The Long-Run Impacts of Same-Race Teachers
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Online Appendix

Appendix A Additional Results

Table A1: Sensitivity of Baseline STAR Estimates

Model:	Name and Date of Birth (1)	Kindergarten Only (2)	Class Size (3)	Percent Black (4)	Baseline (5)	No Controls (6)
A. Black Students						
≥ 1 Black T	0.054	0.108	0.057	0.059	0.059	0.060
	(0.031)	(0.049)	(0.027)	(0.027)	(0.027)	(0.027)
N (Students)	3,590	2,043	4,064	4,064	4,064	4,088
R^2	0.052	0.073	0.057	0.058	0.058	0.006
$E(y)$	0.35	0.339	0.313	0.313	0.313	0.313
N (classrooms)	629	206	638	638	638	640
B. White Students						
≥ 1 Black T	-0.037	-0.069	-0.02	-0.019	-0.019	-0.016
	(0.036)	(0.049)	(0.035)	(0.035)	(0.035)	(0.034)
N (Students)	6,355	4,182	7,135	7,135	7,135	7,135
R^2	0.072	0.092	0.074	0.075	0.075	-0.001
$E(y)$	0.469	0.481	0.435	0.435	0.435	0.435
N (classrooms)	968	251	969	969	969	969
Difference by race (p value)	0.051	0.010	0.075	0.071	0.070	0.071
Chow test (p value)	0.000	0.000	0.000	0.000	0.000	0.000

Notes: 2SLS estimates of the impact of ever having a Black teacher (Black T) in grades K-3, as described in equations (1) and (2), on the probability of ever enrolling in college. All models condition on school-by-cohort fixed effects. Column 1 is restricted to the sample of students who name and date of birth are observed, column 2 is restricted to the kindergarten cohort, column 3 changes the class type dummies to the count of class size, and instruments for size with the type dummy, column 4 adds a control for the share of the class that is Black to the set of baseline controls, column 5 is the baseline specification, and column 6 omits student and teacher controls. Baseline controls include student controls for sex and free-lunch status and teacher controls for a quadratic in experience, highest degree attained, and status on career ladder. Standard errors are clustered by students' first-year classrooms. The pooled models in Panel C fully interact all covariates and school-by-year fixed effects with the Black student (Black S) indicator; a Chow (joint F) test of these interaction terms finds them to be strongly significant ($p < 0.001$) in all six models, suggesting that the education production function is systematically different for white and Black students in the STAR schools. We do not report the coefficient on the Black S variable because it is not directly interpretable, due to these interactions.
Source: Tennessee STAR data merged with National Student Clearing House data (Dynarski et al., 2013).

Table A2: Sample Means by High School (HS) Completion Status

	All (1)	High School Observed (2)	High School Graduate (3)	High School Not Graduate (4)	High School Missing (5)
A. Black Students					
Male	0.525	0.449	0.393	0.564	0.570
FRL	0.819	0.746	0.693	0.855	0.863
Missing NSC Link	0.116	0.026	0.020	0.038	0.170
Low income school	0.814	0.779	0.738	0.863	0.835
Took SAT/ACT	0.269	0.529	0.723	0.129	0.113
College enrollment	0.324	0.566	0.714	0.259	0.181
Two-year enrollment	0.221	0.382	0.461	0.218	0.126
Four-year enrollment	0.200	0.363	0.498	0.085	0.103
Semesters attempted	2.556	4.761	6.413	1.352	1.242
Graduated	0.092	0.179	0.250	0.034	0.039
N	4,064	1,517	1,022	495	2,547
B. White Students					
Male	0.530	0.517	0.495	0.619	0.541
FRL	0.381	0.315	0.257	0.580	0.439
Missing NSC Link	0.109	0.039	0.037	0.048	0.172
Low income school	0.304	0.312	0.301	0.358	0.297
Took SAT/ACT	0.380	0.551	0.659	0.059	0.227
College enrollment	0.432	0.564	0.643	0.205	0.313
Two-year enrollment	0.299	0.391	0.441	0.164	0.217
Four-year enrollment	0.274	0.373	0.438	0.074	0.186
Semesters attempted	3.476	4.738	5.581	0.905	2.343
Graduated	0.193	0.271	0.325	0.023	0.123
N	7,135	3,377	2,768	609	3,758

Notes: HS Grad/Not Grad refers to a high school graduation record in the state of Tennessee. Students who graduated HS in other states could be counted in either column 4 or 5. FRL is free or reduced price lunch. NSC links are names and birth dates.

