More than Dollars for Scholars: The Impact of the Dell Scholars Program on College Access, Persistence and Degree Attainment

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Abstract

Although college enrollment rates have increased substantially over the last several decades, socioeconomic inequalities in college completion have actually widened over time. A critical question, therefore, is how to support low-income and first-generation students to succeed in college after they matriculate. We investigate the impact of the Michael and Susan Dell Foundation Dell Scholars Program which provides a combination of generous financial support and individualized advising to scholarship recipients before and throughout their postsecondary enrollment. The program's design is motivated by a theory of action that, in order to meaningfully increase the share of lower-income students who earn a college degree, it is necessary both to address financial constraints students face and to provide ongoing support for the academic, cultural and other challenges that students experience during their college careers. We isolate the unique impact of the program on college completion by capitalizing on an arbitrary cutoff in the program's algorithmic selection process. Using a regression discontinuity design, we find that although being named a Dell Scholar has no impact on initial college enrollment or early college persistence, scholars at the margin of eligibility are significantly more likely to earn a bachelor's degree on-time or six years after high school graduation. These impacts are sizeable and represent a nearly 25 percent or greater increase in both four- and six-year bachelor's attainment. The program is resource intensive. Yet, back-of-the-envelope calculations indicate that the Dell Scholars program has a positive rate of return.

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1. Introduction

Over the last several decades, a variety of organizations—from local college access programs to the federal government—have invested hundreds of billions of dollars in programs and policies to improve college outcomes for economically-disadvantaged youth. College enrollment rates have increased substantially over this period. Yet, socioeconomic gaps in college completion have actually widened. For example, while the share of young people in the top income quartile earning bachelor's degrees by age 25 increased from 36 to 54 percent between the 1961-1964 and 1979-1982 birth cohorts, degree attainment by age 25 among students in the lowest income quartile only increased from five to nine percent over the same time period (Bailey and Dynarski, 2012).

An extensive body of rigorous empirical research demonstrates that a variety of college access efforts can generate substantial improvements in college entry for lower-income populations (See Page and Scott-Clayton, 2015, for a comprehensive review). For example, researchers have found positive enrollment effects from need-based grant programs administered by state and federal governments (Castleman and Long, forthcoming; Dynarski, 2003; Kane, 2003); merit scholarships that reward academic achievement in high school (Dynarski, 2008; Scott-Clayton, 2011); college advising programs that provide students with individualized support to complete college and financial aid applications (Avery, 2013; Carrell and Sacerdote, 2013; Castleman and Goodman, 2014); and informational campaigns that provide students with simplified information about college and financial aid, reminders to complete important tasks, and access to advising when students need assistance (Castleman and Page, 2014a, 2014b, 2015; Castleman, Page, and Schooley, 2014; Hoxby and Turner, 2013).

A series of recent studies also have demonstrated positive effects of financial, advising, and informational interventions on college persistence and completion. Some of these interventions target students before they enter higher education. Bettinger et al. (2012) show that providing low-income families with assistance completing the Free Application for Federal Student Aid (FAFSA) during the income tax preparation process leads to substantial increases in the share of students that enroll and persist for at least two years in college. In addition, financial aid efforts directed to students based on financial need (e.g., Castleman and Long, forthcoming) and on academic merit (e.g., Scott-Clayton, 2011) have improved rates of bachelor's degree attainment. Not all scholarship programs, however, demonstrate positive long-term effects for students. For example, DesJardins and McCall (2014) find that while the Gates Millenium Scholars program, which is awarded to high-achieving, low-income students, led to modest increases in students' GPA through junior year of college, it had no impact on bachelor's degree attainment.

Other programs provide outreach and support to students after they have begun college. Castleman and Page (forthcoming) provide experimental evidence that targeted text-based reminders about reapplication for financial aid can improve first-to-second year persistence. Other persistence interventions are more comprehensive. Inside Track, for example, is a private company that contracts with colleges to provide students with coaching (primarily delivered via phone) about issues and challenges that arise over the course of the academic year. Freshmen who were randomly assigned to receive one-one-one, sustained college coaching from Inside Track were 4 percentage points more likely to earn a degree than students who did not receive this coaching—a 13 percent relative increase (Bettinger and Baker, 2014). More comprehensive still is the City University of New York's Accelerated Study in Associates Program (ASAP), which provides intensive structural, advising, and financial support for selected community college students. Those who were randomly assigned to participate in ASAP were 66 percent more likely to earn a degree within several years than their peers who were not selected to participate (Scrivener and Weiss, 2013). Finally, Angrist, Autor, Hudson and Pallais (2015) examine the impact of scholarship support from the Susan Thompson Buffett Foundation. Students selected as Buffett Scholars receive generous financial aid and, in some cases, academic and social supports through on-campus learning communities at selected colleges in Nebraska. Experimental evidence reveals that the program has sizeable impacts on both institutional choice and early college persistence. Recipients are substantially more likely to matriculate to a four-year institution and are more likely to persist into their sophomore year of college.

We contribute to the growing but still nascent literature on the long-term effects of interventions focused on college completion by investigating the impact of the Michael and Susan Dell Foundation Dell Scholars Program. The Dell Scholars Program provides a combination of financial support and individualized advising to scholarship recipients, both as they enter college and throughout the duration of their postsecondary enrollment. Like the Buffett program, the Dell approach is resource intensive; Dell Scholars are awarded up to $20,000 of scholarship support in addition to the operating costs of the program itself. This programmatic design is motivated by a theory of action that, in order to meaningfully increase the share of lower-income students who earn a college degree, it is necessary both to address financial constraints students face and to provide ongoing support for the academic, cultural and other challenges that students experience during their college careers. Indeed, in a recent review on factors predicting college completion, Perna and Jones (2013) identify three key aspects of the postsecondary experience: college financing, academic achievement and social integration. Thus, providing a combination of financial supports and other wrap-around supports that target the non-financial domains of student success may be a more effective and efficient approach than offering either in isolation (Page and Scott-Clayton, 2015).

We isolate the unique impact of the Dell Scholars Program on college completion by capitalizing on an arbitrary cutoff in the selection process that determines which applicants are named Dell Scholars. Using a regression discontinuity design, we find that while being named a Dell Scholar has no impact on initial college enrollment or early college persistence, scholars at the margin of eligibility appear more likely to persist into the fourth year of college and are significantly more likely to earn a bachelor's degree on-time or six years after high school graduation. Specifically, students just above the margin of scholar selection are 8 to 9 percentage points more likely to earn a bachelor's degree within four years and 15 to 19 percentage points more likely to earn a bachelor's degree within six years compared to their counterparts who just missed being named a Dell Scholar. These impacts are sizeable and represent a nearly 25 percent or greater increase in both four- and six-year bachelor's attainment.

