# APPENDIX: ADDITIONAL SIMULATIONS FOR "AFFIRMATIVE ACTION IN HIGHER EDUCATION: HOW DO ADMISSION AND FINANCIAL AID RULES AFFECT FUTURE EARNINGS?" (*Econometrica*, Vol. 73, No. 5, September 2005, 1477–1524)

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This supplement to the paper "Affirmative Action in Higher Education: How Do Admission and Financial Aid Rules Affect Future Earnings?" performs additional simulations regarding the effects of removing affirmative action in admissions and aid. The first examines the utility losses associated with removing black advantages in admissions and financial aid. The second makes the necessary assumptions such that it is possible to compare the discounted present value of lifetime earnings across different admissions and financial aid rules.

KEYWORDS: dynamic discrete choice, returns to education, human capital, schooling decisions.

While it is not computationally feasible to calculate the utility losses from removing affirmative action for those who would have attended college under affirmative action, it is possible to calculate ex ante utility losses—the losses in expected utility before receiving the preference shocks in the application stage. Similar to the expected utility of the choice of college and major stage, the expected utility at the application stage is given by the log of the social surplus function. In the BST framework described in Section 2.4, this expression is

$$\begin{aligned}
&\ln(G(v_s')) \\
&\quad = \ln\left(\sum_{n=1}^{N} \frac{1}{M}\left(\sum_{r=1}^{R} (n \in J_r) \exp\left(\frac{v_{sr}'}{\rho_s}\right)\right)^{\rho_s}\right. \\
&\qquad\qquad \left. + \sum_{r=1}^{R}\left(1 - \sum_{n=1}^{N} \frac{(n \in J_r)}{M}\right) \exp(v_{sr}') + \exp(v_{so}')\right) + \gamma,
\end{aligned}$$

where $\gamma$ is Euler's constant. This expression can then be calculated with and without black advantages to obtain the utility losses associated with affirmative action.

To translate the utility losses into more meaningful units, I use the coefficient on the log of the expected value of lifetime earnings from the choice of college and major stage. Hence, the utility losses are expressed as the percentage of lifetime earnings a black male would be willing to give up to keep the current affirmative action rules. However, this parameter is relative to the variance scale parameter for the college and major choice stage. The expression calculated above is relative to the variance scale parameter at the application stage. The coefficient on expected future utility at the application stage gives the variance scale parameter at the college and major choice stage over the variance

TABLE XV

SHARE OF LIFETIME EARNINGS BLACK MALES WOULD GIVE UP TO KEEP AFFIRMATIVE ACTION RULES[a]

| | | Share of Lifetime Earnings | | |
|---|---|---|---|---|
| | Admission Rules: | Black | White | White |
| Quantile | Aid Rules: | White | Black | White |
| 90th | | 0.86% | 0.14% | 0.99% |
| | | (0.46) | (0.18) | (0.47) |
| 95th | | 2.92% | 0.57% | 3.74% |
| | | (1.27) | (0.54) | (1.24) |
| 99th | | 14.53% | 7.36% | 18.89% |
| | | (5.15) | (4.09) | (6.05) |

[a] See text for details of the calculations. Standard errors are given in parentheses.

scale parameter at the application stage times however much discounting occurs between the time individuals apply to college and the time they attend. Since the decision in the model to attend is made two years after the application decision, I assume the discounting at this stage is $\beta^2$, where $\beta$ is set at 0.95.[1]

Results are presented in Table XV for the 90th, 95th, and 99th quantiles of earnings losses. At the 95th percentile and below, no black male would give up more than 4% of his future expected earnings to keep affirmative action in admissions and aid. The numbers do increase, however, at the 99th percentile, where these individuals would give up close to 19% of their earnings to keep advantages in both admissions and aid. Consistent with the rest of the results in the paper, advantages in financial aid are much more important than advantages in earnings.