Source: Tennessee STAR data merged with National Student Clearing House data (Dynarski et al., 2013).

Table A3: Balance Test

	First IV				Second IV			
	Black Teacher in First Year				Expected Black Teachers in Years 2-4			
	All	All	Male	Female	All	All	Male	Female
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A. Black Students								
Male	-0.008	0.001			-0.050	0.002		
	(0.016)	(0.012)			(0.022)	(0.009)		
FRL	-0.019	-0.014	-0.042	0.016	0.102	-0.016	-0.023	-0.018
	(0.038)	(0.021)	(0.027)	(0.030)	(0.062)	(0.014)	(0.016)	(0.022)
Small class	-0.051	-0.021	-0.016	-0.025	0.260	0.198	0.208	0.211
	(0.058)	(0.058)	(0.059)	(0.066)	(0.103)	(0.053)	(0.055)	(0.057)
Missing NSC link	-0.031	-0.024	-0.035	-0.018	0.414	-0.010	-0.015	0.006
	(0.040)	(0.021)	(0.029)	(0.029)	(0.051)	(0.017)	(0.024)	(0.022)
N	4,107	4,064	2,112	1,908	4,107	4,064	2,112	1,908
R^2	0.004	0.329	0.355	0.335	0.069	0.875	0.879	0.879
$E(y)$	0.433	0.437	0.437	0.447	0.926	0.935	0.919	0.972
B. White Students								
Male	0.003	0.004			-0.015	-0.003		
	(0.005)	(0.003)			(0.008)	(0.003)		
FRL	-0.007	-0.006	-0.004	-0.012	-0.032	0.004	0.006	0.001
	(0.009)	(0.004)	(0.006)	(0.006)	(0.014)	(0.004)	(0.005)	(0.006)
Small class	-0.015	-0.009	-0.012	-0.006	-0.030	-0.030	-0.034	-0.027
	(0.017)	(0.013)	(0.015)	(0.013)	(0.027)	(0.020)	(0.020)	(0.021)
Missing NSC link	0.013	-0.006	0.002	-0.013	0.087	0.001	-0.005	0.011
	(0.016)	(0.006)	(0.008)	(0.009)	(0.025)	(0.007)	(0.008)	(0.011)
N	7,138	7,135	3,778	3,348	7,138	7,135	3,778	3,348
R^2	0.003	0.484	0.492	0.516	0.012	0.797	0.794	0.814
$E(y)$	0.0590	0.0587	0.0601	0.0568	0.159	0.158	0.152	0.165
Fixed Effects	No	Yes	Yes	Yes	No	Yes	Yes	Yes

Notes: Instrumental variable (IV) 1 is a binary indicator for having had a Black teacher (T) in the student's first year in STAR. IV 2 is the the expected number of Black teachers the student would have had, had they complied with random assignment and remained in that school for the remaining STAR years. FRL refers to free or reduced price lunch. Missing NSC link refers to missing the student's name or date of birth, which complicates the National Student Clearinghouse data merge. Fixed effects are at the school-by-cohort level, as in the main model.

Source: Tennessee STAR data merged with National Student Clearing House data (Dynarski et al., 2013).

Table A4: Heterogeneous Effects of Black Teacher in First Year on Math Scores

Sample:	Male (1)	Female (2)	Free Lunch (3)	Non-Free Lunch (4)	Free Lunch School (5)	Non-Free Lunch School (6)
A. Black Students						
Black Teacher	2.989	8.381	6.374	-1.647	5.523	-0.739
	(2.808)	(3.425)	(2.769)	(4.769)	(2.881)	(6.074)
N (Students)	1,907	1,720	3,008	599	2,976	690
R^2	0.688	0.627	0.654	0.638	0.649	0.643
$E(y)$	498.2	500.8	497.4	509.3	497.3	508.6
N (classrooms)	503	482	554	269	400	222
B. White Students						
Black Teacher	-7.398	-7.471	-9.715	-5.917	-13.934	-2.920
	(4.108)	(4.599)	(4.773)	(4.032)	(4.554)	(4.176)
N (students)	3,387	2,999	2,357	3,972	1,936	4,467
R^2	0.616	0.590	0.648	0.567	0.553	0.605
$E(y)$	519	520.4	513.9	522.2	521.3	519.2
N (classrooms)	802	762	703	752	289	631
Difference by race (p value)	0.029	0.006	0.004	0.456	0.000	0.721
Chow test (p value)	0.000	0.000	0.000	0.000	0.000	0.000

Notes: OLS estimates of equation (3) on end of grade math scores. All models condition on school-by-cohort fixed effects. Controls include student controls for sex and free-lunch (FRL) status and teacher controls for a quadratic in experience, highest degree attained, and status on career ladder. Standard errors are clustered by students' first-year classrooms.