In addition to our impact analyses, we conduct a back-of-the-envelope cost-benefit analysis to assess whether these substantial increases in college completion are sufficient to merit the intensive investment that the Dell Scholars Program makes in its recipients. Although our calculations hinge on several assumptions, as we outline, they nevertheless suggest that the investment in Dell Scholars has a positive rate of return. Given that those selected as Dell Scholars are predominantly first-generation college students from low-income backgrounds, our findings have important implications for efforts to expand college success in the US.

We structure the paper as follows. In Section 2 we describe the Dell Scholar's program, including their application and selection procedure. In Section 3, we highlight the data and analytic strategies we bring to bear in our investigation. In Section 4 we present our results, and in Section 5 we conclude.

2. Dell Scholar's program

2.1. Description

The Dell Scholars Program is a unique college success initiative sponsored and administrated by the Michael and Susan Dell Foundation.[2] The program targets motivated low-income students who have the potential to enroll and succeed in college. Students selected to be Dell Scholars receive generous financial support towards the costs of higher education. This includes up to $20,000 in scholarship funds, a laptop computer and textbook support. Compared to other scholarship programs, the Dell effort is relatively unique in that it also provides ongoing outreach, close monitoring, and assistance to scholars, even though they are geographically dispersed to postsecondary institutions across the US. As the program materials explain, beyond formal scholarship funding, the program also provides:

> …ongoing support and assistance to address all of the emotional, lifestyle, and financial challenges that may prevent our scholars from completing college. These pressures range from dealing with stress, to getting out of debt, to managing child care, and dealing with life circumstances as they arise.[3]

This ongoing support is actualized by requiring scholars to input postsecondary progress information into a sophisticated data and communication portal that is closely monitored by program staff. Scholars input information about key college success metrics including academic

[2] For more information about the Dell Scholars Program, see http://www.dellscholars.org/.
[3] Text provided by Oscar Sweeten Lopez, Portfolio Director for the Dell Scholars program, January 27, 2016.

performance, financial aid, and social integration.[4] Scholars are required to report information via the portal prior to postsecondary enrollment, at the end of fall and spring semesters freshman year, and once annually after the first year of college. The portal is designed to flag inputs associated with threats to college persistence and to immediately trigger the process of providing individualized follow-up, support and guidance. This data-driven program model allows a small program staff to provide proactive, intensive social support to scholars who are at risk of attrition at any point during their postsecondary trajectory.

Since 2004, the program has selected and supported over 3,000 scholars. Currently, it selects approximately 300 students as Dell scholars annually. Despite the small annual cohort size, the Dell Scholars program is well known. Between 2009 and 2014, for example, the program selected a total of 1,806 scholars from among 39,685 applicants.

2.2. Scholar application and selection process

Students apply to be Dell Scholars during their senior year of high school. To be eligible, students must meet certain preliminary criteria. First, students must have participated in one of several college readiness programs during the last two years of high school.[5] In addition, applicants must be graduating from an accredited high school, earn a minimum 2.4 grade point average, be financially eligible to receive a federal Pell grant in the first year of college, and plan to enroll full time in a four-year college. Qualified students complete an online application that gathers information about high school grades, test scores, the college readiness program (CRP)

[4] In addition to this student self-reported information, students are required to submit documentation, such as transcripts, which are used to verify the student-reported data.

[5] At the time of our writing, these programs included Alliance College-Ready Public Schools, AP Strategies, Aspire, AVID, Bottom Line, Breakthrough Austin, College Forward, Cristo Rey Network, Fulfillment Fund, GEAR UP, Genesys Works, Green Dot Public Schools, IDEA Academy, KIPP Academy/ KIPP Through College(KTC), Mastery Charter Schools, Noble Charter, One Goal, Philadelphia Futures, Upward Bound, Upward Bound - Math Science, YES Prep Public Schools, Uncommon Schools and Uplift Education

in which the student participated, college plans, home and work responsibilities, financial information, and home environment. Each year, eligible high school seniors can apply to the Dell Scholarship Program between November 1 and January 15. After this date, the application is closed, and the selection process begins.

Scholar selection proceeds in two phases. The first phase is the selection of semifinalists from among all qualified applicants, and the second phase is the selection of scholars from among semifinalists. We highlight key components of applicant scoring and selection here and provide further detail in Appendix A.

The Dell Scholars Program assesses prospective scholars based on three main criteria referred to as *GPA*: Grit, Potential, and Ambition. In each phase, the program scores students numerically along three dimensions: academics, disadvantage, and responsibility. These dimensions along with the eligibility criteria map directly onto the Grit-Potential-Ambition framework. Participating in a college readiness program and having a plan to enroll in a four-year college show an applicant's ambition. The academics dimension, which assesses academic achievements in high school, measures the applicant's potential. The final criterion, grit, is intended to target students who have overcome personal challenges in their lives related to their families, schools or communities. This criterion is assessed with the measures of disadvantage and student responsibility. Each dimension includes several sub-categories. For example, the academics dimension consists of an academic difficulty index, course count, and high school grade point average.

The Dell Scholars Program utilizes application score algorithms, one for each phase, to compute overall scores. We refer to these as the semifinalist algorithm and the scholar algorithm, respectively. The semifinalist algorithm computes a total application score for each student who started an application. Students are then ranked on this application score, and the top 900 students are selected as semifinalists. Semifinalists are notified on February 1 and are then required to provide additional application materials, including a high school transcript, a Student Aid Report obtained after completing the Free Application for Federal Student Aid (FAFSA), responses to additional short-answer questions, and a letter of recommendation before March 10. The semifinalists who complete these requirements are referred to as finalists and enter the scholar selection process.

Finalist applications are distributed among and reviewed by a selection committee consisting of approximately 60 members. Each finalist's full application is reviewed and scored by two readers.[6] Each reader in the pair individually reviews each assigned complete application, including recommendation letters, and scores each item in the application. At the end of March, the readers submit all application reviews and the scholar algorithm computes a final score for each application.[7] Students are ranked on these scores, and the top 300 finalists are selected as Dell Scholars and announced on April 10.

2.3. Research questions

Our main objective is to evaluate the impact of the Dell Scholars Program on college enrollment, persistence and completion.[8] In addition, we investigate how these impacts vary by observable

[6] This assignment process ensures that both readers in the pair have zip codes different from the finalists they are reviewing.

[7] Super-readers, a subset of readers with extensive experience in scoring applications, review and score applications that need an additional evaluation because first two readers awarded scores that deviated substantially from each other.

[8] The two-stage selection process lends itself to investigating both the impact of being selected as a semifinalist and the impact of being selected as a scholar. We explored but found no impacts at the margin of semifinalist selection. Therefore, we refrain from presenting results associated with semifinalist selection and instead focus attention on the impact of being selected as a Dell Scholar from among those applicants who reach the stage of finalist.

student characteristics, such as status as a would-be first-generation college student. Our investigation is guided by the following research questions:

1. What is the impact of being selected as a Dell Scholar on college enrollment, persistence and degree completion?
2. To what extent do these impacts vary by salient student-level characteristics?
3. Do the benefits of the Dell Scholars program justify the costs?

