid observations are available on elite HBCU graduates for the 1988–1989 time period

Standard errors are in parentheses

^aSignificant at the 0.01 level

^bSignificant at the 0.05 level

^cSignificant at the 0.10 level

To the extent that HBCUs are not homogeneous, the estimates in Table 2 may be biased if some HBCUs are better able to recruit students that match their institution's educational objectives. The results in Table 3 consider the treatment effects of graduating from an elite HBCU—those HBCUs with historic reputations of having prestige and being having relatively higher admission standards. We classified Fisk University, Hampton University, Howard University, Morehouse College, Spelman College, and Xavier University as elite HBCUs. Our classification of elite HBCUs augments by two the number

Table 4 The effects of graduating from a Historically Black College/University on black identity propensity score matching parameter estimates treatment: HBCU graduation (full sample)

Time period	1992	1988–1989	1987–1988	1979–1980
Treatment effect				
τ^P :	14.39 (2.00) ^a	14.14 (1.86) ^a	−17.14 (2.39) ^a	2.67 (0.531) ^a
τ_T^P :	1.02 (0.558) ^c	2.71 (1.32) ^b	2.15 (1.11) ^b	−1.02 (0.985)
τ_C^P :	15.51 (1.67) ^a	14.93 (1.65) ^a	−18.26 (1.92) ^a	2.82 (0.441) ^a
Number of observations:	246	307	455	879
Number of matches:	4	4	4	4

Sample size varies as a result of attrition and missing variables

Standard errors are in parentheses

^aSignificant at the 0.01 level

^bSignificant at the 0.05 level

^cSignificant at the 0.10 level

Table 5 The effects of graduating from a Historically Black College/University on black identity propensity score matching parameter estimates treatment: elite HBCU graduation (full sample)

Time period	1992	1988–1989	1987–1988	1979–1980
Treatment effect				
τ^P :	4.95 (1.54) ^a		-1.74 (0.694) ^a	2.48 (0.872) ^a
τ_T^P :	0.226 (0.557)		0.119 (0.211)	0.174 (0.253)
τ_C^P :	4.98 (1.52) ^a		-1.75 (0.692) ^a	2.49 (0.870) ^a
Number of observations:	246		455	879
Number of matches:	1		1	1

Sample size varies as a result of attrition and missing variables

Standard errors are in parentheses

^aSignificant at the 0.01 level

^bSignificant at the 0.05 level

^cSignificant at the 0.10 level

considered elite by Fryer and Greenstone (2010), who were limited to the four HBCUs—Howard, Morehouse, Spelman, and Xavier—sampled in the Mellon Foundation’s *College and Beyond* database.

As a result of zero observations conditional on our matching estimator specification for elite HBCUs graduates in the 1988–1989 wave of the NSBA, Table 3 reports treatment parameter estimates across three decades.¹³ In contrast to the results for graduation from an HBCU in general, the treatment effects for graduating from an elite HBCU differ. In general, and with the exception of the 1979–1980 time period for τ^P and τ_C^P , all of the treatment effects are positive and significant. This suggests that relative to HBCUs in general, elite HBCUs recruited optimally across the decades under consideration as the relative labor market returns to graduating from them are strongly positive across time.

Tables 4–9 report parameter estimates for the treatment effects of graduating from an HBCU—both in general and for elite HBCUs—on several measures of psychological outcomes. We use as a dependent variable for each respondent, the Black identity index, Self-Esteem index, and a constructed measure of Total Self-Image equal to the sum of the Black Identity and Self-Esteem Index. As measure of psychological well being are likely to be correlated with an individual’s current labor market status, for each psychological measure, we estimate that portion of it that is uncorrelated with the respondent’s Duncan Socioeconomic Index by estimating the Gran-Schmidt

¹³For estimating the treatment effect of graduating from an elite HBCU, our matching estimators are based on one match, as in each wave, there was no more than one respondent who graduated from an elite HBCU. Identification of treatment effects with matching estimators requires that the number of matches equal the minimum of the number of treated and controls in the sample (Abadie et al. 2001).