Source: Tennessee STAR data merged with National Student Clearing House data (Dynarski et al., 2013).

Table A5: North Carolina Balance Test Regressions

	Base	District-by-Year Fixed Effects	Linear School Time Trends
	(1)	(2)	(3)
% Students Econ. Disadv.	-0.009	0.000	-0.007
	(0.014)	(0.026)	(0.033)
% Students Black	0.269	0.264	0.182
	(0.066)	(0.068)	(0.102)
% Black Gr. 3 Cohort Persist. Disadv.	-0.009	-0.011	-0.010
	(0.006)	(0.007)	(0.009)
% Students Hispanic	0.024	0.008	-0.080
	(0.103)	(0.108)	(0.156)
School Average EOG	-3.005	-3.074	0.006
	(1.776)	(1.982)	(2.536)
Pupil-Teacher Ratio	-0.092	-0.172	-0.131
	(0.092)	(0.111)	(0.134)
Log Enrollment	-0.979	-1.507	-1.238
	(2.236)	(2.441)	(2.761)

Notes: School-level panel regressions condition on school fixed effects (FE) and cluster standard errors by school. Dependent variable is the fraction of teachers for a school-cohort who are Black, multiplied by 100 to be comparable in scale to school characteristics. Persistently disadvantaged refers to students designated as economically disadvantaged in each of grades 3-8. Each predictor entered in separate models.

Source: Data from the North Carolina Education Research Center (North Carolina Education Research Data Center, n.d.) with additional controls from the National Center for Education Statistics (National Center for Education Statistics, 2017).

Table A6: North Carolina Sensitivity Analyses

Outcome:	High School Dropout			College Intent		
Sample:	All	Male	Female	All	Male	Female
	(1)	(2)	(3)	(4)	(5)	(6)
A. Replicate Main Results: Persistently Disadvantaged Students						
$\hat{\delta}$: *BlackSample*	-0.037	-0.085	0.009	0.072	0.065	0.068
(by school-cohort)	(0.015)	(0.023)	(0.020)	(0.022)	(0.029)	(0.033)
(by school)	[0.017]	[0.026]	[0.023]	[0.025]	[0.033]	[0.038]
N	47,883	22,741	25,142	47,857	22,726	25,131
$\hat{\delta}$: *WhiteSample*	-0.005	0.003	0.001	-0.017	-0.023	-0.053
(by school-cohort)	(0.045)	(0.076)	(0.064)	(0.037)	(0.049)	(0.062)
(by school)	[0.050]	[0.090]	[0.071]	[0.041]	[0.056]	[0.072]
N	25,208	12,750	12,458	25,201	12,744	12,457
B. Drop "No-Variation Schools"						
$\hat{\delta}$: *BlackSample*	-0.037	-0.084	0.008	0.073	0.069	0.067
	(0.015)	(0.023)	(0.019)	(0.022)	(0.028)	(0.033)
N	41,461	19,608	21,853	41,440	19,598	21,842
$\hat{\delta}$: *WhiteSample*	0.004	0.019	0.002	-0.019	-0.025	-0.052
	(0.046)	(0.077)	(0.065)	(0.038)	(0.050)	(0.063)
N	11,911	5,998	5,923	11,906	5,984	5922
C. Include School-Specific Linear Time Trends						
$\hat{\delta}$: *BlackSample*	-0.034	-0.056	-0.009	0.087	0.062	0.088
	(0.018)	(0.030)	(0.023)	(0.025)	(0.035)	(0.039)
N	47,883	22,741	25,142	47,857	22,726	25,131
$\hat{\delta}$: *WhiteSample*	0.032	0.106	-0.046	0.037	0.083	0.002
	(0.056)	(0.092)	(0.086)	(0.045)	(0.066)	(0.084)
N	25,208	12,750	12,458	25,201	12,744	12,457
D. FE Logit Coefficient Estimates						
$\hat{\delta}$: *BlackSample*	-0.325	-0.586	0.126	0.341	0.345	0.299
	(0.146)	(0.194)	(0.227)	(0.108)	(0.168)	(0.145)
N	46,592	21,591	22,509	47,576	22,222	24,862
$\hat{\delta}$: *WhiteSample*	-0.009	0.051	-0.041	-0.141	-0.104	-0.413
	(0.284)	(0.418)	(0.420)	(0.345)	(0.579)	(0.465)
N	24,372	11,734	11,324	23,576	10,048	11,081