3. Data and Research Design

The process for selecting Dell Scholars lends itself perfectly to a regression discontinuity design for assessing the program's impact. In this section, we lay out the data and analytic strategy for informing our research questions.

3.1. Data

Our data come from two primary sources. First, we utilize Dell Scholar applicant records, which provide comprehensive information about each applicant from the high school graduating classes of 2009 through 2014. The application data provide basic demographic information, such as gender, race and ethnicity, state of residence, and parents' education level and employment status. The data also include indicators of students' academic background, including standardized test scores, high school achievement, participation in college readiness programs, and top three postsecondary institution preferences (as students apply to be Dell Scholars prior to being admitted to any institutions to which they have applied). While optional and not factored into the scholar selection process, the large majority of applicants took and reported scores for either the SAT or ACT test. We convert SAT test scores (critical reading, math, and writing) to

ACT composite test scores using the ACT-SAT concordance table.[9] Information on applicants' high school achievement includes overall high school GPA as well as information on courses taken and course-level grades earned. Applicants also provide information about their responsibilities at home, work, and in their community. Lastly, these data provide measures of applicants' financial circumstances, including household income and state or federal financial aid eligibility.

In Table 1, we provide detailed counts of applicants across the 2009 through 2014 cohorts. Across these years, the program experienced a substantial growth in applications, with the 2014 applicant cohort being 72 percent larger than that of 2009. Across all years, selected semifinalists complete the finalist application process with a high rate of compliance. On average, nearly 90 percent of the semifinalists submitted the required documents and achieved finalist status for the selection of scholars each year. The final number of selected scholars varies minimally from the target of 300 annually.[10]

In Table 2, we present descriptive statistics of applicants' demographic characteristics, test score performance, and financial aid eligibility, pooled across cohorts. In the first column we present results overall, and in the remaining columns, we present results disaggregated by applicant status (e.g., non-semifinalist, semifinalist, finalist, and scholar). While not reported in the table, rates of missingness on student demographics are very low, ranging from 0 to 4 percent across most items. Missingness was most prevalent for SAT/ACT scores (nearly 16 percent), presumably for those students who either did not take a college entrance test or simply opted not to report their scores in their application. About 3 percent of applicants are missing their parents'

[9] We use the concordance tables retrieved from: http://www.act.org/aap/concordance/pdf/reference.pdf.

[10] Note that we are missing 3 observations on the 2010 applicants who are missing the semifinalist algorithm score. We are also missing 139 observations on the 2011 finalists, one of whom is a scholar, due to an unknown system issue. This explains the discrepancy in the number of selected scholars in 2011.

education,[11] with students less likely to report father's than mother's education. This may be an indication of students living in a single-parent (e.g., mother-headed) household.[12]

Of applicants, 70 percent are female, three-quarters are either black or Hispanic, and nearly sixty percent are would-be first-generation college goers. Applicants exhibit an average ACT composite score of 19.82, which corresponds to approximately the 42nd percentile of performance among all test takers.[13] Those ultimately selected as scholars are similar in terms of gender and race / ethnicity but are even more likely to be first-generation college goers and have average ACT performance of nearly 22, corresponding to approximately the 62nd percentile of the national distribution. Scholars also achieved a slightly higher high school GPA, on average.[14] Therefore, the scholar selection process favors those applicants who are higher performing but from lesser means. As an additional indicator of this final point, while 76 percent of all applicants qualified for subsidized school meals, nearly all of eventual scholars did so.

To examine students' college-going outcomes, we capitalize on college enrollment outcome data from the National Student Clearinghouse (NSC), a non-profit organization that maintains postsecondary enrollment records for approximately 96 percent of colleges and universities in the U.S.[15] NSC data provides semester-level enrollment information at the student level. These data allow us to observe whether and where students enrolled in college and additionally provides classifications related to students' postsecondary institutions such as whether they are public or private and whether they are two-year or four-year institutions.

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[11] This variable indicates the highest educational attainment between the applicant's parents.

[12] Where covariate information is missing, we have imputed a value of 0 and include indicators for missingness on each covariate in all regression analyses.

[13] See http://www.actstudent.org/scores/norms1.html for correspondence between ACT composite scores and percentiles of performance.

[14] Applicant's GPA is normalized with their institution highest GPA scale. For example, an applicant with GPA of 3.6 in an institution with a 0-4 scale has a scaled GPA of 0.90.

[15] The National Student Clearinghouse represents the best, comprehensive source of college enrollment information for US students. Nevertheless, we recognize that coverage is imperfect and that coverage rates vary across states (Dynarski, Hemelt, & Hyman, 2015).

Finally, the NSC data provides an indication of whether students are enrolled full-time, half-time, or part-time, thus allowing us to observe the intensity of students' postsecondary enrollment. For earlier cohorts of Dell Scholars applicants, we are able to observe whether students progressed through to degree completion. Taken together, data from the NSC provides a comprehensive set of outcomes related to college enrollment, persistence and degree attainment.

In Table 3, we list the set of college-going outcomes considered in our analysis, the cohorts for which we examine these outcomes, and the average values of these outcomes, disaggregated by applicant's status.[16] This descriptive evidence reveals a consistent pattern of better college-going outcomes among Dell Scholars compared to non-scholar finalists as well as to the applicant pool overall. While being selected as a Dell Scholar may be the driver of these differences, they may also be attributable to differences in the characteristics of students ultimately selected as scholars, such as their higher levels of prior academic achievement. Therefore, we turn to discussing our analytic strategy for disentangling these possibilities.

3.2. Regression discontinuity analytic strategy

We take advantage of the Dell Scholars Program selection processes to identify the causal impact of being selected as a scholar on college enrollment, persistence and completion outcomes. We exploit the fact that the program uses well-specified rank thresholds for the selection of scholars. Specifically, the program first ranks all applicants based on their semifinalist scores and selects the top 900 scoring applicants as semifinalists. Then, among those semifinalists who complete the finalist application, the program scores and ranks finalists and selects the top 300 scoring

[16] For each outcome that is binary, we code as zero any instances where a student is enrolled less than half-time. Our results are not sensitive to this analytic decision.

finalists as Dell Scholars, such that, in each year, the score of the 300th ranked finalist is the relevant threshold for examining the effect of being selected as a Dell Scholar.

These features allow us to use a regression discontinuity (RD) design to compare the outcomes of finalists with scores just above and below their year-relevant scholar-selection threshold. The students with scores just around the thresholds are comparable on many dimensions, however the finalists with scores just above the relevant thresholds were selected as the program's scholars. Thus, we can rely on the comparison of students at the scholar-selection margins to obtain unbiased estimates of the impacts of scholar selection.