Table 6 The effects of graduating from a Historically Black College/University on self-esteem propensity score matching parameter estimates treatment: HBCU graduation (full sample)

Time period	1992	1988–1989	1987–1988	1979–1980
Treatment effect				
τ^P :	-3.99 (0.655) ^a	-14.53 (2.02) ^a	-2.23 (0.383) ^a	-6.73 (0.759) ^a
τ_T^P :	0.001 (0.520)	-0.257 (0.344)	-0.970 (0.556) ^c	-2.27 (1.17) ^b
τ_C^P :	-4.33 (0.561) ^a	-15.52 (1.70) ^a	-2.30 (0.374) ^a	-6.91 (0.680) ^a
Number of observations:	249	308	461	881
Number of matches:	4	4	4	4

Sample size varies as a result of attrition and missing variables

Standard errors are in parentheses

^aSignificant at the 0.01 level

^bSignificant at the 0.05 level

^cSignificant at the 0.10 level

(Saville and Wood 1991) orthogonalized value for each.¹⁴ The orthogonalized value of each psychological outcome will permit an estimate of how graduating from an HBCU affects psychological well being, which in our theory indirectly affects labor market earnings.

For the effects of HBCU graduation on Black Identity, the parameter estimates reported in Tables 4 and 5 suggest that at least for HBCUs in general, positive treatment effects dominate, both in sign and significance, across τ^P , τ_T^P and τ_C^P . For HBCUs in general, among the sixteen different treatment effects across the three decades under consideration graduation from an HBCU has a positive and significant effect on Black Identity in nine instances. With respect to graduating from an elite HBCU, among the nine different treatment effects across the three decades under consideration, graduation from an elite HBCU has a positive and significant effect on Black Identity in four instances. For HBCUs in general, all treatment effects are positive for the most recent time period under consideration, whereas for elite HBCUs, this is only the case for τ^P and τ_C^P .

With respect to the effects of HBCU graduation on Self-Esteem, the parameter estimates reported in Tables 6 and 7 stand in almost complete contrast to the effect of HBCU graduation of Black Identity. For HBCUs in general, negative treatment effects dominate, and for elite HBCUs, there are positive and significant treatment effects in only three of the nine instances. Even for the most recent time period under consideration, for both HBCUs in general and elite HBCUs the significant treatment effects of HBCU graduation on Self-Esteem are negative. This suggests that to the extent that self-esteem indirectly affects earnings through its impact on the self-image acquired from

¹⁴See Rilling et al. (2008) for an application of this procedure.

Table 7 The effects of graduating from a Historically Black College/University on self-esteem propensity score matching parameter estimates treatment: elite HBCU graduation (full sample)

Time period	1992	1988–1989	1987–1988	1979–1980
Treatment effect				
τ^P :	-2.06 (0.871) ^a		3.08 (0.904) ^a	-2.58 (0.719) ^a
τ^T :	0.021 (0.442)		0.159 (0.016) ^a	0.065 (0.131)
τ^C :	-2.08 (0.867) ^a		3.09 (0.898) ^a	-2.59 (0.715) ^a
Number of observations:	249		461	881
Number of matches:	1		1	1

Sample size varies as a result of attrition and missing variables

Standard errors are in parentheses

^aSignificant at the 0.01 level

^bSignificant at the 0.05 level

^cSignificant at the 0.10 level

a college education, the positive earnings treatment effect of graduating from an HBCU is due to perhaps the positive black identity effects dominating self-esteem, and in this case offsetting any negative self-esteem effects.

