

No. 20-1199

IN THE
Supreme Court of the United States

STUDENTS FOR FAIR ADMISSIONS, INC.,
Petitioner,

v.

PRESIDENT AND FELLOWS OF HARVARD COLLEGE,
Respondent.

**On Writ of Certiorari
to the United States Court of Appeals
for the First Circuit**

**BRIEF OF PROFESSORS OF ECONOMICS
AS *AMICI CURIAE*
IN SUPPORT OF RESPONDENT**

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INTEREST OF *AMICI CURIAE*¹

Amici—George A. Akerlof, Sandy Baum, Rebecca M. Blank, Hilary Hoynes, Guido W. Imbens, Kirabo Jackson, Rucker Johnson, Helen F. Ladd, David S. Lee, Trevon D. Logan, Michael McPherson, Jesse Rothstein, Robert M. Solow, Sarah Turner, Ebonya Washington, and Douglas Webber—are leading economists and statisticians who regularly use and teach statistical analytical methods, including those used in this case by petitioner’s expert, Dr. Peter S. Arcidiacono, and respondent’s expert, Dr. David Card. *Amici* include, among others, three Nobel laureates, multiple former federal officials (including from the Department of Commerce, Department of Labor, Council of Economic Advisers, and others), several research associates at the National Bureau of Economic Research, current and former editors of peer-reviewed journals, and multiple professors whose research focuses on higher education. *Amici* have a wide range of views about the appropriateness of using race as a factor in college admissions. They share the view, however, that Dr. Card is one of the most outstanding and respected scholars in the field of econometrics and applied economics, that his statistical analyses in this case were methodologically sound, and that the criticisms of the lower courts’ consideration of Dr. Card’s analyses in the Brief of Economists as *Amici Curiae* in Support of Petitioner in this Court, No. 20-1199 (U.S.

¹ Pursuant to Supreme Court Rule 37.6, counsel for *amici* represent that they authored this brief in its entirety and that none of the parties or their counsel, nor any other person or entity other than *amici* or their counsel, made a monetary contribution intended to fund the preparation or submission of this brief. Pursuant to Rule 37.3(a), counsel for *amici* also represent that all parties have consented to the filing of this brief.

May 9, 2022), are not credible. Biographies of *amici* are summarized in the Appendix to this brief.

STATEMENT OF THE CASE

A. Principles of Regression Analysis Design

Economists are often called upon to study the relationships between inputs and outcomes. When examining those relationships, it is important to have a means to control for confounding information. Without appropriately isolating the effects of individual variables, it is easy to reach an incorrect and ill-informed conclusion.

For example, consider the way this Court decides which cases to review. Each year, the Court receives petitions for certiorari requesting review in thousands of cases. It could not realistically hear all of them; accordingly, the Court selects a relatively small handful of cases to review by granting certiorari. It also expressly sets out some of the considerations that warrant its review, such as whether there is a split between circuits or whether the case presents an important question of federal law. *See* Sup. Ct. R. 10 (identifying “the character of the reasons the Court considers” in reviewing certiorari petitions).

Although the Court’s internal deliberations about which cases to review are private, its decisions to grant or deny certiorari are announced publicly, which allows members of the public to analyze trends in the data about the Court’s decisions. One stark distinction appears in the rates at which this Court grants review of cases that paid the \$300 docketing fee compared to cases filed by indigent parties for whom the filing fee is waived (“*in forma pauperis*” cases), as shown in the table below.

Table: Percentage of Petitions Granted by Term²

	2017	2018	2019	2020
Fee Paid	4.0%	4.7%	3.7%	3.9%
Fee Waived	0.2%	0.2%	0.1%	0.1%

Looking only at these headline numbers could lead someone to the (presumably false) conclusion that this Court is “discriminating” against indigent petitioners as compared to fee-paying petitioners. In reality, much of the difference between these two categories may disappear upon controlling for other important aspects in this Court’s decisions to review cases. Indigent petitioners, for example, may frequently be prisoners challenging the factual findings underlying their criminal convictions. *Cf.* Sup. Ct. R. 10 (explaining that the Court is unlikely to grant review “when the asserted error consists of erroneous factual findings”). They may bring cases that are less likely to present a circuit split or a question of statutory or constitutional interpretation. *Cf. id.* So before accusing this Court of discrimination, a researcher should take care to make sure those other factors are properly controlled for.

Regression analysis is a statistical tool that statisticians, economists, and many other researchers use for inquiries of this sort. Regression analysis allows researchers to understand the relationship between multiple variables. It can show what impact a factor has on an outcome, when holding all other factors included in the analysis constant. That makes it a

² “Term” refers to this Court’s Terms beginning in October of the year shown (e.g., October Term 2017). Table data sources: *Supreme Court—The Statistics*, 132 Harv. L. Rev. 447, 455 (2018); 133 Harv. L. Rev. 412, 420 (2019); 134 Harv. L. Rev. 610, 618 (2020); 135 Harv. L. Rev. 491, 498 (2021).

potentially useful tool for a case like this one, in which a large number of factors may bear upon an ultimate outcome.

Designing regression analyses necessarily requires professional judgment. See James H. Stock & Mark W. Watson, *Introduction to Econometrics* 231-35, 260-61 (4th ed. 2020) (“Stock & Watson”); Daniel L. Rubinfeld, *Reference Guide on Multiple Regression*, in Fed. Jud. Ctr. & Nat’l Rsch. Council, *Reference Manual on Scientific Evidence* 303, 312 (3d ed. 2011) (“*Reference Manual*”). That judgment extends to, among other things, which variables to include or exclude. See Stock & Watson 261. One may exclude certain information from a regression analysis because the information is irrelevant or including it would bias the results.³

While economists do have a degree of judgment in creating a model, their judgment is bounded by established principles of empirical data analysis that mitigate against the likelihood of a biased or unreliable result. A few key principles are at issue in this case.⁴

³ As an example, Harvard applications include the names of the applicant’s parents. Accordingly, it is technically possible to include “number of letters in mother’s first name” as a variable in a regression analysis. Both Dr. Card and Dr. Arcidiacono implicitly opted not to include that information as a variable, and for good reason: there is no reason to believe that this information is relevant for an applicant’s chances of admission.

⁴ The district court *amicus* brief to which many of these same *amici* were signatories, Am. Br. of Professors of Economics as *Amici Curiae* in Supp. of Defendant, No. 1:14-cv-14176-ADB, ECF No. 531 (D. Mass. Sept. 6, 2018), offered as an illustration of these principles the example of a car dealership seeking to analyze the factors that influence its monthly sales. That illustration retains its usefulness here, and this brief refers to it for further reference should the Court find it helpful.

First, the expert must identify the explanatory variables, which are related to the variable of interest and also are expected to be correlated with the outcome. By controlling for these variables, the regression model will attempt to remove from the raw correlation between the variable of interest and the outcome the correlation attributable to the explanatory variables. *See Reference Manual* 313-16.