For a regression discontinuity strategy to yield valid causal inference, several conditions must be met (Schochet et al, 2010). First, the assignment rule must be clear and followed with a high degree of fidelity. Second, the score utilized to determine scholar status, our forcing variable, should be an ordinal measure with sufficient density on either side of the cut off. Third, these scores should be utilized by the Dell Scholars program only for the purpose of identifying scholar status, and therefore differences that we see at the relevant margin cannot be attributable to other potential mechanisms. Finally, applicants must not able to manipulate their own value of the forcing variable. Regarding this final point, it is highly implausible that applicants would have this ability. The scoring algorithms are complex, are not publically disclosed, and rely on multiple inputs. Further, manipulation of one's position relative to the cutoffs would require perfect information of the selection processes as well as of the inputs associated with other applicants.[17] We provide evidence that the remaining conditions are met in the context of the Dell Scholars program.

[17] An additional, related potential threat to validity is rater manipulation, such that raters are overly generous in scoring certain applications. While we cannot fully rule out the potential of rater manipulation, we argue that it is unlikely to have an undue influence on students' final rank order especially local to the threshold for scholar selection. First, each rater evaluates applications for only a small subset of all finalists. Second, finalist scores are a

In Figure 1, we illustrate the relationship between scholar selection and finalist score, by year. In each year, the relevant threshold is demarcated with a vertical dashed line. These figures provide evidence that the selection rules and processes are followed with a very high – almost perfect – degree of fidelity. Nevertheless, we do observe a few exceptions to the stated selection rules. For example, we find a small number of instances where finalists, whose scores are above the scholar threshold, were not selected as scholars. In Table 4, we report on the relevant threshold values for the identification of scholars and report counts of the number of cases in which the selection rules were not strictly followed, by year. These instances of non-compliance with the stated assignment rules are explained by the fact that the Dell Scholar team reserves the right to manually disqualify applicants after they initially have been selected as a scholar.[18] Despite these small discrepancies, collectively we have strong evidence in support of an RD strategy for assessing programmatic impacts.

Next, we test the validity of the RD assumptions related to the continuity of the forcing variables across the relevant thresholds and assess any evidence of manipulation of position around these thresholds. We utilize the McCrary (2008) test to examine the continuity assumption of the scholar selection forcing variables by assessing the smoothness of the score densities across the relevant thresholds. The intuitive purpose of this exercise is to test whether applicants were able to manipulate their assignment. Graphically, we expect continuity in the

combination of rater evaluation scores and scores attributed to measures like student GPA. In sum, raters are unlikely to know the marginal score that will be in the top 300 and are unlikely to be able to finely manipulate a student's overall score around that relevant margin. Finally, as noted above (footnote 6), raters are never assigned to review the applications of students who reside in the same zip code. Therefore, it is unlikely that raters have a personal connection with any of the students whose application materials they are reviewing.

[18] There are four main reasons for disqualification. First, an applicant may be disqualified if the applicant received a serious disciplinary action in high school. The Dell Scholar Program has yet to disqualify a scholar for this reason. Second, an applicant may be disqualified if the applicant's essay did not meet the minimum criteria or if the applicant used the same responses for all essays. Third, an applicant may be disqualified if the applicant did not plan to attend a four-year college. While it is permissible for scholars to begin their postsecondary education at a community college, they must demonstrate a goal of completing a four-year degree. Lastly, an applicant may be disqualified if the applicant inflated their high school grades. Specifically, the Dell Scholar Program checked whether the self-reported grades matched with the official high-school transcript.

density of the continuous assignment variable around the threshold if applicants were not able to manipulate their assignment. Given the complexity of the scoring algorithms utilized as well as the fact that semifinalist and scholar selection thresholds are determined relative to each year's pool of applicants (rather than being an absolute, pre-determined threshold), we expect for the assumptions to be met.

In Figures 2 and 3, we illustrate the graphical presentation of the McCrary test for the finalists' scores. In Figure 2, we present results by year and in Figure 3, we present data pooled across the 2009 through 2014 cohorts. In each panel, we can observe the continuity of the assignment variable. In Table 5, we provide summary statistics from the McCrary tests. In all but one cohort and for results pooled across cohorts, the test fails to reject the null hypothesis at the 5 percent significance level. The only instance where the data failed to reject the null hypothesis is in the 2011 scholar selection. This result may be driven by the missing data of 138 finalists and 1 scholar in the 2011 finalist dataset. On the other hand, this may also be a false positive, given the multiple hypotheses being tested here.[19] As an additional check, we fit regression discontinuity models examining potential jumps in individual student-level characteristics at the scholar selection thresholds. In no case did these analyses reveal evidence of manipulation around the selection cutoff.[20] Collectively, the results do not point to evidence of manipulation of the forcing variables. Therefore, we conclude that the Dell Scholar selection rules generate a robust quasi-random assignment of scholars local to the relevant selection thresholds.

To account for the modest infidelity to the selection processes, we utilize a two-stage instrumental variables (IV) or "fuzzy" RD approach (e.g., Jacob and Lefgren, 2004; Imbens and Lemieux, 2008). Specifically, we use applicants' scores relative to their year-relevant threshold

[19] We assess the sensitivity of our results to this cohort and find that results are, overall, not sensitive to the inclusion or exclusion of the class of 2011 students for who score data are complete.
[20] These results are not presented but are available upon request.

as an instrument for the selection as a scholar. For the first stage, we use the following linear probability model for finalist *i* in year *t*:

$$SCHOLAR_{it} = \beta_0 + \beta_1 ASSIGN_{it} + \beta_2 SCORE_{it} + \beta_3 (ASSIGN \times SCORE)_{it} + \boldsymbol{\gamma X_{it}} + \varepsilon_{it} \qquad (1)$$

where *SCHOLAR* is an indicator for selection as a Dell Scholar, *ASSIGN* is an indicator for a finalist's score exceeding the year-specific threshold, and *SCORE* is a finalist's score re-centered around the threshold. Note that under a perfect assignment rule, the variables *SCHOLAR* and *ASSIGN* are equivalent for all students. The vector ***X*** comprises control covariates including age, scaled GPA, ACT equivalent score, and indicators for cohort, state of residence, gender, race / ethnicity, parental education, free / reduced lunch eligibility, receipt of food stamps, receipt of federal health insurance, and receipt of Medicaid.[21] The coefficient on the assignment indicator, β_1, represents the difference in the probability of being selected as a scholar between students who are just above and just below the year-specific threshold. The coefficient is equal to 1 if the assignment rule is followed perfectly. We expect the coefficient to be less than but close to 1 since the assignment rule was followed with near perfect fidelity. Our specification allows the slope of the relationship between the probability of being selected as a semifinalist and scores to vary above and below the threshold.