Tables 8 and 9 report parameter estimates for the treatment effect of graduating from HBCUs and elite HBCUs on our constructed measure of Total Self-image—the sum of the orthogonalized values of the Black Identity and Self-Esteem indices. At least for elite HBCUs, the results in Table 9 suggest that positive self-image treatment effects dominate over the time period under consideration, and all three treatment effects were positive and significant for the most recent time period under consideration. For HBCUs in general, the

Table 8 The effects of graduating from a Historically Black College/University on total self-image propensity score matching parameter estimates treatment: HBCU graduation (full sample)

Time period	1992	1988–1989	1987–1988	1979–1980
Treatment effect				
τ^P :	10.44 (1.53) ^a	-0.377 (0.665)	-19.36 (2.61) ^a	-4.01 (0.819) ^a
τ^T :	1.80 (1.35)	2.46 (1.14) ^a	1.18 (0.691) ^c	-3.32 (2.12)
τ^C :	11.16 (1.36) ^a	-0.575 (0.604)	-20.56 (2.14) ^a	-4.04 (0.714) ^a
Number of observations:	246	307	455	879
Number of matches:	4	4	4	4

Sample size varies as a result of attrition and missing variables

Standard errors are in parentheses

^aSignificant at the 0.01 level

^bSignificant at the 0.05 level

^cSignificant at the 0.10 level

Table 9 The effects of graduating from a Historically Black College/University on total self-image propensity score matching parameter estimates treatment: elite HBCU graduation (full sample)

Time period	1992	1988–1989	1987–1988	1979–1980
Treatment effect				
τ^P :	2.88 (1.38) ^b		1.34 (0.994)	-0.103 (0.912)
τ_T^P :	0.247 (0.114) ^b		0.279 (0.226)	0.238 (0.348)
τ_C^P :	2.91 (1.38) ^b		1.34 (0.997)	-0.104 (0.915)
Number of observations:	246		455	879
Number of matches:	1		1	1

Sample size varies as a result of attrition and missing variables

Standard errors are in parentheses

^aSignificant at the 0.01 level

^bSignificant at the 0.05 level

^cSignificant at the 0.10 level

results in Table 8 suggest that positive and significant treatment effects only dominate in the most recent time period under consideration. In general, the treatment effect parameter estimates in Tables 8 and 9 suggest that at least in the most recent time period under consideration, HBCU graduates have a higher self-image relative to non-HBCU graduates, which is an indirect source of the relatively superior labor market returns suggested by the treatment effect parameter estimates reported in Tables 2 and 3.

Table 10 The effects of graduating from a Historically Black College/University on labor market earnings propensity score matching parameter estimates treatment: HBCU graduation (propensity score adjusted sample)

Time period	1992	1988–1989	1987–1988	1979–1980
Treatment effect				
τ^P :	0.951 (0.264) ^a	2.78 (0.471) ^a	0.742 (0.226) ^a	-1.82 (0.318) ^a
τ_T^P :	-0.353 (0.254)	-0.275 (0.158) ^c	-0.269 (0.131) ^b	-0.185 (0.198)
τ_C^P :	1.07 (0.242) ^a	3.04 (0.401) ^a	0.812 (0.224) ^a	-1.90 (0.309) ^a
Number of observations:	197	245	361	689
Number of matches:	4	4	4	4

Sample adjustment reflects deleting untreated observations for which the propensity score is zero and treated observations for which the propensity score is unity

Sample size varies as a result of attrition and missing variables

Standard errors are in parentheses

^aSignificant at the 0.01 level

^bSignificant at the 0.05 level

^cSignificant at the 0.10 level

Table 11 The effects of graduating from a Historically Black College/University on labor market earnings propensity score matching parameter estimates treatment: elite HBCU graduation (propensity score adjusted sample)

Time period	1992	1988–1989	1987–1988	1979–1980
Treatment effect				
τ^P :	1.19 (0.509) ^b		1.30 (0.501) ^b	-0.734 (0.481)
τ^P_T :	0.230 (0.035) ^a		0.189 (0.077) ^b	0.191 (0.085) ^b
τ^P_C :	1.20 (0.510) ^a		1.31 (0.501) ^b	-0.738 (0.482)
Number of observations:	197		361	689
Number of matches:	1		1	1