Notes: Standard errors reported in parentheses. Baseline standard errors in Panels A, B and C clustered by school-cohort. In Panel D, errors are unclustered. Persistently disadvantaged refers to students designated as economically disadvantaged in each of grades 3-8. All models control for time-varying school characteristics and observed student socio-demographics. No variation schools include those with always-100% or always-0% Black teaching staffs.

Source: Data from the North Carolina Education Research Center (North Carolina Education Research Data Center, n.d.) with additional controls from the National Center for Education Statistics (National Center for Education Statistics, 2017).

Table A7: Mixed Process Bi-Probit Model Estimates

		Average Partial Effects	
	Coefficient	Dropout	Intent
	(1)	(2)	(3)
A. Probit First Stage			
Share	2.275		
	(0.091)		
B. Ordered-Probit			
$1[\geq 1 BlackT]$	0.184	-0.039	0.062
	(0.048)	(0.010)	(0.016)

Notes: $N = 48,293$ persistently disadvantaged students. A first-stage probit and second-stage ordered probit are jointly estimated as a mixed process, as in Roodman (2011). The ordinal outcome takes one of three values: high school (HS) drop out, HS graduate, or HS graduate with college intent. The model is otherwise identical to the linear models estimated by 2SLS described in Table **??**. The models control for school fixed effects, which are manually dummied out, and thus might introduce incidental parameters bias. However, this bias is likely minimal, as there tend to be many students per school (Greene, 2004).

Source: Data from the North Carolina Education Research Center (North Carolina Education Research Data Center, n.d.) with additional controls from the National Center for Education Statistics (National Center for Education Statistics, 2017).