The second stage model uses a linear functional form given as follows:

$$Y_{it} = \pi_0 + \pi_1 SCHOLAR_{it} + \pi_2 SCORE_{it} + \pi_3 (SCORE \times ASSIGN)_{it} + \boldsymbol{\theta X_{it}} + \tau_{it} \qquad (2)$$

where *Y* represents a particular outcome such as college enrollment or BA degree completion. Scholar status is instrumented by the position around the threshold as described in the first-stage equation. The coefficient, π_1, indicates the causal impact of being selected as a scholar for those who were selected using the assignment rule.

[21] We impute zero values and include dummies for missingness where students are missing valid values for these covariates.

4. Results

We now turn to presenting impact estimates from our regression discontinuity analysis. We first discuss results from fitting our first stage model (1) to obtain parameter estimates associated with fidelity to the programmatic selection rules and then present results from our instrumental-variables estimates of the effect of being selected as a scholar on subsequent college-persistence and degree attainment outcomes.

4.1. First-stage results

For all parameter estimates of interest, we present results derived from the full sample, from those within an intermediate bandwidth of +/- 100 points, and from those within an "optimal" bandwidth around the threshold. In selecting an optimal bandwidth, we utilize a first-order polynomial, a uniform kernel, and the bandwidth selector of Calonico, Cattaneo, and Titiunik (CCT, 2014a, henceforth). Because of this process, the optimal bandwidth varies modestly across outcomes.

In Table 6, we report results associated with the first-stage models for the finalists, pooling data across the 2009 through 2014 cohorts. The results of most interest are those associated with the first row, labeled "Assignment rule", which estimate the difference in the probability of being selected as a scholar at the threshold. Visual inspection of Figure 1 foreshadows that coefficients associated with the assignment-rule indicator will be close to but somewhat less than 1. Indeed, in column 1, we estimate that a finalist with a score just above the threshold has a 0.945 higher probability of being selected as a scholar. In the remaining columns, we present estimates associated with the intermediate and the optimal bandwidths. Across columns, the results are very similar in terms of both magnitude and statistical significance and are therefore not sensitive to bandwidth selection. While representing a high degree of fidelity, these first-stage results signal a non-negligible imperfection in the assignment rule, for which we can account with our two-stage estimation procedure.

4.2. Impacts on college-going outcomes

Here, we investigate the impacts of being a Dell Scholar on subsequent college-going outcomes, including college enrollment, year-by-year persistence, and bachelor's degree completion.[22] In Table 7, we present impacts on initial college enrollment and bachelor's degree attainment. At the margin of selection, being chosen as a Dell Scholar improves timely enrollment by 2.8 percentage points (Row 1). While this result is not statistically significant, we note that it is similar in magnitude to the impact of the Buffett scholarship on initial college enrollment (Angrist et al., 2015). We estimate that students just below the threshold have a 0.81 probability of enrolling in college. The lack of impact with respect to college enrollment is not necessarily surprising. As discussed above, all students who achieve finalist status in the Dell Scholars application process are likely to be highly college intending, and students were notified of their scholar status well after deciding where to apply and, for many, where to attend. Even for these highly college-intending students, however, it is notable that a sizeable share is not successfully matriculating to college, potentially facing other barriers to timely postsecondary enrollment (e.g., Castleman and Page, 2014a, 2014b).

In contrast, we observe strong, positive and statistically significant impacts of being a Dell Scholar on degree completion. The discontinuities that we estimate are visually apparent in

[22] We focus on immediate enrollment in a four-year institution since the Dell Scholarship Program requires applicants to plan an enrollment in a four-year institution. We additionally examined retention within the same postsecondary institution. Because institutional retention and persistence outcomes yielded similar results, we omit the retention outcomes in our presentation for parsimony.

Figures 4, 5 and 6 which illustrate the relationship between indicators of bachelor's degree attainment, BA attainment within four-years and BA attainment within six years, respectively. In the bottom three sets of results in Table 7, we present impacts associated with these three degree attainment measures. Note that we are only able to observe degree attainment within six years for the 2009 cohort. Like the graphical results, our estimates indicate a strong and statistically significant impact of the Dell Scholar opportunity on ultimate degree completion. Focusing on the results derived from estimation using the optimal bandwidths, we estimate that students who just meet the threshold for scholar selection are about 7 percentage points (p.p.) more likely to earn a bachelor's degree and about 8 p.p. more likely to earn a bachelor's degree on time. We estimate a particularly large impact of being selected as a Dell Scholar on degree completion within six years for students in the class of 2009.[23] Specifically, students who just meet the threshold for scholar selection are 19 p.p. more likely to complete a bachelor's degree within 6 years.

As is typical in the context of RD analysis, we face a trade-off between statistical power and estimating treatment effects local to the relevant thresholds (e.g., Ludwig and Miller, 2007). In Table 7, the magnitude of degree completion effects is very consistent across the three different bandwidths while statistical significance differs in some instances due to a loss of precision when restricting the sample. For example, in considering on-time degree completion, the estimated impact ranges from 8.2 to 9.2 percentage points. The result is not statistically significant, however, when using the narrowest (optimal) bandwidth. Nevertheless, these results provide compelling evidence regarding the substantial impact of the Dell Scholar opportunity on

[23] The only students we are able to observe for a full six years of college enrollment are students in the class of 2009.

college completion. Specifically, these impacts represent a nearly 25 percent or greater increase in both four- and six-year bachelor's degree attainment.

Given these sizeable impacts on degree attainment, a key question is what the mechanisms are by which the program is improving students' college completion outcomes. We consider three dimensions, broadly defined, on which the program might operate. First, being selected as a Dell Scholar may impact the type or "quality" of the institution in which students enroll. This may occur for two reasons. Upon being selected as a Dell Scholar, students participate in in-take interviews conducted prior to postsecondary matriculation. During this interview, the Dell Scholars team provides feedback on college plans and, in some cases, counsels students again certain postsecondary choices, such as planning to enroll in an out-of-state public institution. The justification here is that an in-state public institution is likely to be a more financially viable option. Second, the Dell Scholar award includes a sizeable amount of grant-based financial aid that may enable students to view a different set of postsecondary options as within reach financially. If students are enrolling in "higher quality" institutions as a result of the Dell support, this may translate to better college completion outcomes (e.g., Goodman, Hurwitz and Smith, 2015; Howell and Pender, forthcoming).

We examine a set of indicators related to institutional quality and type. Related to quality, we specifically examined whether students at the margin of scholar selection initially enrolled in institutions that differed in terms of instructional expenditure, given evidence from Hoxby and Turner (2013) that instructional expenditure correlates with other metrics of institutional quality, such as Barron's Profiles of American Colleges.[24] Related to college type, we investigated the impact of scholar selection on characteristics of students' postsecondary institutions, such as

[24] In subsequent work, we will examine a more robust set of measures related to institutional quality (e.g., institutional graduation rate).

whether they enrolled in institutions that were public or private or were in-state versus out-of-state.