Sample adjustment reflects deleting untreated observations for which the propensity score is zero and treated observations for which the propensity score is unity

Sample size varies as a result of attrition and missing variables

Standard errors are in parentheses

^aSignificant at the 0.01 level

^bSignificant at the 0.05 level

^cSignificant at the 0.10 level

Given the distribution of propensity scores in Fig. 1, to the extent that the full sample results in Tables 2–9 compare dissimilar treated and control observations, our matching estimates of the treatment effect could impart a bias, as a result of matching unrepresentative treated and control observations. In the sample, no control observation had an estimated propensity score higher than

Table 12 The effects of graduating from a Historically Black College/University on black identity propensity score matching parameter estimates treatment: HBCU graduation (propensity score adjusted sample)

Time period	1992	1988–1989	1987–1988	1979–1980
Treatment effect				
τ^P :	13.67 (2.06) ^a	13.53 (1.92) ^a	-16.10 (2.36) ^a	3.23 (0.526) ^a
τ^P_T :	0.788 (0.489)	2.08 (0.859) ^b	1.41 (0.633) ^b	-0.127 (0.555)
τ^P_C :	14.91 (1.74) ^a	14.49 (1.72) ^a	-17.30 (1.94) ^a	3.38 (0.476) ^a
Number of observations:	194	244	359	687
Number of matches:	4	4	4	4

Sample adjustment reflects deleting untreated observations for which the propensity score is zero and treated observations for which the propensity score is unity

Sample size varies as a result of attrition and missing variables

Standard errors are in parentheses

^aSignificant at the 0.01 level

^bSignificant at the 0.05 level

^cSignificant at the 0.10 level

Table 13 The effects of graduating from a Historically Black College/University on black identity propensity score matching parameter estimates treatment: elite BCU graduation (propensity score adjusted sample)

Time period	1992	1988–1989	1987–1988	1979–1980
Treatment effect				
τ^P :	4.86 (1.53) ^a		-1.71 (0.706) ^b	2.81 (0.939) ^b
τ_T^P :	0.226 (0.557)		0.119 (0.211)	0.174 (0.253)
τ_C^P :	4.91 (1.51) ^a		-1.72 (0.703) ^a	2.82 (0.936) ^a
Number of observations:	194		359	687
Number of matches:	1		1	1

Sample adjustment reflects deleting untreated observations for which the propensity score is zero and treated observations for which the propensity score is unity

Sample size varies as a result of attrition and missing variables

Standard errors are in parentheses

^aSignificant at the 0.01 level

^bSignificant at the 0.05 level

^cSignificant at the 0.10 level

0.58, approximately, and this was not true for the treated observations. There were a number of control observations for which the estimated propensity score was zero, and this was not the case for any treated observations. In addition, a few of the treated observation had propensity scores of one. To see if our results are sensitive to matching on dissimilar treated and control

Table 14 The effects of graduating from a Historically Black College/University on self-esteem propensity score matching parameter estimates treatment: HBCU graduation (propensity score adjusted sample)

Time period	1992	1988–1989	1987–1988	1979–1980
Treatment effect				
τ^P :	-3.78 (0.656) ^a	-13.78 (2.07) ^a	-2.15 (0.376) ^a	-6.44 (0.777) ^a
τ_T^P :	-0.135 (0.496)	-0.123 (0.273)	-0.568 (0.300) ^b	-1.25 (0.651) ^b
τ_C^P :	-4.12 (0.575) ^a	-14.92 (1.75) ^a	-2.26 (0.372) ^a	-6.69 (0.701) ^a
Number of observations:	197	245	361	689
Number of matches:	4	4	4	4

Sample adjustment reflects deleting untreated observations for which the propensity score is zero and treated observations for which the propensity score is unity

