IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF MASSACHUSETTS
BOSTON DIVISION

STUDENTS FOR FAIR ADMISSIONS, INC.,

Plaintiff,

v.

PRESIDENT AND FELLOWS OF HARVARD COLLEGE (HARVARD CORPORATION),

Defendant.

Civil Action No. 1:14-cv-14176-ADB

Leave To File Granted On September 6, 2018

AMENDED BRIEF OF PROFESSORS OF ECONOMICS AS *AMICI CURIAE* IN SUPPORT OF DEFENDANT

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INTEREST OF *AMICI CURIAE* [1]

Amici — Professor George A. Akerlof, Professor Susan Dynarski, Professor Harry Holzer, Professor Hilary Hoynes, Professor Guido W. Imbens, Professor Alan B. Krueger, Professor Helen F. Ladd, Professor David S. Lee, Professor Trevon D. Logan, Professor Alexandre Mas, Professor Michael McPherson, Professor Jesse Rothstein, Professor Cecilia Rouse, Professor Robert M. Solow, Professor Lowell J. Taylor, Professor Sarah Turner, Professor Douglas Webber, and Professor Janet L. Yellen — are leading economists and statisticians who regularly use and teach statistical analytical methods, including those used by Plaintiff's expert, Dr. Peter S. Arcidiacono, and Defendant's expert, Dr. David Card, in this case. *Amici* include, among others, two Nobel laureates, the former chair of the Federal Reserve's Board of Governors, four former Chief Economists of federal agencies, current and former university administrators, 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. However, they share the view 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 his modeling approach in the Brief of Economists as *Amici Curiae* in Support of Plaintiff, Dkt. 450 ("Plaintiff's *Amici* Br."), are not based on sound statistical principles or practices. Biographies of *amici* are summarized in Appendix A to this brief.

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[1] Counsel for *amici curiae* state that (1) this brief was written by counsel for *amici curiae* and not by counsel for any party, in whole or in part; (2) no party or counsel for any party contributed money that was intended to fund preparing or submitting the brief; and (3) apart from *amici curiae* and their counsel, no person contributed money that was intended to fund preparing or submitting the brief. By Order dated July 24, 2018 (Dkt. 432), this Court granted *amici curiae* leave to file this brief.

SUMMARY OF ARGUMENT

Plaintiff's expert, Dr. Peter S. Arcidiacono, and Defendant's expert, Dr. David Card, both apply regression analysis as a statistical method to examine whether there is evidence of racial bias in Harvard's admissions process. Plaintiff's *amici* criticize Dr. Card for certain decisions he made in designing his regression model. Based on their collective decades of training and experience in statistical methods, *amici* are unanimous in their view that the criticisms by Plaintiff's *amici* are unfounded and that Dr. Card's model relies on reasonable and accepted statistical methods.

Plaintiff's *amici* offer three principal criticisms of Dr. Card's statistical modeling approach: (1) he did not carve out from the population so-called ALDC applicants (athletes recruited by Harvard's athletic teams, Harvard alumni's children, applicants on a Dean's or Director's Interest List, and faculty/staff's children); (2) he did not exclude applicants' personal ratings as a control variable; and (3) he did not include a race-disadvantaged status interaction variable. These criticisms do not undermine the reliability of Dr. Card's analysis, for two reasons. First, Dr. Card's selection of the population and control variables was in accordance with accepted principles of statistical analysis. If ALDC applicants competed for admission within the same applicant pool as other applicants in a given year — which Dr. Card noted that they did[2] — then it would be well-justified to include them in the population under study. It is appropriate to include personal ratings as a control variable unless there is any persuasive reason to exclude them — none of which Dr. Card found after considering and rejecting the reasons

[2] Other record evidence supports Dr. Card's observation. *See*, *e.g.*, Declaration of Robin Worth ¶ 6, Dkt. 438-52 (sworn statement by Harvard admissions officer that "Harvard has no separate admissions track for any category of applicants. All applicants compete against each other for admission in the same admissions process.").

proposed by Dr. Arcidiacono — because they were part of Harvard's evaluation of each applicant's qualitative, non-academic characteristics. And it was appropriate to exclude a race-disadvantaged status interaction variable because there was no persuasive reason to include it. Second, and equally importantly, even if Plaintiff's *amici*'s criticisms were methodologically well-founded (which they are not), Dr. Card performed alternative statistical analyses that demonstrated that none of the changes Plaintiff's *amici* claim he should have made would have changed his findings. For example, Dr. Card's substantive conclusions remain generally unchanged even if the personal ratings are excluded from his regression model. These alternative analyses — which Plaintiff's *amici* ignore — demonstrate that the methodological criticisms offered by Plaintiff's *amici* are not only unpersuasive but also immaterial.

BACKGROUND

I. Basic Principles Of Regression Analysis

Regression analysis is a statistical tool that statisticians, economists, and many other researchers use to examine relationships between multiple variables. In general terms, regression analysis can show the association between any included variable and an outcome when holding all other included variables constant.