We additionally examined whether students specifically enrolled in in-state, public institutions, given the guidance from the Dell Scholars program noted above. We present the RD estimates for these outcomes in Table 8. Across these measures of institutional quality and type, we find no systematic evidence that students' specific institutional choices change along these dimensions as a result of being selected as Dell Scholars. The one exception is the positive and significant impact that we estimate on enrollment in a four-year, in-state, public institution when estimated within the optimal bandwidth. Given the instability of this result across bandwidths, however, we refrain from placing too much stock in this singular result. Given the timing of the application and selection process, the overall lack of impact on where to enroll, as with the lack of impact on whether to enroll, is not necessarily surprising.

Second, the generous financial support that Dell Scholars receive may substantially alleviate the financial constraints that students and families experience in covering costs associated with college attendance. These include academic costs, such as tuition, fees, and books, as well as non-academic costs, such as child care. If the scholarship improves students' ability to finance college, semester over semester, then we may expect to see substantially higher persistence among Dell Scholars. Third, through gathering data on scholars' postsecondary experiences and providing them with feedback and support, as needed, the program may provide students with the guideposts, encouragement and direction that they need to be more successful throughout their college careers. Improvements in outcomes such as persistence as well as other success metrics such as college GPA, number of credits attempted and number of credits earned each semester would align with this mechanism.

While we lack data for both scholars and applicants on academic performance in college, we do utilize data from the National Student Clearinghouse to examine year-by-year persistence and retention outcomes through the first four years of college. We present these results in Table 7. Like immediate enrollment, we find no impact on second-year persistence or retention at the margin of being selected as a scholar. While the results across all years lack sufficient precision to be statistically significant, point estimates associated with persistence in years 3 and 4 are substantively meaningful in magnitude. Therefore, we interpret these results as suggestive that the program has a positive impact on postsecondary persistence, especially in the later years of college. Still, because the impacts that we observe on degree completion are both significant and larger than those that we observe on persistence, we reason that the Dell Scholars opportunity is likely operating through multiple channels to help students not only to persist in college but also to be more successful, conditional on continued enrollment. We consider these potential mechanisms further in the discussion section of the paper, though we lack data to investigate in a more detailed way the undergraduate experiences of students around the scholar selection margin.

Finally, certain demographic groups are heavily represented in the Dell Scholars applicant data, as noted above. About 70 percent of the applicants are female, about 75 percent are either black or Hispanic, and about 57 percent are first-generation college goers. To complete our investigation, we disaggregate impacts on subgroups defined along these dimensions. We estimate subgroup effects within the full range of the data. We do not observe patterns indicating that our results differ systematically by gender (Table 9), by race / ethnicity (Table 10) or by first-generation status (Table 11), suggesting that monetary and other supports provided by the

Dell Scholars program are meaningful for students regardless of these background characteristics.

5. Discussion

While being selected as a Dell Scholar does not have observable impacts on initial college enrollment or persistence across the first several years of college, we find suggestive evidence of impacts on later persistence and strong and significant impacts on college completion. At the margin of being selected into the program, Scholars are 8-9 percentage points more likely to earn a bachelor's degree on-time and nearly 15-19 percentage points more likely to do so within six years than they would have been absent the Dell Scholar opportunity.

While the large impacts on degree completion absent equally large impacts on persistence may seem counter-intuitive, the magnitude of the degree effects are similar in structure to those observed by Scott-Clayton (2011) in her examination of the West Virginia (WV) PROMISE program (this paper also utilizes a regression discontinuity design with an academically-similar population of students). Scott-Clayton concludes that the WV PROMISE program provided academic achievement "guideposts" to students that helped to improve the quality of their postsecondary enrollment. Students supported through the WV PROMISE earned more credits over four years and achieved higher GPAs, for example, than their non-PROMISE counterparts, due to the motivation of the structural requirements of the financial support. Although we are not able to observe these "process" measures in the data to which we currently have access, we hypothesize that the Dell opportunity may operate through improving the academic success of the Dell Scholars by combining generous financial support with both guideposts for success and close monitoring, feedback and support to keep scholars on track for degree attainment.

The impact that we observe on on-time four-year degree attainment (8 – 9 percentage points) is also of similar magnitude to that observed by Scott-Clayton at the margin of PROMISE eligibility. In that only a third of the WV students qualified for a Pell Grant compared to all of the Dell Scholar recipients, the magnitude of the Dell Scholars program impact on on-time degree attainment is particularly remarkable. Further, different from the WV PROMISE context, we observe that over a longer time horizon, the impact on degree completion grows. Specifically, we estimate a 15 – 19 percentage point impact on attainment of a bachelor's degree within six years.

Given the positive impacts of the Dell Scholars Program on degree attainment, an important question is whether these increases in college completion exceed the costs of the program. Therefore, we provide a back-of-the envelope calculation regarding the relative costs and benefits of the program in the spirit of Deming (2009) and Pallais (2015). Consider the population of program finalists to whom we can generalize our results (i.e., finalists just above and below the index cut-off for selection into the program). For the sake of our calculation, we make the simplifying assumption that, over the life of the Dell Scholars Program, 1,000 students were sufficiently close to the cutoff that our impact estimates would apply to them. Utilizing our intermediate bandwidth point estimate, our results suggest that scholar selection would have induced approximately 161 more students (or 16.1 percent) to earn a bachelor's degree within six years. The total cost of the Dell Scholars program is approximately $30,000 per student,[25] or $30 million total in this example. Therefore, the cost per student induced to earn a bachelor's degree is approximately $186,335.

Next, consider the benefits of this increase in educational attainment. The differential in annual earnings and tax payments between median full-time workers with a bachelor's degree

[25] Inclusive of the non-monetary supports provided by the program.

and those with only some college was $16,100 in 2011 (Baum, Ma, and Payea, 2013). While this is an observed difference, Card (1999) reports that causal estimates of the effect of education on earnings are often 20 to 40 percent larger. Assuming, for the sake of simplicity, that this differential remained constant in subsequent years, the social and private monetary benefits of the Dell Scholars program would exceed the costs after twelve years of post-college earning. Even if the earnings differential between Dell Scholars recipients and finalists just below the threshold were smaller, given that the latter group persisted through several years of college at more similar rates, the program still looks to have a positive rate of return, albeit over a long time horizon.

Of course, this simple calculation leaves aside many factors. For example, we might consider this estimate conservative, in that we do not attempt to monetize the many other types of benefits, both public and private, that accrue as a result of higher education (Baum, Ma and Payea, 2013). Similarly, we do not adjust for an increase in earnings differentials over time. While recognizing the many assumptions that we have made, these calculations nevertheless suggest a positive rate of return for the Dell investment in their Dell Scholars program.