Failing to include a relevant explanatory variable will lead to misleading inferences from the data. This statistical problem is known as “omitted variable bias.” As a simple illustration, consider a model to analyze whether a petitioner’s indigent status affects the likelihood of this Court granting the petition for review, and suppose that model failed to take account of whether the petition involved a circuit split. That model could suffer from omitted variable bias if in fact the fee-waived petitions are less likely to involve circuit splits.

Second, a well-designed statistical analysis should reflect as closely as practical the population of interest and correctly identify the outcome being investigated. *See Stock & Watson* 332 (“the true causal effect might not be the same in the population studied and the population of interest . . . because the population was chosen in a way that makes it different from the population of interest”). Returning to the hypothetical model of this Court’s certiorari grants, if the model excluded petitioners in state prisons, or if it considered only petitions involving First Amendment claims, it would fail to reflect the population of interest, which is all parties who file petitions for review in this Court.

Third, in evaluating a regression analysis, the modeling choices should be justifiable *a priori*, without first looking at relationships in the data. *See id.* at

334-35. A researcher should be able to accept the arguments underlying the regression specification (that is, the selection of variables and relevant population) without having seen the results first. And an available explanatory variable should be excluded only when there is a compelling *a priori* explanation to exclude it. If the arguments depend on the specifics of what was observed in the data, they may reflect *ex post* rationalization of the model rather than a principled prior decision. Using the same hypothetical certiorari analysis, a researcher should likely include as a variable whether the case involves the invalidation of a state law based on a federal statute. *Cf.* Sup. Ct. R. 10 (Court considers whether there is an “important federal question”). Suppose a researcher excluded that variable and justified the exclusion by arguing that a disproportionately high percentage of such petitions were granted in a recent Term and that they were overwhelmingly associated with paid cases. That researcher’s model would not be complying with the *a priori* principle, and would be suspect, because the rationale depends on analyses of the data rather than *a priori* reasoning.

B. The Experts’ Regression Analyses

In the district court, both parties submitted regression analyses. Petitioner’s expert, Dr. Peter S. Arcidiacono, performed a regression analysis and concluded that Asian American identity has a statistically significant negative effect on the probability of admission relative to white applicants. Pet.App.197. Dr. Arcidiacono’s findings were influenced by certain methodological decisions he made in designing his regression analysis. For example, Dr. Arcidiacono excluded so-called “ALDC” applicants (recruited athletes, “legacy”

relatives of alumni, “Dean’s List” applicants, and children of faculty and staff). He also pooled together all applicant data from across six admission class years rather than evaluating them on a year-by-year basis. Pet.App.198.

Harvard offered rebuttal testimony from Dr. David Card. Subsequent to his engagement in this case, Dr. Card was awarded the Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel (more commonly called the Nobel Prize in Economics). He is a leading economist with a stellar professional reputation.

Based on his review of the record on Harvard’s admissions process and his analyses of admissions data, Dr. Card concluded that Dr. Arcidiacono’s analyses were not credible. Dr. Card concluded that Dr. Arcidiacono’s regression models mistakenly focused on applicants’ academic achievements (such as GPAs and ACT/SAT scores) to the exclusion of other pertinent non-academic information Harvard considered in making admissions decisions, such as applicants’ personal factors. *See* CAJA2845:13-2846:13, 2985:4-15, 6048;⁵ Expert Report of David Card ¶¶ 12-13, No. 1:14-cv-14176-ADB, ECF No. 419-33 (D. Mass. Dec. 15, 2017) (“Card Report”). Dr. Card also concluded that Dr. Arcidiacono incorrectly narrowed the relevant population by excluding ALDC applicants. Dr. Card opined that there was no statistical justification for removing these applicants from an analysis of Harvard’s admissions process. Similarly, Dr. Card found that Dr. Arcidiacono had inappropriately pooled all of the applicants from six admissions cycles into a single

⁵ References to “CAJA” are to the Joint Appendix filed in the First Circuit (No. 19-2005). References to “JA” are to the Joint Appendix filed in this Court by petitioner.

model, rather than analyze each year of admissions data separately.

Dr. Card then performed his own analysis, which corrected for the flaws in Dr. Arcidiacono's model. Among other things, Dr. Card's model included ALDC applicants (on the theory that they are part of the population of Harvard applicants and compete with other applicants for admission), and it examined each admissions cycle separately (on the theory that each year's applicants compete only with applicants from that year, not from prior or subsequent years). CAJA2904:6-2905:08, 2918:25-2921:15. Dr. Card also controlled not only for applicants' academic, extra-curricular, and athletic qualities (for which Dr. Arcidiacono controlled) but also for other factors including personal ratings, parental occupation, and intended career (for which Dr. Arcidiacono failed to control adequately). See CAJA2895:6-2896:4, 6048; Card Report ¶¶ 95-100.⁶ Controlling for these factors helped make Dr. Card's analysis robust and persuasive. Through his regression models, Dr. Card analyzed the

⁶ Petitioner's *amici* advance a new argument that, as we understand it, neither *amici* nor petitioner raised at any prior stage of this case. They contend (at 15 n.6) that parental occupation may serve as a proxy for whether an applicant is Asian American, on the grounds that "Asian-American applicants are much more likely than other applicants to have parents in STEM fields." Petitioner's *amici* notably offer no supporting citation for that assertion, which appears to be based entirely on the same stereotypes that petitioner decries. See Pet. Br. 63 ("Every day, Asian Americans are stereotyped as . . . model minorities who are interested only in math and science."). As noted above, a well-designed regression analysis should include or exclude variables based on *a priori* evidence and reasoning. Dr. Card's analysis did so; petitioner's *amici*, on the other hand, appear to be relying on a post-hoc, stereotype-driven assertion to try to explain away statistical findings that undermine their preferred result.

difference in admissions rates between Asian American applicants and white applicants if all observed factors included in the regression model were equal. Dr. Card found no statistically significant evidence of racial discrimination against Asian American applicants. CAJA3108:23-3109:15.

C. The District Court's Findings of Fact

Following a bench trial at which both Dr. Arcidiacono and Dr. Card testified, the district court ruled in Harvard's favor. In finding that Harvard's admissions process did not discriminate against Asian American applicants, the court issued a detailed opinion evaluating both parties' statistical analyses and trial testimony.

Although it found "both experts' approaches" were "defensible," Pet.App.198, the court ultimately found Dr. Card's model more persuasive and chose to "rely on" Dr. Card's model while rejecting Dr. Arcidiacono's, Pet.App.203. In particular, the court agreed with Dr. Card that ALDC applicants should be included in the applicant population and that each year of applicants should be considered separately. It reasoned that "excluding ALDCs distorts the analysis" because they are evaluated through the same admissions process as other applicants. Pet.App.170 n.43, 199-200. Similarly, the court concluded that Dr. Card's year-by-year analysis better reflected the realities of Harvard's admissions process; applicants in any given year are competing only against other applicants in that same year. Pet.App.201.⁷

⁷ The effect of these choices is significant. For example, even with all of Dr. Arcidiacono's other modeling choices, simply including ALDC applicants reduced the average marginal effect of Asian American identity on admissions outcome by 25%.