A well-designed statistical model should reflect as closely as practical the population of interest, and the outcome and control variables should depend on the question being investigated. In this case, admission to Harvard is the outcome variable of interest. To test whether racial discrimination exists, in addition to the race indicators, the control variables that are included in the regression model should be those that raise or lower the likelihood of admission, but are not themselves influenced by the alleged discrimination.

To illustrate these principles, consider, for example, a car dealership that wishes to do an analysis of factors impacting the number of sales the dealership makes per month, including the

effectiveness of monthly sales promotions it offers. The population in this model should be all car sales made in a given time period. That population would include, for example, both financed and cash purchases, because the dealership employs one marketing process regardless of whether a buyer intends to finance their purchase. Similarly, if the same sales promotions apply to retail and enterprise purchases, then both types of purchases would naturally be included in the population for the model, even though those transaction types may have substantially different profiles.

After identifying the relevant population, the expert must then identify the variables that are related to the variable of interest and are expected to correlate with the outcome. By controlling for these variables, the regression model will remove from the raw correlation between the variable of interest and the outcome the part of that correlation attributable to the control variables. Returning to the car dealership, for instance, the analysis should include as a variable which promotion the dealership was offering during the month, if any, because the dealership wishes to learn how effective its promotions are and because they can reasonably be expected to affect sales. But the model should also include other variables that can also influence the dealership's sales and the decision to offer the promotions. As an example, these variables could include measures of the strength of the economy in the local area each month, such as unemployment rates, as more people may be willing and able to buy cars when the economy is doing well (and the dealership may be less inclined to offer promotions at that time). Similarly, the model could include whether competitors are offering promotions, as those could lead the dealership to offer promotions of its own to keep up and could lessen the effectiveness of the dealership's promotions by drawing away potential customers.

Failing to include a significant explanatory variable that correlates with the outcome and is related to the variable of interest will lead to misleading inferences from the data. For example, in the car sales illustration, suppose that the model failed to include variables measuring the local economy, such as the unemployment rate. A regression model might show that promotions actually had a negative impact on car sales but, in reality, both the decline in sales and the dealership's decision to hold a promotion were caused by increases in the local unemployment rate. In this example, the model's results would be misleading due to the omitted variable, which provides at least a portion of the actual explanation for why sales declined. This statistical problem is known as "omitted variable bias."

In evaluating a regression analysis, two additional principles help guard against biased estimation. *First*, would a researcher accept the arguments underlying the regression specification (i.e., selection of variables) without having seen the results first? 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 sound and principled prior decision. In the car dealership example, excluding cash purchases from the population because they show much less variation on a month-to-month basis than financed purchases may be such an *ex post* rationalization; there is no *a priori* reason to take this approach, and it becomes evident only after looking at the data. *Second*, are the arguments about methodology applied consistently to all aspects of the data? Again in the dealership example, if one strongly believes in controlling for the extent to which other competitors are advertising, it would be unclear why one would include control variables for competitors' radio ads but ignore their television ads, absent some compelling *a priori* explanation for treating these two forms of advertising differently. A well-designed regression analysis should satisfy both of these principles.

II. The Experts' Regression Analyses In This Litigation

Plaintiff claims that Harvard's undergraduate admissions decisions exhibit bias against Asian American applicants. Plaintiff's expert, Dr. Arcidiacono, concluded that there is statistical evidence in support of Plaintiff's claims. Harvard asked Dr. Card to assess whether Dr. Arcidiacono's statistical analyses are reliable. Based on his review of the record on Harvard's admissions process and his analyses of admissions data, Dr. Card concluded that they are not. Dr. Card concluded that Dr. Arcidiacono's regression models mistakenly focused on applicants' GPAs and ACT/SAT scores ("academic factors") to the exclusion of other pertinent information about applicants — for example, four of Dr. Arcidiacono's models did not include applicants' subscores for extracurricular, personal, and athletic factors. *See* Report of David Card, Dkt. 419-33 at 7, ¶¶ 12-13 ("Card Rep."). Given the abundant number of applicants with stellar academic records in Harvard's applicant pool, Harvard sought to admit students who exhibit excellence in a variety of forms — both academic and non-academic. *See id.* at 6-7, 16-23, ¶¶ 11, 33-44. By excluding information about applicants' non-academic achievements, such as the "personal ratings" and other non-academic variables, Dr. Arcidiacono chose to largely disregard the differences in applicants' life experiences, backgrounds, skills, and career interests, all of which Harvard considered in making admissions decisions. *See id.* at 7-8, 40-45, ¶¶ 13-16, 79-90.

In his own analysis, Dr. Card found no statistically significant evidence supporting the conclusion that Harvard's admissions process was biased against Asian American applicants. Through his own regression models, Dr. Card analyzed the difference in admissions rates between Asian American applicants and others if all other observed factors included in the regression model were equal. Dr. Card controlled not only for applicants' academic, extracurricular, and athletic qualities (factors for which both Dr. Card and Dr. Arcidiacono controlled) but also for contextual information such as the quality of applicants' high school and neighborhood and their

family background (factors for which Dr. Arcidiacono failed to control adequately), among other things. *See id.* at 46-50, ¶¶ 95-100 & Ex. 14. Dr. Card's analysis showed that these non-academic factors accounted for the racial disparities in admissions rates that Dr. Arcidiacono attributed to bias against Asian American applicants. *See id.* at 62-72, ¶¶ 128-153. Due to the complexity of Harvard's admissions process, Dr. Card could not control for *all* non-academic factors that Harvard considered. *See id.* at 8-9, ¶ 18. Some factors were not individually quantified in Harvard's database, such as the content of an applicant's personal essay and recommendation letters. Dr. Card thus noted that these missing data, not the alleged bias against Asian American applicants, likely explain any remaining racial disparities. *See id.* at 70-71, ¶¶ 147-148.