Some college access and persistence efforts focus on financial barriers to college success by providing students with scholarship funds. Other efforts focus on additional outreach and counseling to assist students in navigating the academic and behavioral challenges that emerge in college. While evidence suggests that both types of efforts hold promise for improving the college-going outcomes of low-income and first-generation college-going students, it may be that offering students a suite of supports across these domains may be more successful than the sum of its parts. The ASAP program in New York City suggests this to be true in the community college context. Our examination of the Dell Scholars program provides further supporting evidence, primarily in the context of four-year colleges and universities.

As discussed above, there are several eligibility criteria that students must meet to initially apply and be selected as a Dell Scholar. Upon selection, there are several steps that students must take in order to remain eligible. This includes regular reporting back to the Dell Scholars program staff on academic progress as well as challenges that they are facing, be they related to academics, physical health, mental health, college finances, or general life management. By incorporating this reporting mechanism into their ongoing work with scholars, the Dell Scholars staff is able to track their students closely and triage additional team support to students when needed.

Our results indicate that this support, coupled with generous and flexible financial aid, leads to improved rates of successful bachelor's degree attainment, on-time and within six years of college completion while having more limited impact on postsecondary persistence. Taken together, the results point to the Dell Scholar program supporting scholars to be more efficient and effective in their postsecondary educational experiences. Although we are not able to shed light on the specific mechanisms through which the program operating, in subsequent work, we will turn to a rich investigation of the process through which the Dell Scholars program helps students to persist and succeed in college through to degree completion. This work will help to inform the college access and success community in efforts to go beyond initial college enrollment to focus on ultimate degree attainment and to understand the many facets of the college experience with which students may benefit from increased structure, guidance and support.

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Tables and Figures

Table 1. Counts of Applicants across cohorts with non-missing algorithm score

Year	Total Applicants	Semifinalists	Finalists	Scholars
2009	4,912	775	643	300
2010	5,340	921	811	301
2011	6,533	900	760	299
2012	6,815	901	805	301
2013	7,561	900	766	303
2014	8,426	907	820	302
Total	39,587	5,304	4,605	1,806

Source: The Dell Scholars Program Database, Michael and Susan Dell Foundation.

Notes: three 2010 non-semifinalists are missing the semifinalists algorithm score. There are 138 finalists and 1 scholar in 2011 missing the finalist score.

Table 2. Summary statistics of all applicants, overall and by applicant status, 2009-2014

Variables	**All**	**Non Semi-finalist**	**Semi-finalist**	**Finalist**	**Non-Scholar**	**Scholar**
Age	18.28	18.27	18.34	18.33	18.33	18.34
	(0.50)	(0.49)	(0.54)	(0.54)	(0.53)	(0.55)
Scaled GPA	0.85	0.84	0.90	0.90	0.89	0.92
	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)	(0.10)
ACT Equivalent Score	19.82	19.63	21.00	21.10	20.53	21.95
	(7.99)	(7.96)	(7.99)	(7.68)	(7.75)	(7.40)
Female	0.70	0.69	0.71	0.71	0.71	0.71
Asian	0.10	0.09	0.15	0.16	0.15	0.18
Black	0.22	0.23	0.22	0.21	0.21	0.22
Caucasian	0.16	0.17	0.13	0.12	0.11	0.13
Hispanic	0.53	0.54	0.50	0.50	0.53	0.46
Other Ethnicity	0.04	0.04	0.04	0.04	0.04	0.05
Received lunch program	0.76	0.73	0.96	0.97	0.97	0.97
Received food stamp	0.26	0.21	0.57	0.57	0.58	0.56
Enrolled in WIC	0.10	0.08	0.18	0.18	0.19	0.17
Enrolled in TANF	0.03	0.02	0.09	0.09	0.08	0.10
Enrolled in LIHEAP	0.10	0.08	0.21	0.21	0.20	0.23
Enrolled in SSI	0.08	0.06	0.17	0.18	0.18	0.17
Enrolled in free housing	0.07	0.05	0.17	0.17	0.15	0.19
Enrolled in SSD	0.10	0.09	0.17	0.17	0.16	0.19
Enrolled in health insurance	0.29	0.26	0.47	0.48	0.47	0.50
Enrolled in Medicaid	0.22	0.18	0.45	0.45	0.46	0.44
Parent's education, < HS	0.31	0.28	0.48	0.50	0.49	0.50
Parent's education, HS	0.26	0.26	0.26	0.26	0.25	0.27
Parent's education, some college	0.27	0.28	0.18	0.17	0.18	0.15
Parent's education, college	0.14	0.15	0.06	0.06	0.06	0.06
Parent's education, missing	0.03	0.03	0.02	0.02	0.02	0.02
N	39586	34283	5303	4604	2798	1806

Source: The Dell Scholars Program Database, Michael and Susan Dell Foundation.

Table 3. Summary statistics of applicants' outcome by treatment status

Variable	Cohort	All Applicants		Non-semifinalists		Semifinalist		Finalists		Non-scholars		Scholars	
		Mean	N	Mean	N	Mean	N	Mean	N	Mean	N	Mean	N
Immediate enrollment	2009-2014	0.85	39586	0.84	34283	0.87	5303	0.88	4604	0.88	2798	0.90	1806
2nd year persistence rate	2009-2013	0.56	31161	0.54	26764	0.63	4397	0.67	3785	0.62	2281	0.74	1504
2nd year retention rate	2009-2013	0.52	31161	0.51	26764	0.59	4397	0.62	3785	0.57	2281	0.69	1504
3rd year persistence rate	2009-2012	0.48	23600	0.47	20103	0.55	3497	0.58	3019	0.52	1818	0.67	1201
3rd year retention rate	2009-2012	0.43	23600	0.42	20103	0.49	3497	0.52	3019	0.47	1818	0.60	1201
4th year persistence rate	2009-2011	0.43	16785	0.42	14189	0.49	2596	0.52	2214	0.45	1314	0.61	900
4th year retention rate	2009-2011	0.37	16785	0.36	14189	0.42	2596	0.45	2214	0.39	1314	0.53	900
Completed a 4Y bachelor degree	2009-2011	0.35	16785	0.34	14189	0.45	2596	0.46	2214	0.38	1314	0.58	900
Completed a 4Y bachelor degree on time	2009-2011	0.19	16785	0.18	14189	0.24	2596	0.25	2214	0.19	1314	0.33	900
Completed a 4Y bachelor degree in 6 year	2009	0.49	4912	0.47	4137	0.59	775	0.62	643	0.52	343	0.74	300

Source: The Dell Scholars Program Database, Michael and Susan Dell Foundation, and the National Student Clearinghouse.

Table 4. Threshold scores and assignment of scholars by year

Year	Threshold score	N Non Scholar with score below threshold	N Non Scholar with score above threshold	N Scholar with score below threshold	N Scholar with score above threshold	N Scholars
2009	505	343	0	0	300	300
2010	522	505	5	6	295	301
2011	518	455	6	3	296	299
2012	526	496	8	8	293	301
2013	517	457	6	7	296	303
2014	527.41	511	7	9	293	302

Source: The Dell Scholars Program database, Michael and Susan Dell Foundation.