Sample size varies as a result of attrition and missing variables

Standard errors are in parentheses

^aSignificant at the 0.01 level

^bSignificant at the 0.05 level

^cSignificant at the 0.10 level

Table 15 The effects of graduating from a Historically Black College/University on self-esteem propensity score matching parameter estimates treatment: elite HBCU graduation (propensity score adjusted sample)

Time period	1992	1988–1989	1987–1988	1979–1980
Treatment effect				
τ^P :	-2.01 (0.891) ^b		3.02 (0.904) ^a	-3.09 (0.833) ^a
τ^P_T :	0.021 (0.442)		0.159 (0.016) ^a	0.065 (0.131)
τ^P_C :	-2.03 (0.887) ^b		3.03 (0.896) ^a	-3.10 (0.825) ^a
Number of observations:	197		361	689
Number of matches:	1		1	1

Sample adjustment reflects deleting untreated observations for which the propensity score is zero and treated observations for which the propensity score is unity

Sample size varies as a result of attrition and missing variables

Standard errors are in parentheses

^aSignificant at the 0.01 level

^bSignificant at the 0.05 level

^cSignificant at the 0.10 level

observations, we estimated all the treatment effects with the sample adjusted by eliminating control observations with an estimated propensity score of zero, and treated observations with an estimated propensity score of 0.58, approximately. The results are reported in Tables 10, 11, 12, 13, 14, 15, 16 and 17. Evaluation of the parameter estimates of the treatment effects on the

Table 16 The effects of graduating from a Historically Black College/University on total self-image propensity score matching parameter estimates treatment: HBCU graduation (propensity score adjusted sample)

Time period	1992	1988–1989	1987–1988	1979–1980
Treatment effect				
τ^P :	9.92 (1.61) ^a	-0.230 (0.635)	-18.25 (2.61) ^a	-3.17 (0.710) ^a
τ^P_T :	1.03 (0.961)	1.96 (0.816) ^b	0.845 (0.538)	-1.41 (1.14)
τ^P_C :	10.77 (1.43) ^a	-0.415 (0.618)	-19.56 (2.17) ^a	-3.25 (0.684) ^a
Number of observations:	194	244	359	687
Number of matches:	4	4	4	4

Sample adjustment reflects deleting untreated observations for which the propensity score is zero and treated observations for which the propensity score is unity

Sample size varies as a result of attrition and missing variables

Standard errors are in parentheses

^aSignificant at the 0.01 level

^bSignificant at the 0.05 level

^cSignificant at the 0.10 level

Table 17 The effects of graduating from a Historically Black College/University on total self-image propensity score matching parameter estimates treatment: HBCU graduation (propensity score adjusted sample)

Time period	1992	1988–1989	1987–1988	1979–1980
Treatment effect				
τ^P :	2.84 (1.44) ^c		1.30 (0.983)	–.285 (0.913)
τ^P_T :	0.247 (0.114) ^b		0.279 (0.226)	0.238 (0.348)
τ^P_C :	2.87 (1.44) ^b		1.31 (0.987)	–0.287 (0.917)
Number of observations:	194		359	687
Number of matches:	1		1	1

Sample adjustment reflects deleting untreated observations for which the propensity score is zero and treated observations for which the propensity score is unity

Sample size varies as a result of attrition and missing variables

Standard errors are in parentheses

^aSignificant at the 0.01 level

^bSignificant at the 0.05 level

^cSignificant at the 0.10 level

propensity score adjusted sample reveal that they are approximately similar to those on the full sample.

Overall, our results suggest that on average, graduation from an HBCU affords its graduates superior long-run labor market outcomes relative to graduating from a non-HBCU. This is evidenced by the positive and significant population average treatment effect on the Duncan Score for HBCUs in general, and approximately the same for elite HBCUs. For those actually receiving the treatment—actually graduating from an HBCU—elite HBCUs appear to be better at recruiting student's that match their institutional educational goals, as the population average treatment effect for the treated is only positive and significant for these institutions over the time period under consideration in our sample. Consistent with a theory in which colleges/universities aim to inculcate a high self-image among its graduates, our results also suggest that HBCUs confer upon its graduates relatively superior psychological outcomes which indirectly enhance earnings—at least in the last decade under consideration in our sample.