Plaintiff's *amici* subsequently filed a brief in support of Plaintiff's motion for summary judgment, in which they criticized Dr. Card's methodology. *Amici* here respond to those criticisms.

ARGUMENT

I. THE CRITICISMS OF DR. CARD'S DEFINITION OF THE POPULATION OF INTEREST ARE UNFOUNDED

Dr. Card's statistical model defined the population of interest to include all applicants who competed for admission in a given year through the same evaluation process. As discussed above, in conducting a regression analysis, absent any strong *a priori* reason to treat certain subgroups differently, the most natural, relevant, and transparent population to analyze is all of the applicants affected within the same admissions cycle. Harvard is choosing a single undergraduate class of students, one year at a time. Plaintiff's *amici* criticize Dr. Card's analyses as unreliable on the grounds (at 3 n.2) that Dr. Card did not "pool" applicants across different admissions cycles and (at 16-18) that he did not exclude from the population a specific

subset of applicants. For the reasons explained below, those criticisms are *ad hoc* and do not follow from a modeling approach that seeks to be transparent or representative.

A. Dr. Card's Decision Not To "Pool" Applicants Across Six Years Has Strong Justification

It was well-justified not to "pool" applicants across multiple years because Harvard runs its admissions process on an annual cycle with a new committee deciding admissions each year (meaning the standards for scores and ratings may shift from year to year), the features of the applicant pool may change from year to year, and admissions decisions in one year are independent of those in others. *See* Card Rep. at 51, ¶ 103. An applicant for the class of 2017 does not compete for admission with an applicant for the class of 2011. To take one example of these considerations, Harvard has seen an increase over time in the number of applicants interested in pursuing computer science; if Harvard wished to maintain a roughly constant proportion of students in each field, then it would be "harder" for an applicant interested in computer science to gain admission in 2017 than in 2011, holding all else equal. *See id.* at 52-53, ¶ 105 & Ex. 15. Dr. Card's decision not to pool applicant data across years in the way Dr. Arcidiacono did was scientifically sound and supported by strong *a priori* justifications.[3]

[3] Dr. Arcidiacono's original report did not provide an explanation for his decision to pool data across years. In his rebuttal report, Dr. Arcidiacono advanced two arguments, both of which are scientifically unsound. *First*, he argued that not "all" applicants within each year are compared to one another, such as the plainly unfit candidates whose applicants are rejected without a second review. *See* Rebuttal Expert Report of Peter S. Arcidiacono at 34, Dkt. 415-2 ("Arcidiacono Rebuttal Rep."). But that is a red herring. The fact that some applicants are rejected out of hand does not mean that applicants are ever compared across multiple years. Dr. Arcidiacono's model does not reflect the independence of the admissions committee's decisions from different years. *Second*, he argued that the larger population size in the pooled model gives it more statistical power. *Id.* at 34-35. But Dr. Card demonstrated that his year-by-year analysis and averaging yearly results across six admissions cycles actually has greater statistical power than Dr. Arcidiacono's pooled approach. *See* Rebuttal Report of David Card at 44-45, ¶ 82 & Ex. 10, Dkt. 419-37 ("Card Rebuttal Rep."). In fact, Dr. Card's preferred year-by-year analysis found that the effect of Asian American ethnicity was not statistically significant in any one year

B. Dr. Card's Decision To Include In His Analyses All Applicants Who Competed For Admission In A Given Year Was Well-Founded

As discussed above, it is appropriate to include all applicants who were subject to the admissions process in order to measure the impact of a particular variable (here, race) on admissions decisions. Plaintiff's *amici* argue (at 16-18) that Dr. Card's inclusion of ALDC applicants was inappropriate because they are admitted at higher rates than other applicants.[4] But that is not a valid basis for excluding these applicants, and Plaintiff's *amici*'s reliance on features observed from the data raises questions as to whether there was a valid *a priori* rationale for this exclusion.

To answer the question, "Considering all applicants to Harvard and controlling for other factors we observe that are important for admissions decisions, are there significant differences in admissions rates between different demographic groups?," the analysis should include all applicants. Importantly, that is a different question from, "*Setting aside certain select subgroups of applicants to Harvard* and controlling for other factors we observe that are important for admissions decisions, are there significant differences in admissions rates between different demographic groups?" For this latter question, it would be natural to exclude those select subgroups from the analysis; but that does not appear to be the question at issue here. Because Harvard takes into account more criteria than just narrow measures of academic achievement in its admissions process, it is inappropriate to systematically exclude from the analysis groups of

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or across all six on average, and that in four of six years the effect of Asian American ethnicity was *positive* (i.e., correlated with higher chances of admission). *See* Card Rep. at 8, ¶ 17.