The court also made certain small modifications to Dr. Card's model. Most significantly, Dr. Card had included the personal rating in his model, and petitioner had argued that this introduced "included variable bias." Accordingly, the court considered two forms of Dr. Card's model, both "with and without the personal rating." Pet.App.199. It explained that, "although the Court believes that including the personal rating results in a more comprehensive analysis, models with and without the personal rating are econometrically reasonable and provide evidence that is probative of the effect of race on the admissions process." *Id.*⁸

With the personal ratings variable included, the model adopted by the district court showed no statistically significant evidence of discrimination against Asian American applicants. JA1803 (overall marginal effect of -0.08%). In fact, Dr. Card's model without modifications shows "a slight *positive* average marginal effect for Asian American identity in *three of the six admission cycles* that the experts analyzed." Pet.App.203 (emphases added).

CAJA2402:4-18. And the district court, of course, did not accept all of Dr. Arcidiacono's other modeling choices.

⁸ The court also added one feature of Dr. Arcidiacono's model to Dr. Card's: an interaction term between race and disadvantaged status. Pet.App.198-99.

Class	Average Marginal Effect of Asian-American Ethnicity (Percentage Points; Not Statistically Significant)
2014	-0.39
2015	-0.05
2016	0.09
2017	0.11
2018	-0.42
2019	0.34
Overall	-0.05

CAJA2883:24-2885:11, 6044.

Even without the personal ratings variable, “the lower probability of admission to Harvard that appears associated with Asian American identity is slight, with an average marginal effect of Asian American racial identity on admissions probability that is well below minus one percentage point.” Pet.App.203; *see* CAJA3149:9-3151:23; Card Report ¶ 152 & Ex. 21 (overall marginal effect of -0.34%). And that result is explained almost entirely by a single anomalous year: while one year in the model without personal ratings had a relatively strong correlation between Asian American identity and admission, the other five years showed no statistically significant correlation. *See* CAJA3150:1-3152:3, 5700, 5703; Card Report ¶¶ 147, 152-153 & Exs. 19, 21-22. The natural interpretation of that result would be that, according to the statistical evidence in Dr. Card’s model, there was no consistent evidence of bias for or against Asian American students, holding all other factors constant.

Taking into account both of these results, the court concluded that “statistical disparities between applicants from different racial groups on which SFFA’s case rests are not the result of any racial animus or conscious prejudice.” Pet.App.247.

D. The Court of Appeals' Affirmance

On appeal, petitioner argued that the district court erred in considering Dr. Card's regression model including the personal ratings variable. Petitioner did not challenge the district court's conclusion that Dr. Arcidiacono's admissions outcome models were unpersuasive due to his improper treatment of the population (by excluding ALDC applicants and pooling applicants across class years). Instead, petitioner focused its argument principally on the inclusion of the personal ratings, arguing that the district court's consideration of the model including them was clearly erroneous. *See* Pet.App.95; Br. of Appellant at 29-43, No. 19-2005 (1st Cir. Feb. 20, 2020).

The court of appeals affirmed. It concluded that the district court properly considered Dr. Card's model with personal ratings because "the model would suffer from omitted variable bias" without them. Pet.App.94. The court of appeals observed that "the statistical model using the personal rating showed no discrimination against Asian Americans." *Id.* It noted that excluding the personal ratings model yields a slightly negative overall effect with statistical significance, but only in one year out of six on a year-by-year basis. Pet.App.96. Accordingly, it found no clear error in the district court's factual conclusion that the statistical evidence did not suggest any conscious prejudice against Asian American applicants. Pet.App.98.

SUMMARY OF ARGUMENT

Based on our collective decades of training and experience in statistical methods, we are unanimous in our view that Dr. Card's analysis, as accepted by the district court, was credible and consistent with principles of statistical modeling. We are also unanimous in our view that petitioner's and its *amici*'s critiques of Dr. Card's analysis and the lower courts' reliance thereon are misplaced.

First, Dr. Card's decision to include personal ratings as a control variable was appropriate as a matter of sound statistical principles, and the lower courts properly concluded that excluding personal ratings likely leads to omitted variable bias. Petitioner's *amici*'s argument to the contrary is meritless, and it is misplaced in any event: even if personal ratings were excluded, the statistical evidence still would not support the position petitioner and its *amici* advocate.

Second, for related reasons, the assertion by petitioner's *amici* (at 21) that there is "compelling statistical evidence" making this case an "optimal vehicle" for the questions presented is incorrect. The statistical evidence accepted by the district court and affirmed by the court of appeals—namely, Dr. Card's analysis with minor modifications—does not support an assertion that Harvard discriminated against Asian American applicants.

Third, petitioner's *amici* argue that Dr. Card should have compared Asian American applicants to black and Hispanic applicants rather than white applicants. This argument not only contradicts the approach that *petitioner's* own expert took, but also is inconsistent with generally accepted practice among experts in this field.

ARGUMENT**I. THE LOWER COURTS PROPERLY CONSIDERED DR. CARD'S MODEL WITH THE PERSONAL RATINGS VARIABLE**

In the court of appeals, petitioner did not contest the district court's decision to adopt Dr. Card's model over Dr. Arcidiacono's. Rather, the sole dispute petitioner raised with respect to the district court's consideration of the regression analyses, as we understand it, was whether the district court erred in considering the version of Dr. Card's model that included the personal ratings variable (along with one that excluded it). The model that included the personal ratings showed no statistically significant effect of Asian American identity on admissions outcome when controlling for all other factors in the model. The district court credited and relied on that model. Pet.App.203; JA1803.

At least as a matter of statistical evidence, that finding of no statistically significant correlation supports the lower courts' conclusions and does not support petitioner's theory; in general terms, it means that the statistical evidence provides no credible basis to believe that Harvard's admissions decisions involved significant discrimination with respect to Asian American applicants (either in favor of or against). As a result, petitioner and its *amici* strain to argue that the personal rating should have been excluded. But Dr. Card's model including the personal rating, and the lower courts' acceptance of it, were sound as a matter of statistical principles. The arguments petitioner's *amici* now raise in opposition are meritless and misconstrue much of the statistical evidence. And, in any event, even if the personal rating was included as petitioner and its *amici* advocate, that still would not provide statistical evidence consistent with petitioner's narrative.