Conclusions

This paper considered the labor market consequences of graduating from an HBCU relative to a non-HBCU with data from the NSBA. Theoretically, we followed Akerlof and Kranton (2002), and viewed colleges/universities as institutions that not only endow its graduates with human capital, but institutions with social goals that include imparting to its graduates certain identities and behavioral traits that also have labor market consequences. We

employed a potential outcomes approach to identify the effect that graduating from an HBCU relative to a non-HBCU, has on long-run labor market earnings, and on psychological outcomes. Econometrically, propensity score matching estimators were used to estimate three treatment effects across three decades. In general, our findings cohere with previous analyses, based on linear parametric specifications of earnings equations, of the favorable labor market consequences of graduating from an HBCU (Burnim 1980; Constantine 1995; Strayhorn 2008) as we find that the labor market effect is positive. Our results however are closer in methodological spirit to Black et al. (2006), and Fryer and Greenstone (2010), as our propensity score matching estimators are nonparametric, allowing for nonlinearity in the treatment effect of graduating from an HBCU.

Our results, which suggest that HBCUs afford its graduates relatively superior long-run labor market outcomes stand in contrast to the recent results of Fryer and Greenstone (2010)—who find that over time the relative returns to graduating from an HBCU have become negative—and complementary to those of Mykerezi and Mills (2008) who find that HBCUs have a positive effect on the long-run labor market earnings of black males. Moreover, we cannot conclude, as Fryer and Greenstone (2010) do, that HBCUs retard black progress, as our results suggest that HBCU graduates realize higher earnings relative to non-HBCU graduates. As such, our results lend support to the idea that HBCUs continue to have a compelling educational justification, as the labor market outcomes of their graduates are superior to what they would have been had they graduated from a non-HBCU. Our estimates of the effects HBCUs have on the psychological outcomes of graduates also lend support to the idea that HBCUs have a comparative advantage in nurturing the self-image, self-esteem, and identity of its graduates, which theoretically matters for labor market outcomes. The recent findings of Dale and Krueger (2011) who find that the labor market returns for elite HBCU graduates is low relative to that for black graduates of non-HBCUs, also stand in contrast to our findings. We find that for graduates of elite HBCUs, the relative return is higher than for graduating from a the typical non-HBCU in our sample.

There are some possible limitations of our results. Propensity score matching estimates of the treatment effects of HBCU graduation are identified if assignment to the treatment is only conditioned on observable characteristics of individuals.¹⁵ This is also known as selection on observables (Barnow et al. 1980), and it allows identification of treatment effects as the treatment is orthogonal to any unobservables in the treatment specification. If assignment to the treatment under consideration in this paper—graduating from a HBCU—is correlated with any unobservables, could results could be biased, in either direction. To the extent however that the decisive unobservable is ability, our

¹⁵For a critique on the empirical performance of propensity score based estimators, see Wilde and Hollister (2007).

estimated propensity score accounts for this, as we include for each respondent his/her birth order, which is correlated with ability (Black et al. 2005).

That we include a measure of ability—which is an important unobservable for identifying causal effects when agents choose treatments optimally—in our estimated propensity score is in our view, a reason to have confidence that our results are identified. Imbens (2004) notes that the selection on observables argument is compelling if the differences in optimizing choices (e.g. to attend and graduate from an HBCU or non-HBCU) among agents is driven by unobservables that are unrelated to the outcomes of interest. As our propensity score is a function of most of the variables that have been used to explain college attendance and graduation, the inclusion of a measure of ability leaves us with confidence that any remaining unobservables are not likely to matter for the outcomes of interest—earnings and psychological well being. In this context, we are confident that our parameter estimates identify the casual effect of an individual graduating from an HBCU relative to a non-HBCU.