[4] Among other things, Plaintiff's *amici* cite (at 18) the "Chow test" and argue that Dr. Card fails to meet the Chow test's burdens. This is a *non sequitur*. The Chow test can be used to evaluate whether variables affect two sub-populations in a single model differently, but it is not a prerequisite for determining whether to include both sub-populations in a model in the first place.

applicants who have outstanding non-academic attributes in addition to their academic achievements (i.e., ALDC applicants).

It is notable that, in at least one of his prior studies, Dr. Arcidiacono took the same approach as Dr. Card — namely, including special category applicants like legacies — when statistically analyzing racial preferences in college admissions process.[5] Dr. Arcidiacono does not explain why he departed from his prior methodology in this case, and the departure is important here because the exclusion of ALDC applicants was material to Dr. Arcidiacono's conclusion that Harvard's admissions process exhibited racial disparities. *See* Expert Report of Peter S. Arcidiacono at 21-22, 61, Dkt. 415-1 ("Arcidiacono Rep.").

C. Plaintiff's *Amici* Ignore Dr. Card's Alternative Analyses, Which Show That Dr. Arcidiacono's Criticisms Do Not Affect His Conclusions

It is important to highlight that Dr. Card performed a sensitivity analysis to examine whether his findings meaningfully change if the admissions data are pooled across the years. Dr. Card found no meaningful differences. *See* Card Rep. at 48 n.84. He also completed a sensitivity analysis showing that his findings do not change even if his models allowed race to have a different effect for the ALDC applicants, compared to the rest of the applicant pool. *See* Card Rebuttal Rep. at 55-56, ¶ 107 & Ex. 14. Dr. Arcidiacono himself acknowledges that adding an interaction variable between race and the ALDC status would resolve his concerns relating to the inclusion of the ALDC students in the population. *See* Arcidiacono Rebuttal Rep. at 36. These alternative analyses — which Plaintiff's *amici* ignore — demonstrate that Plaintiff's

[5] *See* Peter Arcidiacono *et al.*, *Representation Versus Assimilation: How Do Preferences in College Admissions Affect Social Interactions?*, 95 J. Pub. Econ. 1, 5 & n.19 (2011) (analyzing racial preferences in the undergraduate admissions process), *available at* https://www.sciencedirect.com/science/article/abs/pii/S0047272710001465.

amici's criticisms of Dr. Card's treatment of the population not only lack merit but also are immaterial.

II. THE CRITICISMS OF DR. CARD'S SELECTION OF VARIABLES ARE UNFOUNDED

Dr. Card's selection of the control variables for regression models was well-founded given the undisputed facts regarding Harvard's admissions process. Plaintiff's *amici* criticize (at 3-13) Dr. Card's decision to include the "personal ratings" as a control variable and his decision not to add an interaction variable between race and disadvantaged status. Their criticisms again lack merit, because the personal ratings were a critical non-academic factor that Harvard considered in evaluating an applicant's qualifications and were not captured by any of the other variables in the model. Dr. Arcidiacono offered no persuasive reason for excluding the variable from regression models. His claim that the personal ratings were tainted with racial bias lacks credible evidence to support it. Likewise, there was no compelling reason for adding an interaction variable to allow the effect of disadvantaged status to vary on the basis of race.

A. Dr. Card's Decision To Include The Personal Ratings Has Strong Justifications

The most transparent approach to the regression analysis would be to include all variables that are known to be used in the actual decision-making process, as long as they are not tainted by discrimination. The failure to include appropriate explanatory variables may produce unreliable results. In particular, failure to control for real factors that Harvard considered in making admissions decisions and that are correlated with race, such as non-academic skills, would lead to unreliable estimates about the effects of race in the admissions process. 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 on the basis of race. For example, while Harvard's admissions database may include a street number for every applicant's address, there is clearly no relationship between the street number and admissions (all else equal, an applicant living at house number 101 would not have any better or worse odds than an applicant living at house number 999), so it makes sense not to include the street number as a variable in the regression model.[6] There is no compelling evidence here that the personal ratings were assigned on the basis of race, and thus no compelling reason to exclude them from the model.

Dr. Card's modeling was consistent with these fundamental modeling principles. Dr. Card included in his regression models all measurable factors that Harvard actually considered and recorded in its database, except one (described below). By including this broad range of variables, Dr. Card's model incorporates information that Harvard considered in making admissions decisions, such as personal essays and recommendation letters.

The one factor Dr. Card excluded was Harvard's "overall ratings" for its applicants, and he provided a compelling reason to exclude the overall ratings. As Dr. Card noted, among many numerical ratings Harvard assigned to applicants, the record suggests that admissions officers may consider race in assigning applicants' "overall ratings." Card Rep. at 10, ¶ 21. For example, the overall ratings for African American applications tended to "reflect the contribution they would make to the racial diversity of the student body." *Id.* at 73, ¶ 154. Given that evidence, it was appropriate to exclude overall ratings from the model.