A. Inclusion of the Personal Ratings Variable Is Methodologically Justified

Dr. Card's decision to include the personal ratings variable was consistent with the fundamental empirical modeling principles described above. Harvard expressly considered personal ratings in evaluating applicants' qualifications, and they provide data that are not captured by any of the other variables in the model. Excluding that variable would therefore likely result in an overstatement of the effect of race in the admissions process as a result of omitted variable bias. Accordingly, as a matter of sound statistical principles, it was appropriate for Dr. Card to include the personal ratings variable in his model and for the lower courts to accept the model that included it. The district court appropriately concluded that this made Dr. Card's model that included the personal ratings variable the "more comprehensive analysis." Pet.App.199; *see* Pet.App.87.

Petitioner argues (at 73) that the data show a correlation between personal ratings and Asian American identity, and infers from the correlation that the personal rating must be the tool through which Harvard applies an "anti-Asian penalty." From that, petitioner's *amici* argue (at 24-25) that the personal rating should have been excluded from the model, because otherwise the model would incorrectly suggest there is no racial discrimination. As we noted above, however, an available explanatory variable should be excluded only when there is a compelling *a priori* explanation for excluding it, such as if it is clear that the proposed explanatory variable had no independent effect on the outcome and on the variable of interest, or if the values of the variable were assigned based on race. *See supra* p. 6. Justifying the inclusion

or exclusion of a variable based on *ex post* analyses of the data violates sound principles of modeling, because it allows the modeler to inject his or her own subjective or results-driven views, disguised as empirical decisions. *See id.*

Petitioner’s *amici* commit that error here. Neither Dr. Arcidiacono, nor petitioner, nor petitioner’s *amici* identify any *a priori* qualitative evidence suggesting that admissions officers consider an applicant’s race in assigning personal ratings. To the contrary, the district court repeatedly noted that Harvard’s admissions officers “credibly testified that they did not use race in assigning personal ratings (or any of the profile ratings) and did not observe any improper discrimination in the admissions process.” Pet.App.190. This “consistent, unambiguous, and convincing” testimony, Pet.App.264, is an appropriate *a priori* justification for *including* the personal ratings variable. There was no similarly compelling reason to *exclude* the variable. Rather, the only reason petitioner and its *amici* offer is that, upon an *ex post* review of the data, they believe race appears to have some influence on personal ratings. That is not a sufficient basis to exclude the personal rating as a matter of sound modeling principles; it is certainly not a sufficient basis to say that the lower courts clearly erred in considering it.⁹

⁹ Petitioner’s *amici* also argue at length (at 7-10) that the overall ratings should have been excluded for the same reason. That argument confuses the issue. Neither Dr. Arcidiacono nor Dr. Card used the overall ratings as an input to their regression analyses of admissions outcome, and there is no dispute that this was the right approach in this case. *See* Pet.App.195. The reason for excluding the overall ratings was sound: unlike with the personal rating, there was (as petitioner’s *amici* themselves acknowledge) a strong *a priori* reason to believe that race affected the overall ratings—namely, Harvard’s overt use of racial “tip[s]”

Moreover, Dr. Card’s and the lower courts’ inclusion of the personal ratings is affirmatively justified because excluding the personal ratings would have increased the risk of omitted variable bias. The record shows that the personal ratings score reflects data that bear on Harvard’s admissions decisions but is not reflected elsewhere. For example, personal ratings are assigned based in part on teacher and guidance counselor recommendation letters. Pet.App.191-92. And, in fact, teacher and guidance counselor letters help explain much of the racial disparities that petitioner and its *amici* point to in the personal ratings. *Id.* Petitioner’s *amici* are wrong as a matter of accepted modeling standards when they insist (at 27-29) that these data should have been excluded.¹⁰

Dr. Card’s model identified other relevant observable data as well. He used Dr. Arcidiacono’s “non-academic admissions index”—which summarizes an applicant’s strength across all non-academic factors—to show that Asian American applicants are less likely than white applicants to be in the top deciles of the index, again suggesting that white applicants may outperform Asian American applicants in non-

when assigning overall ratings. Pet.App.137-38, 196. Excluding the overall ratings was therefore an appropriate step in an analysis aimed at determining whether race influences admissions outcomes while holding all other relevant factors equal.

¹⁰ Petitioner’s *amici* argue (at 28) that, if the reason why white applicants receive stronger support letters from teachers and guidance counselors than do Asian American applicants is that the teachers and guidance counselors themselves were racially biased, that would be a reason to exclude the personal ratings from the model. But neither petitioner nor its *amici* have shown that any racial disparities in support letters are a result of racial bias (indeed, they do not appear to have even attempted to do so). To the contrary, the lower courts found no clear evidence of such racial bias. Pet.App.92 & n.41; Pet.App.193.

academic measures. CAJA2971:1-3, 3005:17-3010:18. Moreover, Dr. Arcidiacono's own regression models show that racial disparities in the personal ratings shrink as he adds more non-academic factors. CAJA2425:13-17. All of this evidence suggests that omitted variables, not racial bias, may explain the observed racial disparities in admissions. Here, because the observable data are correlated with race, it was reasonable for the district court to conclude that unobservable factors would likely be correlated with race as well—which implies that the effect of race on admissions was overstated without the personal ratings variable due to omitted variable bias.

Despite their protests, petitioner's *amici* cannot escape from the fact that excluding the personal ratings variable necessarily omits various dimensions that play a key role in Harvard's admissions decisions. No other variables could adequately control for the quality of personal essays, recommendation letters, and school support materials—among other missing data—even though Harvard considered these in the admissions process. Failing to include a significant explanatory variable like the personal ratings may cause race to be credited with an effect that is actually caused by the excluded variables. For this reason, the district court's consideration of Dr. Card's model that included the personal ratings variable does not conflict with statistical methods; in fact, it is in line with sound modeling principles.

B. Petitioner and Its *Amici* Misconstrue the Record in Attacking the Personal Rating

Petitioner and its *amici* offer other arguments against the personal ratings that misconstrue statistical evidence in various other ways. We offer a brief corrective to certain of those misstatements.

First, petitioner’s *amici* argue (at 26) that Dr. Arcidiacono’s regression model of the personal ratings showed “little risk” of omitted variable bias, so the lower courts should have accepted it instead of Dr. Card’s model. That is incorrect. The risk of omitted variable bias becomes obvious after examining Dr. Arcidiacono’s models for the “academic rating” and “extracurricular rating.” Those two models indicate that, holding all other factors in the models equal, Asian American applicants receive *higher* academic and extracurricular ratings—in other words, that there is discrimination *in favor* of Asian American applicants. CAJA2970:22-25, 2981:5-18. If accepted at face value, Dr. Arcidiacono’s models would indicate that Harvard discriminates against Asian American applicants on one subscore only to discriminate in favor on two others—a finding that he himself has acknowledged is not plausible. The more realistic explanation for these findings is that Dr. Arcidiacono’s regression models are simply not reliable enough to measure all the applicant qualities that determine Harvard’s assignment of these ratings—i.e., that they are subject to omitted variable bias. CAJA2979:4-2980:21, 2981:5-2984:2.¹¹ The assertion by petitioner’s *amici* that there was “little risk” of omitted variable bias in Dr. Arcidiacono’s analysis is counter to the statistical evidence. The lower courts did not err in rejecting that analysis.