Acknowledgements The authors would like to thank participants of the 3rd Annual Research Network on Race and Ethnic Inequality, Terry Sanford Institute of Public Policy, Duke University, March 28–30, 2008, and the 16th World Congress of The International Union of Anthropological and Ethnological Sciences, July 27–31, 2009, Kunming, Peoples Republic of China for critical comments on earlier versions of this paper.

References

- Abadie A, Drukker D, Leber Herr J, Imbens GW. Implementing matching estimators for average treatment effects in stata. *Stata J* 2001;1:1–18.
- Akerlof GA, Kranton RE. Identity and schooling: some lessons for the economics of education. *J Econ Lit* 2002;40:1167–1201.
- Augurzky B, Kluve J. Assessing the performance of matching estimates when selection into treatment is strong. *J Appl Econ* 2007;22:533–557.
- Barnow BS, Cain GG, Goldberger AS. Issues in the analysis of selectivity bias. *Eval Stud* 1980;5:42–59.
- Black D, Haviland A, Sanders S, Taylor L. Why do minority men earn less? A study of wage differential among the highly educated. *Rev Econ Stat* 2006;88:300–313.
- Black SE, Devereux PJ, Salvanes KG. The more the merrier? The effects of family size and birth order on children's education. *Q J Econ* 2005;120:669–700.
- Bowen WG, Bok D. *The shape of the river: long-term consequences of considering race in college and university admissions*. Princeton: Princeton University Press; 1998.
- Boyd RL. Historically black colleges and universities and the black business elite. *Sociol Perspect* 2007;50:545–560.
- Brand JE, Halaby CN. Regression and matching estimates of the effects of elite college attendance on educational and career achievement. *Soc Sci Res* 2006;35:749–770.
- Brewer DJ, Eide ER, Ehrenberg RG. Does it pay to attend an elite private college? Cross-cohort evidence on the effects of college type on earnings. *J Hum Resour* 1999;34:104–123.
- Burnim ML. The earnings effect of black matriculation in predominantly white colleges. *Ind Labor Relat Rev* 1980;33:518–524.
- Chiswick BR. Jacob Mincer, experience and the distribution of earnings. Discussion Paper No. 847, The Institute for the Study of Labor (IZA), Bonn Germany; 2003.
- Constantine J. The effect of attending historically black colleges and universities on future wages of black students. *Ind Labor Relat Rev* 1995;48:531–546.