There was no similarly compelling reason to exclude personal ratings. Dr. Arcidiacono did not identify any *a priori* qualitative evidence that admissions officers consider an applicant's

[6] This is not to say that information about an applicant's *location* should be excluded; rather, the applicant's address may well convey relevant information about the applicant, such as whether they live in an urban or rural area.

race in assigning personal ratings. And based on his review of the record on Harvard's admissions process, deposition testimony, and admissions data, Dr. Card found that the personal ratings incorporated critical data on an applicant's non-academic qualities that were not captured by any other factors. *See id.* at 9-10, ¶ 21. Those personal qualities included, among other things, an applicant's "economic resources and family hardship, personal essays and interviews, artistic qualities, maturity and ability to balance multiple commitments, and the degree of parental involvement." *Id.* at 20, ¶ 40. These factors are often referred to in the economics literature as "non-cognitive factors," and they are inherently hard to quantify. To measure them, Harvard employed a "labor intensive," "rigorous comparative process." *Id.* at 25, ¶ 50. The personal ratings were the numerical output of that process. Thus, Dr. Card's decision not to disregard those ratings had strong *a priori* justifications.

In contrast to Dr. Card's inclusive approach, Dr. Arcidiacono excluded the personal ratings based on the assertion that they are tainted with Harvard's bias against Asian American applicants. *See* Arcidiacono Rep. at 55. However, Dr. Arcidiacono has not offered any persuasive evidence that is capable of showing reliably that the racial disparities found in the personal ratings are the result of racial bias.

Dr. Arcidiacono's regression model omits the important factors that are captured by the personal ratings. His model included no adequate control variables regarding the content of personal essays and recommendation letters, among other missing data, even though these were considered by Harvard in the admissions process. *See* Card Rebuttal Rep. at 4-5, 21 ¶¶ 7, 40. As a result, his model ignored the differences in what applicants wrote in their personal essays and what other people wrote about them. If the content of such recommendation letters or other materials was tainted by racial bias, one could argue that the personal ratings should be excluded

on that basis, but no compelling evidence of such bias has been presented here. Failing to include a significant explanatory variable like the personal ratings may cause race to be credited with an effect that actually is caused by the excluded variable. Because they omit the important personal ratings variable, Dr. Arcidiacono's regression models and findings may well suffer from this defect. Indeed, by excluding the personal ratings variable, Dr. Arcidiacono's models rely on an unsupported, implicit assertion that key admissions factors such as essays and recommendation letters, which are not otherwise captured in his models, are not legitimately considered in an admissions process.

The flaws in Dr. Arcidiacono's models are also evident from his regression models for the "academic rating" and "extracurricular rating." Those 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 a bias *in favor* of Asian American applicants. *See* Card Rep. at 71, ¶ 149. Dr. Arcidiacono's findings are implausible, because they would indicate that Harvard discriminates against Asian American applicants on one subscore only to turn around and discriminate in their favor on two others. The better and more plausible explanation of these findings is that Dr. Arcidiacono's regression models are simply not reliable enough to measure all the applicant qualities that drive Harvard's assignment of these ratings. *See id.* at 9, ¶ 20. 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 the personal scores; in either case, any disparities cannot be attributed to bias because these strengths and weaknesses are not controlled for directly. Dr. Arcidiacono agrees that his findings of racial disparities in the academic and extracurricular ratings are

attributable to missing, unobservable data, not to a racial bias. *See* Arcidiacono Rebuttal Rep. at 25-26; Card Rebuttal Rep. at 5, 22, ¶¶ 8, 42.

Plaintiff's *amici* argue (at 12-13) that "[i]t makes sense to infer that missing data may explain the gap *favoring* Asian Americans in the academic and extracurricular rating scores relative to their test scores, because Asian Americans objectively outperform all other applicants in academic and extracurricular measures," but "[i]t *does not* make sense to infer that missing data explains away the much starker disparity, *disfavoring* Asian Americans, in the subjective personal rating scores, because no observable data justifies that inference." But, contrary to that unsubstantiated assertion, Dr. Card has provided observable data that justify his inference in multiple respects. *First*, Dr. Card showed that, on average, Asian American applicants are less likely than white applicants to receive strong scores collectively across the teacher and guidance counselor ratings, two factors that inform the personal ratings. *See* Card Rebuttal Rep. at 25, ¶¶ 47-48 & Ex. 4. *Second*, Dr. Card 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, suggesting that white applicants may objectively outperform Asian American applicants in non-academic measures. *See id.* at 30, ¶ 53 & Ex. 8. *Third*, Dr. Arcidiacono's own regression models show that, as he adds more non-academic factors, the racial disparities shrink. *See id.* at 23-25, ¶ 46. That effect suggests that omitted variables, not racial bias, may explain the racial disparities.