¹¹ For example, an applicant’s essay and recommendation letters may indicate strengths that are captured in the academic and extracurricular scores, just as they may indicate weaknesses captured in other scores; in either case, any disparities cannot be attributed to bias because these strengths and weaknesses are not controlled for directly. Even Dr. Arcidiacono agrees that his findings of racial disparities in the academic and extracurricular ratings are attributable to missing, unobservable data, not racial bias. CAJA2447:21-2448:8.

Second, and relatedly, petitioner’s *amici* criticize (at 26-28) the lower courts for speculating about the reasons for racial disparities in observed school support ratings (which reflect the overall strength of teacher and guidance counselor recommendations, and in turn inform Harvard’s admissions decisions). *See also* Pet. Br. 35-36, 74. Even assuming any such speculation occurred (we do not purport to speak for the lower courts or say what conclusions were necessary to their holdings), this criticism by petitioner’s *amici* is misplaced. There are countless ways that race could be associated with a student’s high school achievements, personal essays, and recommendation letters, and many of them cannot be expressed as quantifiable variables. This is an example of “non-observable data,” and the statistical remedy to prevent non-observable data from biasing a model’s results is to include as much relevant observable data as possible. It is precisely because there are so many ways that omitted variables can reflect racial disparities that it is important not to compound the problem by omitting known, quantifiable variables like the personal ratings. The lower courts correctly observed that a model excluding personal ratings may not adequately account for those non-quantifiable aspects of applicants’ qualifications. Accordingly, contrary to the arguments by petitioner’s *amici*, this was yet another valid reason for the lower courts to embrace Dr. Card’s model rather than Dr. Arcidiacono’s.

Third, petitioner’s *amici* accuse the court of appeals (at 22) of “profound[ly] misunderstanding . . . the record,” because that court referred to Dr. Card’s model excluding the personal rating as “*Petitioner’s* preferred model.” This appears to be little more than a semantic game; we see no evidence of any misunderstanding of statistical principles. Petitioner

has argued throughout this litigation that the personal ratings variable should be excluded from the regression model. After the district court decided to rely on two models (the version of Dr. Card's model with the personal ratings variable, and the version without it), it was accurate to describe the version without the personal ratings variable as the one petitioner "preferred." We are not aware of any reason to believe that this naming shorthand led to any error with respect to the application of sound statistical principles in the court of appeals.

C. Excluding Personal Ratings Still Would Not Yield Statistical Evidence Supporting Petitioner's Theory

Dr. Card's inclusion of personal ratings in his model was appropriate, and the district court's consideration of that model including personal ratings was not clear error. But even if that were wrong, excluding personal ratings in the model still would not yield statistical evidence supporting petitioner's theory.

Petitioner's *amici* misconstrue the economic evidence. They insist (at 24) that Dr. Card's regression model excluding the personal ratings variable shows "significant" racial discrimination. That is a misuse of the relevant statistical concept. Dr. Card's model without personal ratings shows a *statistically* significant effect of Asian American identity, meaning an effect unlikely to be explained by random chance; but that effect is only "slightly negative" in terms of its magnitude. Contrary to petitioner's *amici*'s argument (at 23), the court of appeals correctly interpreted the result as showing a relatively small effect of Asian American identity, compared to substantially larger effects from other factors (for example, across all applicants, high school and neighborhood characteristics explained the admissions outcomes 30 times

better than race; intended major and intended career each did so five times better, CAJA3036:10-3037:22, 6107). And other analyses Dr. Card performed show that even this small effect may be illusory: it largely disappears if Dr. Arcidiacono's "race-disadvantage" interaction variable is removed. Pet.App.203; CAJA3150:1-3152:3.

Analyzing the data on a year-by-year basis, as Dr. Card did and as the district court endorsed, it becomes clear that the slightly negative overall effect from his model without personal ratings was driven by one highly statistically significant correlation in a single year. See CAJA3150:1-3152:3, 5700, 5703; Card Report ¶¶ 147, 152-153 & Exs. 19, 21-22. In other words, five out of six years of Harvard admissions data showed no statistically meaningful correlation between Asian American identity and admissions chances, even when excluding the personal rating as petitioner's *amici* advocate. To be sure, the remaining one year did show a statistically significant relationship. But we are not aware of any persuasive qualitative explanation for that result; petitioner has not, for example, argued that Harvard opted to discriminate against Asian American applicants in only one year out of six, nor articulated any reason why it would have done so. Accordingly, even if petitioner's *amici* were correct that the personal rating should be excluded, the statistical evidence still does not demonstrate that Harvard's admissions officers discriminated against Asian American applicants on even a remotely consistent basis. *Contra* Pet. Br. 72 (arguing that Harvard "has repeatedly penalized" Asian Americans).

II. PETITIONER'S *AMICI* MISSTATE THE MEANING OF THE STATISTICAL EVIDENCE IN THIS CASE

Petitioner's *amici* insist (at 21) that “the compelling statistical evidence of discrimination in the record makes this case an optimal vehicle” “to revisit the legality of racial discrimination in college admissions.” We express no view on the legal question at issue, but we are unanimous in our view that petitioner's *amici* sorely misstate the record.

As noted above, the statistical evidence accepted by the district court consisted of two modified versions of Dr. Card's model: one that included personal ratings and one that excluded it. And, as noted above, the former version found no statistically significant effect of Asian American identity at all (i.e., no statistical evidence of discrimination against Asian American applicants), while the latter found a statistically significant effect in just one year out of six. That is not “compelling statistical evidence of discrimination”; to the contrary, it is a noteworthy *absence* of statistical evidence of systematic discrimination in Harvard's admissions decisions on the basis of Asian American identity—even though one would expect to find such evidence if petitioner's theory were correct.

We express no view on whether non-statistical evidence might make this case an “optimal vehicle” for the legal question presented. But we disagree with petitioner's *amici* as to the statistical evidence; we do not see how a case in which the best statistical evidence suggests an *absence* of discrimination would be an “optimal vehicle” for addressing the legality of discrimination.

III. THE OTHER ARGUMENTS RAISED BY PETITIONER'S *AMICI* FAIL

Petitioner's *amici* also raise a pair of new arguments against Dr. Card's model. As we understand it, neither petitioner nor its *amici* raised those arguments in the district court or on appeal. In any event, these new arguments uniformly fail on their merits.