- Cook PJ, Ludwig J. Weighing the burden of 'Acting White': are there race differences in attitudes toward education? *J Policy Anal Manage* 1997;16:256–278.
- Dale S, Krueger AB. Estimating the return to college selectivity over the career using administrative earning data. Working paper No. 563. Princeton: Princeton University Industrial Relations Section; 2011.
- Darity WA, Mason PL, Stewart, JB. The economics of identity: the origin and persistence of racial identity norms. *J Econ Behav Organ* 2006;60:283–305.
- Duncan OD. A socioeconomic index for all occupations. In: Reis AJ, editor. *Occupations and social status*. New York: Free Press; 1961. pp. 109–138.
- Duncan OD, Featherman DL, Duncan B. *Socioeconomic background and achievement*. New York: Seminar Press; 1972.
- Ehrenberg RG, Rothstein DS. Do historically black institutions of higher education confer unique advantages on black students? An initial analysis. In: Ehrenberg R, editor. *Choices and consequences: contemporary policy issues in education*. Ithaca: ILR Press, School of Industrial and Labor Relations, Cornell University; 1994. pp. 89–147.
- Fryer RG, Greenstone M. The changing consequences of attending historically black colleges and universities. *A EJ: Applied Economics* 2010;2:116–148.
- Gaviria A, Raphael S. School based peer effects and juvenile behavior. *Rev Econ Stat* 2001;83:257–268.
- Goldsmith AH, Veum JR, Darity W Jr. The impact of psychological and human capital on wages. *Econ Inq* 1997;35:815–829.
- Imbens G. Nonparametric estimation of average treatment effects under exogeneity: a review. *Rev Econ Stat* 2004;86:4–29.
- Jackson JS, Gurin G. National survey of black Americans, waves 1–4 1979–1980, 1987–1988, 1988–1989, 1992 [Computer File] Conducted by University of Michigan, Survey Research Center. ICPSR version Ann Arbor MI: Inter-University Consortium for Political and Social Research; 1997.
- Jones CC. National longitudinal study of the high school class of 1972: postsecondary education transcript study, data file user's manual. Washington DC: United States Government Printing Office; 1986.
- Loury LD. Am i still too black for you? Schooling and secular change in skin tone effects. *Econ Educ Rev* 2009;28:428–433.
- Mincer J. Investment in human capital and personal income distribution. *J Polit Econ* 1958;66:281–302.
- Mykerezzi E, Mills BF. The wage earnings impact of historically black colleges and universities. *South Econ J* 2008;75:173–187.
- Mykerezzi E, Mills BF. Education and economic well-being in racially diverse rural counties: the role of historically black colleges and universities. *Rev Reg Stud* 2004;34:303–319.
- Palmer R, Gasman M. It takes a village to raise a child: social capital and academic success at historically black colleges and universities. *J Coll Stud Dev* 2008;49:52–70.
- Redd KE. Historically black colleges and universities: making a comeback. In: Merisotis JP, O'Brien CT, editors. *Minority-serving institutions: distinct purposes, common goals*. San Francisco: Jossey-Bass; 1998.
- Rilling JK, Goldsmith DR, Griffin AL, Jairam MR, Elfenbein HA, Dagenais JE, Murdock CD, Pagnoni G. The neural correlates of the affective response to unreciprocated cooperation. *Neuropsychologia* 2008;46:1256–1266.
- Robinson B, Albert A. HBCU's institutional advantage: returns to teacher education. In: Gasman M, Baez B, Sotello Viernes C, editors. *Understanding minority-serving institutions*. Albany: State University of New York Press; 2008.
- Roebuck JB, Murty KS. *Historically black colleges and universities: their place in american higher education*. Westport: Praeger; 1993.
- Rosen S. Human capital: a survey of empirical research. In: Ehrenberg R, editor. *Research in labor economics*, vol. 1. Greenwich: JAI Press; 1977.
- Saville DJ, Wood GR. *Statistical methods: the geometric approach*. New York: Springer-Verlag; 1991.
- Sobel J. Can we trust social capital? *J Econ Lit* 2002;40:139–154.
- Solnick LM. Black college attendance and job success of black college graduates. *Econ Educ Rev* 1990;9:135–148.

- Strayhorn TL. Influences on labor market outcomes of african american college graduates: a national study. *J High Educ* 2008;79:27–57.
- Sulloway FJ. *Born to rebel: birth order, family dynamics, and creative lives*. New York: Pantheon; 1996.
- Wilde ET, Hollister R. How close is close enough? Evaluating propensity score matching using data from a class size reduction experiment. *J Policy Anal Manage* 2007;3:455–477.
- Wilson VR. The effect of attending an HBCU on persistence and graduation outcomes of African-American college students. *Rev Black Polit Econ* 2007;34:11–52.
- Wine JS, Cominole MB, Wheelless S, Dudley K, Franklin J. 1993/03 Baccalaureate and beyond longitudinal study (B&B:93/03). NCES 2006–166, U.S. Department of Education, National Center for Education Statistics, Washington DC; 2005.
- Zhao Z. Using matching to estimate treatment effects: data requirements, matching metrics, and Monte Carlo evidence. *Rev Econ Stat* 2004;86:91–107.
- Zimmerman DJ. Regression toward mediocrity in economic status. *Am Econ Rev* 1992;82:409–429.