Other reasons that Dr. Arcidiacono relies on to argue that the personal ratings are biased are also flawed. In particular, Dr. Arcidiacono relies on alumni ratings to argue that the personal ratings are biased, contending that "there is a stark divergence between the alumni personal

ratings and the personal ratings assigned by Harvard's admissions office that is indicative of a penalty against Asian-American applicants in the scoring of the personal ratings." Arcidiacono Rep. at 50. That argument is unconvincing. Not only do alumni rate Asian American applicants lower than applicants of other races on personal ratings in 9 out of 10 academic deciles (all but the bottom 10%),[7] but they also rely on a much narrower set of information compared to the admissions officers. *See* Card Rep. at 74, ¶ 156 ("An alumni personal rating reflects only the alumni interviewer's brief interaction with the applicant, whereas the personal rating assigned by Harvard admissions officers considers not just the alumni interview . . . but also the candidate's essays, teacher recommendations, secondary school report, and so on."). Moreover, Dr. Card demonstrated, using Dr. Arcidiacono's econometric specification, that the distribution of Asian American applicants in non-academic measures is shifted lower compared to that of white applicants (i.e., that "Asian-American applicants are more likely . . . to have weaker non-academic qualifications" than white applicants) and that this finding holds "even if personal ratings . . . are excluded from the non-academic qualifications." *Id.* at 38, ¶ 76.

B. Dr. Card's Decision Not To Include The Race-Disadvantaged Status Interaction Variable Was Well-Founded

Plaintiff's *amici* (at 14-16) criticize Dr. Card's analyses for not including an interaction variable between an applicant's "disadvantaged status" and race. This criticism also lacks merit.

Interaction variables are designed to allow the effect of one variable to vary by another variable. Because the number of possible interaction variables is virtually unlimited and adding interaction variables necessitates a greater sample size to obtain reliable results, sound modeling principles require a process for deciding which interaction variables are appropriate to include

[7] Dr. Arcidiacono himself admits that "there is some racial disparity in the alumni personal rating." Arcidiacono Rep. at 50.

while others are not. By default, interaction variables are not included, and an analyst should include only those interactions for which there is a principled reason to expect a meaningful interaction effect. For example, if examining admissions criteria for a university with a major outreach program for disadvantaged students in the local area near the university, it may be reasonable to include a location-disadvantaged status interaction variable on the theory that the university offers admissions advantages to local disadvantaged students that differ from those of local students and of disadvantaged students more generally. There would be no reason, on the other hand, to include any number of other interaction variables in this example, such as location-race or gender-disadvantaged status, because there are no similar principled reasons to expect other interactions.[8]

Dr. Arcidiacono does not appear to have articulated a defensible process for deciding which interaction variables to include. The reason given in his report for including the race-disadvantaged status interaction variable was that he observed from the data analysis that the relationship between disadvantaged status and admissions rates was not identical across races. *See* Arcidiacono Rep. at 64 (observing differences). Dr. Arcidiacono asserts that the disadvantaged status gave virtually no significant benefit to African American and Hispanic applicants because they were already given strong preferences. *See id.* at 34 & n.43. But, as

[8] There are two main reasons that this is an important best practice for researchers. *First*, interaction terms can require significantly greater sample sizes to yield precise results; there is no way, however, to increase the sample size in Harvard's data pool, because a fixed number of students applied for admission to Harvard each year. *Second*, the nature of any statistical testing is that there will necessarily be false positives. At the conventional 95% level of statistical significance, we would expect to find one false positive (a statistically significant relationship between two variables even though in truth there is no connection) for every 20 relationships we examine. If an analyst includes many interactions between variables without any discipline or rules in selecting which interactions to include in the model, some are bound to be significant just by chance, but these are false positives.

noted above, explanations that depend on the contents of the data are disfavored because they may be *ex post* rationalizations, and neither Dr. Arcidiacono nor Plaintiff's *amici* have provided any *a priori* rationale for this treatment. The absence of such an explanation creates a significant risk that Dr. Arcidiacono's decision to include the race-disadvantaged status interaction variable may have been driven by its outcome, rather than an outcome of a rigorous process for selecting interaction variables to include out of a virtually unlimited number of possible interaction variables. His report did not provide the principled justification that sound statistical methodology requires.

C. Plaintiff's *Amici* Ignore Dr. Card's Alternative Analyses, Which Show That Dr. Arcidiacono's Criticisms Do Not Affect His Conclusions

Even if Plaintiff's *amici*'s criticisms had any merit, Dr. Card's alternative analyses showed that his findings remain unaffected.

With respect to the personal ratings, Dr. Card completed two alternative analyses, in which he assumed that the personal ratings might have been influenced by applicants' race. In the first alternative analysis, Dr. Card removed the personal ratings from his models entirely (thereby ignoring an important part of Harvard's admissions process as discussed above). In five out of six years, Dr. Card found no statistical evidence of bias against Asian American applicants. *See* Card Rep. at 71-72, ¶ 152 & Ex. 21. In the second alternative analysis, Dr. Card statistically adjusted academic, extracurricular, and personal ratings to eliminate the alleged racial bias as reported by Dr. Arcidiacono. Dr. Card found no statistical evidence of bias against Asian American applicants in any of the six years or in the average across all six years. *See* Card Rebuttal Rep. at 33-34, ¶ 57 & Ex. 9. Plaintiff's *amici* flatly ignore the results of these alternative analyses.