First, petitioner's *amici* contend (at 21) that the district court improperly focused on the comparison between Asian American applicants and white applicants, and instead should have compared Asian American applicants to those of other minority groups, particularly African Americans. That suggestion lacks merit as a matter of empirical analysis.

As an initial point, both Dr. Card and Dr. Arcidicono used white applicants as the reference group against which to compare Asian American applicants. CAJA2239:24-25, 2884:3-8. So, too, did the federal Office of Civil Rights analysis from the 1990s on which petitioner relies. CAJA4477; Pet. Br. 26-27. If petitioner's *amici* were correct, they would have a Pyrrhic victory, because petitioner would be left with no statistical evidence supporting its position either.

But petitioner's *amici* are not correct as a matter of economic principles. Dr. Card's (and Dr. Arcidicono's) decision to use non-minority (i.e., white) applicants as the reference group rather than using another minority group has strong justification. As a matter of empirical analysis, the best reference group to use is a majority group that is unlikely to experience the type of bias, positive or negative, for which a researcher is testing. At trial, Dr. Card justified his choice of white applicants as the reference group on this basis. CAJA2878:4-14. That is consistent with accepted practice among experts in this field: the

econometric literature reveals that studies of racial disparities almost always use whites as the reference group.¹² Dr. Card's (and Dr. Arcidiacono's) choice of reference group is consistent with this principle and well-established expert practice; *amici*'s contrary suggestion is not, and they notably cite no authority for their position.

Petitioner's *amici* are mistaken for the additional reason that their suggested approach would produce an estimate of the effects of Asian American identity with much lower statistical power than the results presented at trial. Statistical power refers to the likelihood that the model will detect a statistical relationship if in fact one exists. *See* Stock & Watson 115. Generally speaking, statistical power decreases when the size of the population of interest decreases; in simplified terms, this means the size of the statistical "error bars" forming a confidence interval around any point estimate will be larger when dealing with smaller samples. African American and Hispanic applicants each account for only about 10% of the domestic applicants to Harvard each year—approximately one-sixth of the size of the pool of white applicants. JA1820. Accordingly, adopting the approach

¹² *See, e.g.*, Peter Arcidiacono, *Affirmative Action in Higher Education: How Do Admission and Financial Aid Rules Affect Future Earnings?*, 73 *Econometric Soc'y* 1477, 1450 (2005); Thomas J. Espenshade et al., *Admission Preferences for Minority Students, Athletes, and Legacies at Elite Universities*, 85 *Soc. Sci. Q.* 1422, 1430 (2004); Kate Antonovics & Ben Backes, *The Effect of Banning Affirmative Action on College Admissions Policies and Student Quality*, 49 *J. Hum. Res.* 295, 311 (2014); Danny Yagan, *Supply vs. Demand under an Affirmative Action Ban: Estimates from UC Law Schools*, 137 *J. Pub. Econ.* 38, 45 (2016); Julie R. Posselt et al., *Metrics First, Diversity Later? Making the Short List and Getting Admitted to Physics PhD Programs*, 25 *J. Women & Minorities Sci. & Eng'g* 283, 297 (2019).

that petitioner’s *amici* now urge would increase the risk of generating confidence intervals so wide that it would be impossible to say as a matter of statistics whether there was any effect at all. That concern is particularly salient here given the hundreds of control variables used in the experts’ regression models in this case.

Finally, even if petitioner’s *amici* were correct on the statistical principles, neither they, nor petitioner, nor Dr. Arcidiacono have attempted to conduct a regression analysis in this way. Petitioner’s *amici* do not and cannot say what the result of such a regression analysis would be. Proper statistical analysis requires doing a statistical analysis; merely speculating about what the results of an analysis *might* show is no substitute.

Second, petitioner’s *amici* also argue (at 20) that race-based “tips” for African American and Hispanic applicants “significantly increase the[ir] chance of admission . . . and therefore necessarily decrease the chance of admission for whites and Asian Americans.” This argument falsely assumes that the strength of applicants in each applicant group has the same distribution. Simply comparing the average admissions rates of each racial group does not prove the effect of race on individual applicants’ chances of admission, especially given the significant variation in applicants’ qualifications within each group, CAJA2834:1-7—just as the earlier example of the average rate of this Court’s decisions to review paid and fee-waived cases does not represent any credible evidence of discrimination on the basis of the petitioners’ financial means.

Petitioner makes the same error in pointing to the differences in average admissions rates as evidence of racial discrimination, including in its reliance

on Dr. Arcidiacono's analysis of academic deciles. See Pet. Br. 23-24. The district court held that this analysis was inapt because it omitted other important explanatory variables, Pet.App.181, and even Dr. Arcidiacono admitted that its explanatory value was limited, CAJA2235:24-2236:14, 2346:16-2348:2. That is because a high-level analysis like this one fails to take into account relevant variables that can explain the real reasons for superficial disparities in the data, as the example of this Court's decisions to review cases showed. The need to control for other factors is precisely why regression analyses are important; petitioner's and its *amici's* speculation outside the context of a regression analysis, and therefore outside the context in which other variables are controlled for, has no meaningful import.

CONCLUSION

The lower courts did not clearly err in accepting Dr. Card's statistical analysis. The Court should affirm the lower courts' rulings with respect to the statistical evidence presented.

Respectfully submitted,

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APPENDIX

List of Amici Curiae

George A. Akerlof is a University Professor at the McCourt School of Public Policy at Georgetown University and the Daniel E. Koshland, Sr. Distinguished Professor Emeritus of Economics at the University of California, Berkeley; he was honored with the Nobel Prize in Economic Sciences in 2001 for his theory of asymmetric information and its effect on economic behavior. Professor Akerlof was educated at Yale and the Massachusetts Institute of Technology, where he received his Ph.D. in 1966, the same year he became an assistant professor at Berkeley. He became a full professor in 1978. He is also the 2006 President of the American Economic Association. He served earlier as vice president and member of the executive committee. He also has been on the North American Council of the Econometric Association. Professor Akerlof's research interests include sociology and economics, theory of unemployment, asymmetric information, staggered contract theory, money demand, labor market flows, theory of business cycles, economics of social customs, measurement of unemployment, and economics of discrimination.

Sandy Baum is a nonresident senior fellow for the Center on Education Data and Policy at the Urban Institute and professor emerita of economics at Skidmore College. Dr. Baum earned her B.A. in sociology at Bryn Mawr College, where she was a member of the Board of Trustees from 2012 to 2022, and her Ph.D. in economics at Columbia University. She has written and spoken extensively on issues relating to college access, college pricing, student aid policy, student debt, affordability, and other aspects of higher education finance. Dr. Baum co-authored the College Board's annual publications *Trends in Student Aid*

and *Trends in College Pricing* from 2002 to 2019. Through the College Board and the Brookings Institution, she has chaired major study groups that released proposals for reforming federal and state student aid. She has published numerous articles on higher education finance in professional journals, books, and the trade press. She is the principal researcher on the Urban Institute's website on college affordability. Her recent work includes Urban Institute briefs on Parent PLUS loans, college endowments, funding short-term certificate study, and strengthening the federal-state partnership in higher education. She is the author of *Student Debt: Rhetoric and Realities of Higher Education Financing* and co-author of *Making College Work: Pathways to Success for Disadvantaged Students* and *Can College Level the Playing Field: Higher Education in an Unequal Society*, as well as a forthcoming book, *Campus Economics: How Economic Thinking Can Help Improve College and University Decisions*.