The second simulation examines how the expected discounted present value of lifetime earnings changes when affirmative action is removed. To accomplish this, it is necessary to specify the growth rate on earnings for college and no-college workers across the life cycle. The NLS72 does not track individuals far enough out to obtain these growth rates. Instead, I take individuals aged 19–65 in 1976 and regress earnings on a quartic function of experience, where experience is measured as age minus years of education minus six, and

[1] The details of this conversion are as follows. First, the coefficient on future earnings in the case with unobserved heterogeneity was 4.4129. This is the actual coefficient, $\alpha_w$, divided by the variance scale parameter, $\mu_c$. The coefficient on future utility at the application stage was 4.2749. This number is the ratio of the variance scale parameters, $\mu_c/\mu_s$, times the discounting that occurs across the two stages. To switch the units from utils to share of lifetime earnings, I multiply the changes in utility by $(0.95^2)/(4.4129 \times 4.2749)$.

perform this regression on college and no-college individuals separately.[2] I further assume that individuals who pursue the no-college option start working at age 19, whereas those who pursue the college option start working at age 22. All individuals retire at 65. The same restrictions on earnings and hours for the NLS72 sample were used here as well. Similar to Table XII, the calculations are ex ante: an individual's expected earnings in a particular year is the sum of the probabilities of choosing each educational path times the associated earnings stream from that path. The calculations are then the same as in Table XII except lifetime earnings are substituted for earnings fourteen years after high school.

Using the calculated growth rates, Table XVI gives the losses in the expected present value of lifetime earnings due to the removal of various parts of affirmative action under different assumptions about the discount factor and the unemployment rates across the college and no-college sectors. The calculations are made only for the model that accounts for unobserved heterogeneity. Throughout, I assume a discount factor of 0.95. Results are again for the 90th, 95th, and 99th quantiles of earnings losses.

With unemployment set to zero, the present value of the 99th percentile of losses from removing black advantages in financial aid is $9,092. This increases to $14,165 when both admissions and financial aid rules are removed. As with the previous tables, the results are much smaller at the 90th or even the 95th percentile of losses. The next set of columns displays the earnings losses under different assumptions about the unemployment rates in the college and no-college sectors. The largest earnings losses occur when the unemployment rate is set at zero in the college sector and 10% in the no-college sector. Earnings losses then rise as high as $20,762 at the 99th percentile. In terms of percentage decreases in lifetime earnings, the maximum loss occurs when the unemployment rate in the college sector is set at 5% and the no-college unemployment rate is set at 15%. Here, the expected present value losses at the 99th percentile are still less than 2.5% of the present value of lifetime earnings.

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[2] The specification for college graduates for the experience portion yielded $0.1512 \times \text{EXPER} - 0.00777 \times \text{EXPER}^2 + 0.000189 \times \text{EXPER}^3 + (1.845x10e^{-6}) \times \text{EXPER}^4$. The results I used for the no-college sector were $0.1283 \times \text{EXPER} - 0.00575 \times \text{EXPER}^2 + 0.000118 \times \text{EXPER}^3 + (0.966x10e^{-6}) \times \text{EXPER}^4$.

TABLE XVI

SIMULATED PRESENT VALUE OF LIFETIME EARNINGS LOSSES UNDER DIFFERENT ASSUMPTIONS ON UNEMPLOYMENT RATES (UR)[a]

| | | College UR = 0% No-College UR = 0% | | | College UR = 0% No-College UR = 10% | | | College UR = 10% No-College UR = 10% | | | College UR = 10% No-College UR = 15% | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Admission Rules: | Black | White | White | Black | White | White | Black | White | White | Black | White | White |
| Quantile | Aid Rules: | White | Black | White | White | Black | White | Black | White | White | Black | White | White |
| 90th | | $3,643 | $821 | $4,307 | $5,871 | $1,209 | $6,576 | $4,668 | $977 | $5,182 | $5,674 | $1,168 | $6,372 |
| | | (1,375) | (821) | (1,322) | (2,110) | (1,285) | (2,004) | (1,668) | (1,007) | (1,617) | (2,047) | (1,246) | (1,937) |
| 95th | | $5,569 | $1,975 | $7,029 | $8,152 | $2,808 | $10,436 | $6,472 | $2,266 | $8,365 | $7,886 | $2,715 | $10,149 |
| | | (1,692) | (1,269) | (1,567) | (2,694) | (1,888) | (2,365) | (2,074) | (1,508) | (1,873) | (2,614) | (1,824) | (2,295) |
| 99th | | $9,092 | $4,774 | $14,165 | $13,693 | $6,739 | $20,762 | $10,623 | $5,395 | $16,816 | $13,274 | $6,514 | $20,045 |
| | | (3,072) | (3,122) | (3,300) | (4,705) | (4,115) | (4,292) | (3,720) | (3,418) | (3,606) | (4,548) | (3,965) | (4,132) |

[a]Experience effects estimated from the 1976 Current Population Survey using a quartic on wages for males aged 19–65. No-college workers enter the workforce at age 19; college workers enter at 22. The discount factor is set at 0.95. See text for details of the calculations. Standard errors are given in parentheses.