Dr. Card also completed an alternative analysis to evaluate whether including the race-disadvantaged status interaction variable would impact his findings. In that alternative analysis, Dr. Card allowed the effect of disadvantaged status to vary by race, precisely what Plaintiff's *amici* claim (at 15-16) Dr. Card failed to do. *See* Card Rebuttal Rep. at 56-57, ¶ 108 & Ex. 15. Nonetheless, Dr. Card found no statistical evidence of bias against Asian American applicants. Plaintiff's *amici* simply ignore these alternative analyses and findings.

CONCLUSION

For the foregoing reasons, *amici* believe that the criticisms put forward by Plaintiff's *amici* are unpersuasive, and Dr. Card's methodology is reasonable and consistent with a transparent and principled approach as to each of these disputed points.

Respectfully submitted,

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September 6, 2018

CERTIFICATE OF SERVICE

I hereby certify that, on September 6, 2018, I caused the foregoing brief to be filed electronically with the Clerk of Court using the CM/ECF system. Notice of this filing will be sent to all registered ECF participants as identified on the Notice of Electronic Filing.

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Appendix A

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.

Susan Dynarski is a professor of public policy, education, and economics at the University of Michigan, where she holds appointments at the Gerald R. Ford School of Public Policy, School of Education, Department of Economics and Institute for Social Research. She is co-director of the Education Policy Initiative. She is a faculty research associate at the National Bureau of Economic Research and a nonresident senior fellow in the Economic Studies Program at the Brookings Institution. She earned an AB in Social Studies from Harvard, a Master of Public Policy from Harvard, and a PhD in Economics from Massachusetts Institute of Technology. She has been a visiting fellow at the Federal Reserve Bank of Boston and Princeton University as well as a professor at Harvard University. She serves on the board of editors of the American Economic Journal/Economic Policy and is a former editor of The Journal of Labor Economics and Educational Evaluation and Policy Analysis. She has been elected to the board of the Association for Public Policy and Management. She serves on the board of the Association for Education Finance and Policy and recently served as its president. Her research focuses on understanding and reducing inequality in education. She uses large-scale datasets and methods of causal inference to understand the effects of charter schools, financial aid, postsecondary schooling, class size, and high school reforms on academic achievement and educational attainment. She has testified before the U.S. Senate Committee on Finance, the U.S. Senate Committee on Health, Education, Labor, and Pensions, the U.S. House Ways and Means Committee, and the President's Commission on Tax Reform. She has consulted broadly with government agencies, including the Federal Reserve Bank of New York, the Federal Reserve Board of Governors, the Consumer Financial Protection Bureau, U.S. Treasury, U.S. Department of Education, the Council of Economic Advisers, the U.S. Government Accountability Office, school districts, and state offices.

Harry Holzer is the John LaFarge, Jr. S.J. Chair and Professor at Georgetown University. He joined the McCourt School (then known as the Georgetown Public Policy Institute) as Professor of Public Policy in the Fall of 2000. He served as Associate Dean from 2004 through 2006 and was Acting Dean in the Fall of 2006. He is also currently an Institute Fellow at the American Institutes for Research, a Nonresident Senior Fellow at the Brookings Institution, a Senior Affiliate at the Urban Institute, and a Research Affiliate of the Institute for Research on Poverty at the University of Wisconsin at Madison. He has also been a faculty director of the

Georgetown Center on Poverty, Inequality and Public Policy. He received his BA (1978) and Ph.D. (1983) in Economics from Harvard University. Prior to coming to Georgetown, Professor Holzer served as Chief Economist for the U.S. Department of Labor and professor of economics at Michigan State University. He has also been a Visiting Scholar at the Russell Sage Foundation in 1995, and a Faculty Research Fellow at the National Bureau of Economic Research.

Hilary Hoynes is a Professor of Economics and Public Policy and holds the Haas Distinguished Chair in Economic Disparities at the University of California, Berkeley. From 2011 to 2016, she was the co-editor of the leading journal in economics, the American Economic Review. She specializes in the study of poverty, inequality, food and nutrition programs, and the impacts of government tax and transfer programs on low-income families. Current projects include evaluating the effects of the access to the social safety net in early life on later life health and human capital outcomes, examining the effects of the Great Recession on poverty and the role of the safety net in mitigating income losses, and estimating the impact of Head Start on cognitive and non-cognitive outcomes. Her work has been published in leading journals such as the American Economic Review, the Review of Economics and Statistics, the American Economic Journal: Economic Policy, and Econometrica. She received her PhD in Economics from Stanford in 1992 and her undergraduate degree in Economics and Mathematics from Colby College in 1983. Prior to joining the Goldman School, she was a Professor of Economics at the University of California, Davis. Professor Hoynes is a member of the American Academy of Arts and Sciences, the American Economic Association's Executive Committee, the National Academy of Sciences Committee on Building an Agenda to Reduce the Number of Children in Poverty by Half in 10 Years, and the California Task Force on Lifting Children and Families out of Poverty. Previously, she was a member of the Federal Commission on Evidence-Based Policy Making and the Advisory Committee for the National Science Foundation, Directorate for the Social, Behavioral, and Economic Sciences.