Rebecca M. Blank is a professor at the Robert M. La Follette School of Public Affairs and the Department of Economics of University of Wisconsin-Madison. She served as the Chancellor of the University of Wisconsin-Madison from 2013 to 2022. An expert in social policy and poverty issues, she spent four years in top positions of the U.S. Department of Commerce prior to becoming Chancellor, including service as Commerce's Deputy Secretary and (for more than a year) as Acting Secretary. From 1999 to 2008, Professor Blank served as Dean and professor of public policy and economics in the Gerald R. Ford School of Public Policy at the University of Michigan. She was also a Fellow at the Brookings Institution, a Washington, D.C. think tank, before joining the Department of Commerce. She was a member of the faculty of

Northwestern University and Princeton University. From 1997 to 1999, she was a member of the President's Council of Economic Advisers. Professor Blank holds an undergraduate degree from the University of Minnesota and a doctoral degree from the Massachusetts Institute of Technology, both in economics.

Hilary Hoynes is Professor of Economics and Public Policy and holds the Haas Distinguished Chair of Economic Disparities at the University of California, Berkeley. She also directs the Berkeley Opportunity Lab. She is an economist who works on poverty, inequality, food and nutrition programs, and the impacts of government tax and transfer programs on low-income families. Her current work examines how access to the social safety net in early life affects children's later life health and human capital outcomes. Professor Hoynes is a member of the American Academy of Art and Sciences, the National Academy of Social Insurance, and a Fellow of the Society of Labor Economists. She has served as co-editor of the *American Economic Review* and the *American Economic Journal: Economic Policy*. She served on the National Academy of Sciences Committee on Building an Agenda to Reduce the Number of Children in Poverty by Half in 10 Years, the State of California Task Force on Lifting Children and Families Out of Poverty, and the Federal Commission on Evidence-Based Policy Making. She currently serves on California Governor Gavin Newsom's Council of Economic Advisors. In 2014, she received the Carolyn Shaw Bell Award from the Committee on the Status of the Economics Profession of the American Economic Association. Professor Hoynes received her Ph.D. in economics from Stanford University in 1992 and her undergraduate degree in economics and mathematics from Colby College in 1983.

Guido W. Imbens is the Applied Econometrics Professor and Professor of Economics at the Stanford Graduate School of Business (GSB). He does research in econometrics and statistics. His research focuses on developing methods for drawing causal inferences in observational studies, using matching, instrumental variables, and regression discontinuity designs. In 2021, Professor Imbens was honored with the Nobel Prize in Economic Sciences jointly with Joshua Angrist for their methodological contributions to the analysis of causal relationships. After graduating from Brown University, Professor Imbens taught at Harvard University, University of California, Los Angeles, and University of California, Berkeley. He joined the GSB in 2012. He is a fellow of the National Academy of Sciences, the Econometric Society, and the American Academy of Arts and Sciences. He earned his Ph.D. in economics from Brown University in 1991. He has an honorary doctorate from The University of St. Gallen and is a foreign member of the Royal Netherlands Academy of Sciences.

Kirabo Jackson is the Abraham Harris Professor of Education and Social Policy at Northwestern University Institute for Policy Research. He is a labor economist who studies education and social policy issues. Professor Jackson's scholarly articles have appeared in leading economics journals such as the *Quarterly Journal of Economics*, *American Economic Journal*, *Journal of Labor Economics*, *The Review of Economics and Statistics*, and *The Journal of Human Resources*. His work has been supported by the National Science Foundation, Spencer Foundation, Carnegie Corporation of New York, Smith Richardson Foundation, and other organizations. Professor Jackson serves as a co-editor at the *American Economic Journal: Economic*

Policy, and he was previously co-editor of *The Journal of Human Resources*. He previously served on the American Economic Association's committee on the status of minority groups in the economics profession and is a research associate at the National Bureau of Economic Research. In 2020, he received the David N. Kershaw Award from the Association for Public Policy Analysis & Management, which recognizes distinguished policy research contributions for scholars under 40. He is an elected member of the National Academy of Education. Professor Jackson earned his bachelor's degree in ethics, politics, and economics from Yale University in 1998 and his Ph.D. in economics from Harvard University in 2007. He was an assistant professor of labor economics at Cornell University between 2007 and 2010, and then moved to Northwestern University where he subsequently earned tenure in 2012.

Rucker Johnson is the Chancellor's Professor of Public Policy in the Goldman School of Public Policy at the University of California, Berkeley, and a faculty research associate at the National Bureau of Economic Research. As a labor economist who specializes in the economics of education, his work considers the role of poverty and inequality in affecting life chances. Professor Johnson was inducted as the Sir Arthur Lewis Fellow of the American Academy of Political and Social Science, inducted as a member of the American Academy of Arts & Sciences, the National Academy of Education, and received the 2017 Andrew Carnegie Fellowship. His research has appeared in leading academic journals, featured in mainstream media outlets, and he has been invited to give policy briefings at the White House and on Capitol Hill. He is the author of the book *Children of the Dream: Why*

School Integration Works. He is committed to advance his scholarly agenda of fusing insights from multiple disciplinary perspectives to improve our understanding of the causes, consequences, and remedies of inequality in this country. Professor Johnson earned his Ph.D. in economics at the University of Michigan. At University of California Berkeley, he teaches graduate and undergraduate courses in applied econometrics and topical courses in race, poverty & inequality.

Helen F. Ladd is the Susan B. King Professor Emerita of Public Policy and Economics at Duke University's Sanford School of Public Policy. Her education research focuses on school finance and accountability, teacher labor markets, school choice, and early childhood programs. With colleagues at Duke University and UNC, she has used rich longitudinal administrative data from North Carolina to study school segregation, teacher labor markets, teacher quality, charter schools, and early childhood programs. With her husband, Edward Fiske, she has written books and articles on education reform efforts in New Zealand, South Africa, the Netherlands, and England. Prior to 1986, she taught at Dartmouth College, Wellesley College, and Harvard University, first in the City and Regional Planning Program and then in the Kennedy School of Government. She graduated with a B.A. degree from Wellesley College in 1967, received a master's degree from the London School of Economics in 1968, and earned her Ph.D. in economics from Harvard University in 1974. She is a member of the National Academy of Education.