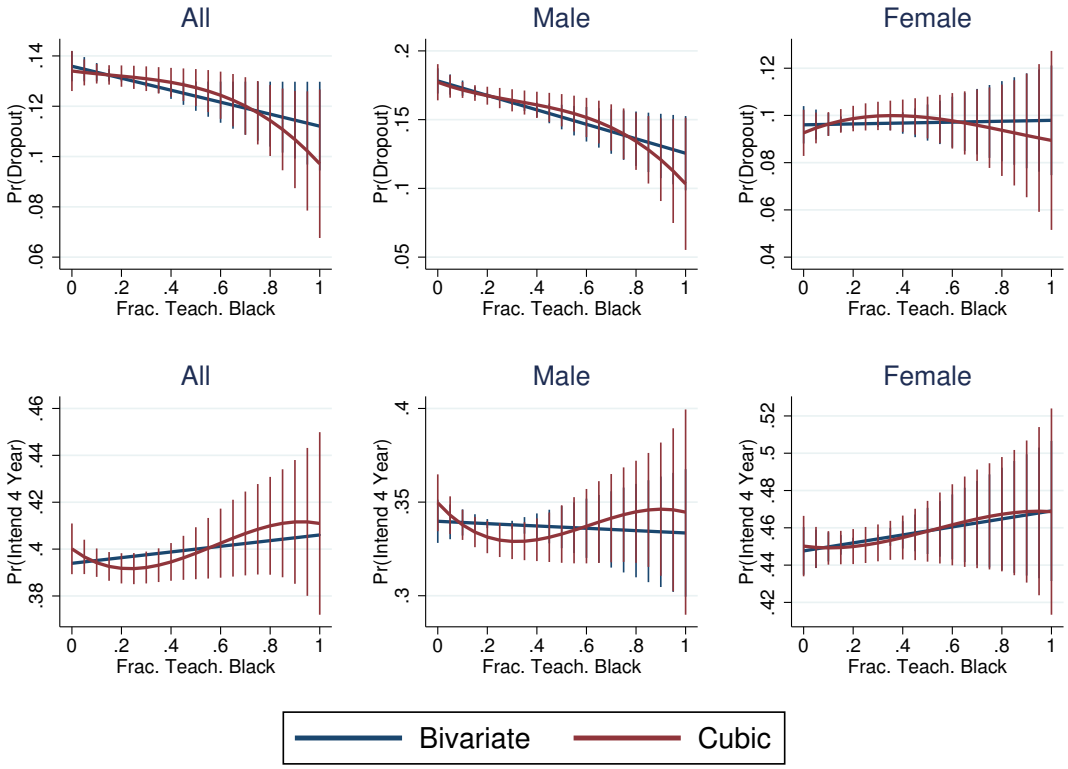

Figure A1: Effect of Same-Race K-3 Teacher on HS Graduation . *Notes:* Fitted values from equation **??** using either linear or cubic specification of *Share* with 95% confidence intervals clustered by school-cohort.
Source: Tennessee STAR data merged with National Student Clearing House data (Dynarski et al., 2013).

Appendix B Calculations for Cost-Benefit Analysis

This paper shows that there are long-run benefits for Black students of having a Black teacher. This result is often used as motivation for calls to diversify the teacher workforce (i.e., to hire more Black teachers). Currently, there are approximately 3.8 million K-12 teachers in the U.S., and only 256,000, or 6.7%, of them are Black (National Center for Education Statistics, 2017). One way to relatively quickly increase the fraction of teachers who are Black is to induce Black college graduates who are not teachers to become teachers. However, there are costs to such a policy that are sometimes overlooked by advocates of such policies. On average, Black college graduates who are not teachers earn higher wages than those who are teachers, suggesting that if policymakers were able to somehow induce some of these individuals into teaching, they would suffer an income loss. Alternatively, we can view the difference in wages as the amount it would cost to induce such workers into teaching (i.e., a compensating wage differential).

Suppose the goal was to double the fraction of teachers who are Black from 6.7%, or 256,000 to 13.4%, or 512,000. To calculate income distributions for Black workers, we use data from the 2018 March CPS (Ruggles et al., 2018). We include all Black individuals ages 21-65 who have at least a Bachelor's degree, worked for at least 26 weeks in 2017, whose primary occupation in 2017 was not in the armed forces, and who earned at least $1,000 and less than the top-coded value of $1,099,999 in their primary occupation in 2017. In this sample, the fraction of college educated Blacks who are teachers is 8.3%. We next calculate average wage and salary income for Blacks in our sample by occupation (i.e., teacher versus non-teacher). Average income for teachers is $51,129, for non-teachers is $65,888, and overall is $64,663. The income gap between Black teachers and Black non-teachers is $14,759, or 28.9%. Given this $14,759 gap between Black teachers and non-teachers, and the current number of 256,000 Black teachers, doubling the fraction of teachers would lead to a yearly loss of income of $3,778,302,000 from Black college graduates, or $151,132,160,000 over a 40-year work life. This could be viewed as the amount of money it would take to double the number of Black teachers over a 40-year long career.

There are a few reasons this basic calculation is likely an overestimate. First, average income of non-teachers includes those with doctoral degrees and professional graduate degrees who earn far more than teachers (for whom 88% have either a Bachelor's or Master's degree (National Center for Education Statistics, 2017)), and would be unlikely to switch into teaching. Second, average income is skewed right by very high-income earners who disproportionately affect non-teacher average income, while teacher salaries tend to be compressed. Third, over three quarters of teachers are female (National Center for Education

Statistics, 2017), and females earn less than males, so the average income of non-teachers is higher because more of them are men.

We thus recalculate our statistics using median income for female workers who earned a Bachelor's degree but not higher than a Master's degree. Among Blacks, median income for teachers is $45,000, for non-teachers is $49,000, and overall is $48,000. Given this difference in median income of $4,000, doubling the fraction of teachers who are Black would lead to approximately $4,000 lower income for 256,000 Black workers, or a total of $1,024,000,000 from Black college graduates, or $40,960,000,000 over a 40-year work life.

This back-of-the-envelope calculation suggests that it would cost approximately $4,000 per year to induce (or compensate) one extra Black college graduate into teaching. However, there are certainly many concerns with this simple calculation. For example, we do not attempt to focus on some subset of the non-teachers who may be most likely to switch into teaching. A more serious attempt at calculating this number might attempt to match teachers to non-teachers based on their observable characteristics. We leave such attempts to future research, though note that researchers have attempted similar calculations in the past, albeit not explicitly focused on Black teachers, and come up with estimates similar to those reported here (Goldhaber, 2010).

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