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. After graduating from Brown University, Professor Imbens taught at Harvard University, UCLA, and UC Berkeley. He joined the GSB in 2012. He is a fellow of 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.

Alan B. Krueger is the Bendheim Professor of Economics and Public Affairs at Princeton University. He has published widely on the economics of education, unemployment, labor demand, income distribution, social insurance, labor market regulation, terrorism, and environmental economics. Since 1987, he has held a joint appointment in the Economics Department and the Woodrow Wilson School at Princeton University. He is the founding Director of the Princeton University Survey Research Center. He served as Chairman of President Barack Obama's Council of Economic Advisers and as a Member of the Cabinet from 2011 to 2013. He also served as Assistant Secretary for Economic Policy and Chief Economist of the U.S. Department of the Treasury in 2009-10 and as Chief Economist at the U.S.

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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.

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.

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Alexandre Mas is a Professor of Economics and Public Affairs at Princeton University. He is a research fellow at the Institute for the Study of Labor (IZA) and a Research Associate at the National Bureau of Economic Research (NBER). He is also Editor-in-Chief of American Economic Journals: Applied Economics, co-Director for the Labor Studies program at the National Bureau of Economics Research, and Director of the Industrial Relations Section at Princeton. He has held a joint appointment in the Department of Economics and the Woodrow Wilson School of Public and International Affairs at Princeton University, and has been a faculty associate of the Industrial Relations Section since 2009. From 2010 to 2011, he served as the

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Michael McPherson is president emeritus of the Spencer Foundation. He held the position of president from 2003-2017. 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 BA in mathematics, an MA in economics, and a PhD 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.

Cecilia Elena Rouse is the Dean of the Woodrow Wilson School of Public and International Affairs and the Lawrence and Shirley Katzman and Lewis and Anna Ernst Professor in the Economics of Education. She is the founding director of the Princeton University Education Research Section and is a member of the National Academy of Education and the 2018 Eleanor Roosevelt Fellow of the American Academy of Political and Social Science. Her primary research interests are in labor economics with a focus on the economics of education. Rouse has

served as an editor of the Journal of Labor Economics and is currently a senior editor of The Future of Children and a member of the editorial board of the American Economic Journal: Economic Policy. In 1998-99, she served a year in the White House as a Special Assistant to the President at the National Economic Council and from 2009-2011 served as a member of the President's Council of Economic Advisers. She is a member of the board of directors of the Council on Foreign Relations, the National Bureau of Economic Research and MDRC, and is a Director of the T. Rowe Price Equity Mutual Funds and T. Rowe Price Fixed Income Mutual Funds. She received her B.A. in economics from Harvard University in 1986 and a Ph.D. in economics from Harvard University in 1992.

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 labour. 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.

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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. She is a Principal Investigator of the Expanding College Opportunities project, a randomized controlled trial that had significant effects on the college choices of low-income high achievers. Her research also examines scientific labor markets and

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Douglas Webber is an Associate Professor in the Economics Department at Temple University 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, Labour Economics, the Journal of Policy Analysis and Management, and the Economics of Education Review, as well as popular press outlets such as the Chronicle of Higher Education and Fivethirtyeight. He is currently a Co-Editor at Contemporary Economic Policy and serves on the Editorial Board at the Economics of Education Review. He has testified in front of the U.S. Senate Committee on Health, Education, Labor, and Pensions 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.

Janet L. Yellen is a Distinguished Fellow in Residence with the Economic Studies Program at the Brookings Institution and is the former Chair of the Board of Governors of the Federal Reserve System. Prior to her appointment as Chair, Dr. Yellen served as Vice Chair of the Board of Governors, taking office in October 2010. Dr. Yellen is Professor Emerita at the University of California, Berkeley, where she was the Eugene E. and Catherine M. Trefethen Professor of Business and Professor of Economics and has been a faculty member since 1980. She took leave from Berkeley for five years starting August 1994. She served as a member of the Board of Governors of the Federal Reserve System through February 1997, and then left the Federal Reserve to become chair of the Council of Economic Advisers through August 1999. She chaired the Economic Policy Committee of the Organization for Economic Cooperation and Development from 1997 to 1999. She served as President and Chief Executive Officer of the Federal Reserve Bank of San Francisco from 2004 to 2010. She is a member of both the Council on Foreign Relations and the American Academy of Arts and Sciences. She has served as President of the Western Economic Association, Vice President of the American Economic Association, and a Fellow of the Yale Corporation. She graduated *summa cum laude* from Brown University with a degree in economics in 1967 and received her Ph.D. in Economics from Yale University in 1971. She received the Wilbur Cross Medal from Yale in 1997, an honorary doctor of laws degree from Brown in 1998, and an honorary doctor of humane letters from Bard College in 2000. She was an Assistant Professor at Harvard University from 1971 to 1976, and served as an Economist with the Federal Reserve's Board of Governors in 1977 and 1978, and on the faculty of the London School of Economics and Political Science from 1978 to 1980. Dr. Yellen has written on a wide variety of macroeconomic issues, while specializing in the causes, mechanisms, and implications of unemployment.