David S. Lee is Chemical Bank Chairman's Professor of Economics and Public Affairs at Princeton University. He has research interests in labor economics and econometrics. He has worked on issues of inequality

in the labor market, and has also worked on the analysis of elections, and how they can be used in quasi-experimental empirical analysis of the impacts of unions in the labor market, and policy convergence in Congress. Professor Lee is continuing his work on various labor market issues as well as on econometric methodologies appropriate for analyzing experiments and quasi-experiments. He received his Ph.D. from Princeton and has previously held appointments in economics departments at Harvard, Berkeley, and Columbia.

Trevon D. Logan is the Hazel C. Youngberg Trustees Distinguished Professor of Economics and Associate Dean of the College of Arts and Sciences at The Ohio State University. He was formerly the inaugural North Hall Chair of Economics at the University of California, Santa Barbara. He specializes in economic history and economic demography. He also does work that intersects with health economics, applied econometrics, applied microeconomics, and sociology. He is the author of *Economics, Sexuality, and Male Sex Work*, from Cambridge University Press. He graduated with a B.S. degree in economics from the University of Wisconsin-Madison with honors in 1999, received master's degrees in economics and demography from the University of California, Berkeley in 2003. He earned his Ph.D. in economics from the University of California, Berkeley in 2004. He is also a Research Associate at the National Bureau of Economic Research.

Michael McPherson is president emeritus of the Spencer Foundation. He held the position of president from 2003 to 2017. He is a nationally known economist whose expertise focuses on the interplay between education and economics. He was previously president

of Macalester College (1996-2003) and spent the 22 years prior to assuming the Macalester presidency as professor of economics, chairman of the economics department, and dean of faculty at Williams College. He has co-authored and edited several books, including *Lesson Plan: An Agenda for Change in American Higher Education*, *Crossing the Finish Line: Completing College at America's Public Universities*, *Keeping College Affordable*, and *Economic Analysis and Moral Philosophy*, and was the co-founder and co-editor of *Economics and Philosophy*. He has served as a trustee of the College Board, the American Council on Education, and Wesleyan University. He was a fellow of the Institute for Advanced Study and a senior fellow at the Brookings Institution. He is currently President of the Board of Overseers of TIAA-CREF. He holds a B.A. in mathematics, an M.A. in economics, and a Ph.D. in economics, all from the University of Chicago.

Jesse Rothstein is a Professor of Public Policy and Economics, the Director of Institute for Research on Labor and Employment, and the Director of California Policy Lab at the University of California, Berkeley. His research focuses on education and tax policy, and particularly on the way that public institutions ameliorate or reinforce the effects of children's families on their academic and economic outcomes. Within education, he has conducted studies on teacher evaluation; on the value of school infrastructure spending; on affirmative action in college and graduate school admissions; and on the causes and consequences of racial segregation. He has also written about the effects of unemployment insurance on job search and labor force participation; the role of structural factors in impeding recovery from the Great Recession; and the incidence of the Earned Income Tax Credit. His

work has been published in the *American Economic Review*, the *Quarterly Journal of Economics*, the *Journal of Public Economics*, the *Chicago Law Review*, and the *American Economic Journal: Economic Policy*, among other outlets. He has a Ph.D. in economics from the University of California, Berkeley, and an MPP from the Goldman School, and he is a Research Associate at the National Bureau of Economic Research. In 2009-10, he served as a Senior Economist for the Council of Economic Advisers and then as Chief Economist at the U.S. Department of Labor.

Robert M. Solow is an American economist who was awarded the 1987 Nobel Prize in Economic Sciences for his important contributions to theories of economic growth. He received a B.A. (1947), an M.A. (1949), and a Ph.D. (1951) from Harvard University. He began teaching economics at the Massachusetts Institute of Technology (MIT) in 1949, becoming professor of economics there in 1958 and professor emeritus in 1995. He also served on the Council of Economic Advisers in 1961-62 and was a consultant to that body from 1962 to 1968. In the 1950s, Dr. Solow developed a mathematical model illustrating how various factors can contribute to sustained national economic growth. Contrary to traditional economic thinking, he showed that advances in the rate of technological progress do more to boost economic growth than do capital accumulation and labour increases. In his 1957 article “Technical Change and the Aggregate Production Function,” Dr. Solow observed that about half of economic growth cannot be accounted for by increases in capital and labor. He attributed this unaccounted-for portion—now called the “Solow residual”—to technological innovation. From the 1960s on, Dr. Solow’s

studies helped persuade governments to channel their funds into technological research and development to spur economic growth. A Keynesian, Solow was a witty critic of economists ranging from interventionists such as John Kenneth Galbraith to free marketers such as Milton Friedman. He was awarded the National Medal of Science in 1999, and the Presidential Medal of Freedom in 2015.

Sarah Turner is a University Professor and the Souder Family Professor at the University of Virginia and a research associate with the National Bureau of Economic Research. Her research focuses on the economics of the education market, with particular attention to higher education. Recent work focuses on the economics of college choice and how federal financial aid affects students' collegiate attainment. Her research also examines scientific labor markets and the flow of foreign students to colleges and universities in the United States. Her research has appeared in scholarly journals such as the *Journal of Labor Economics*, the *Journal of Human Resources, Science*, the *Journal of Public Economics*, *American Economic Journal: Applied Economics*, and the *Economics of Education Review*. She received her B.A. from Princeton University and her Ph.D. in economics from the University of Michigan.

Ebonya Washington is the Laurans A. and Arlene Mendelson Professor of Economics and a professor of international and public affairs at Columbia University. She was formerly the Samuel C. Park Jr. Professor of Economics at Yale University. She received her Ph.D. in economics at Massachusetts Institute of Technology in 2003. She specializes in public finance and political economy with research interests in the

interplay of race, gender, and political representation; the behavioral motivations and consequences of political participation; and the processes through which low-income Americans meet their financial needs. Her work has appeared in the *American Economic Review* and the *Quarterly Journal of Economics*. Professor Washington serves as Faculty Fellow at Yale University Institution for Social and Policy Studies.

Douglas Webber is a co-editor at *Economics of Education Review* and a Research Fellow at the Institute for Labor Economics. He has published on a wide variety of topics in the fields of labor economics and the economics of higher education, including: earnings inequality, expenditures in higher education, the gender pay gap, the economic returns to college major, and student loan debt. His research has appeared in scholarly journals such as the *Journal of Labor Economics*, the *Journal of Human Resources*, *Labour Economics*, the *Journal of Policy Analysis and Management*, and the *Economics of Education Review*, as well as popular press outlets such as the *New York Times* and the *Chronicle of Higher Education*. He has testified in front of both the U.S. Senate and U.S. House of Representatives on the topic of student loan policy and higher education finance. Dr. Webber holds Bachelor's degrees in economics and mathematics from the University of Florida, as well as master's and Ph.D. degrees in economics from Cornell University.