Table 5. Results of the McCrary Density Tests, by year

Year	Finalist		
	Mean	**SE**	**t-statistic**
2009	0.049	0.180	0.275
2010	-0.177	0.185	-0.954
2011	0.460	0.205	2.250
2012	0.128	0.156	0.822
2013	-0.320	0.173	-1.850
2014	-0.210	0.195	-1.073
Pooled, 2009-2014	-0.019	0.076	-0.243

Source: The Dell Scholars Program database, Michael and Susan Dell Foundation.

Table 6. First-stage estimation: relationship between scholar status and assignment rule

	Full sample	**Intermediate bandwidth (+/-100)**	**Optimal Bandwidth (+/-33)**
Assignment rule	0.945***	0.944***	0.942***
	(0.007)	(0.008)	(0.009)
Centered score	0.000***	0.000***	0.000***
	(0.00)	(0.00)	(0.000)
Centered Score x Assign. rule	-0.000*	-0.000	0.000
	(0.000)	(0.000)	(0.000)
Mean of outcome below threshold	0.0295	0.0288	0.0269
Observations	4604	4561	3181
Adjusted R^2	0.94	0.95	0.94

Source: The Dell Scholars Program database, Michael and Susan Dell Foundation, and the National Student Clearinghouse.

Notes: Robust standard errors are in the parentheses. The signs *, **, *** indicate significance at 10%, 5%, and 1% level, respectively. The impact coefficients of being selected as a scholar are estimated using an instrumental variable estimation, where scholar status is instrumented by the assignment rule. Additional controls include age, scaled GPA, ACT equivalent score, and indicators for cohort, state of residence, gender, race / ethnicity, parental education, free / reduced lunch eligibility, receipt of food stamps, receipt of federal health insurance, and receipt of Medicaid. We impute zero values and include dummies for missingness where students are missing valid values for these covariates. All specifications use a first-order polynomial, a uniform kernel, and bandwidth selector of Calonico, Cattaneo, and Titiunik (2014).

Table 7. Impact of scholar selection on immediate college enrollment and completion outcomes

Outcome	μ	Treatment effect estimates across bandwidths: Full sample	Intermediate bandwidth (+/-100)	Optimal bandwidth	Range of optimal bandwidth	Cohorts
Immediate enrollment	0.812	0.011	0.036	0.028	+/-41	2009-14
		(0.021)	(0.025)	(0.038)		
		[4604]	[3866]	[2040]		
2nd year persistence rate	0.672	0.022	0.048	0.013	+/-27	2009-13
		(0.026)	(0.031)	(0.061)		
		[3785]	[3229]	[1179]		
3rd year persistence rate	0.563	0.048	0.046	0.077	+/-30	2009-12
		(0.031)	(0.037)	(0.069)		
		[3019]	[2585]	[1049]		
4th year persistence rate	0.461	0.040	0.026	0.088	+/-29	2009-11
		(0.036)	(0.042)	(0.080)		
		[2214]	[1917]	[753]		
BA degree attainment	0.458	0.083**	0.090**	0.067	+/- 40	2009-11
		(0.034)	(0.040)	(0.062)		
		[2214]	[1917]	[1020]		
BA attainment, in 4 years	0.246	0.092***	0.090**	0.082	+/-33	2009-11
		(0.032)	(0.038)	(0.067)		
		[2214]	[1917]	[847]		
BA attainment, in 6 years	0.605	0.147**	0.161**	0.192*	+/-45	2009
		(0.063)	(0.073)	(0.108)		
		[643]	[563]	[337]		

Source: The Dell Scholars Program database, Michael and Susan Dell Foundation, and the National Student Clearinghouse.

Notes: Robust standard errors are in the parentheses, sample size in brackets. The signs *, **, *** indicate significance at 10%, 5%, and 1% level, respectively. The impact coefficients of being selected as a scholar are estimated using an instrumental variable estimation, where scholar status is instrumented by the assignment rule. The numbers in the first columns are the means of the outcome variables among applicants just below the threshold from estimations using the full sample. Additional controls include age, scaled GPA, ACT equivalent score, and indicators for cohort, state of residence, gender, race / ethnicity, parental education, free / reduced lunch eligibility, receipt of food stamps, receipt of federal health insurance, and receipt of Medicaid. We impute zero values and include dummies for missingness where students are missing valid values for these covariates. All specifications use a first-order polynomial, a uniform kernel, and bandwidth selector of Calonico, Cattaneo, and Titiunik (2014).

Table 8. Impact of scholar selection on college quality and college type

		Treatment effect estimates across bandwidths				
Outcome	μ	**Full sample**	**Intermediate bandwidth (+/-100)**	**Optimal bandwidth**	**Range of optimal bandwidth**	**Cohorts**
Instructional expenditure PFTE[a]	$9521.59	-290.60	411.30	342.70	+/-25	2009-14
		(644.00)	(570.90)	(1083.40)		
		[4604]	[3886]	[1280]		
Enrollment in four-year, public institution	0.644	0.009	0.036	0.059	+/-37	2009-14
		(0.026)	(0.031)	(0.051)		
		[4604]	[3886]	[1866]		
Enrollment in four-year, in-state institution	0.563	0.011	0.024	0.036	+/-43	2009-14
		(0.025)	(0.029)	(0.045)		
		[4604]	[3886]	[2131]		
Enrollment in four-year, in-state, public institution	0.532	0.013	0.031	0.106**	+/-34	2009-14
		(0.026)	(0.031)	(0.053)		
		[4604]	[3866]	[1726]		

Source: The Dell Scholars Program database, Michael and Susan Dell Foundation, and the National Student Clearinghouse.

Notes: Robust standard errors are in the parentheses, sample size in brackets. The signs *, **, *** indicate significance at 10%, 5%, and 1% level, respectively. The impact coefficients of being selected as a scholar are estimated using an instrumental variable estimation, where scholar status is instrumented by the assignment rule. The numbers in the first columns are the means of the outcome variables among applicants just below the threshold from estimations using the full sample. Additional controls include age, scaled GPA, ACT equivalent score, and indicators for cohort, state of residence, gender, race / ethnicity, parental education, free / reduced lunch eligibility, receipt of food stamps, receipt of federal health insurance, and receipt of Medicaid. We impute zero values and include dummies for missingness where students are missing valid values for these covariates. All specifications use a first-order polynomial, a uniform kernel, and bandwidth selector of Calonico, Cattaneo, and Titiunik (2014).

[a] Instructional expenditure per full-time equivalent (PFTE) is adjusted for inflation.

Table 9. Impacts of scholar selection on bachelor's degree attainment, by gender

	4th year persistence	**BA degree attainment**	**BA degree attainment, on time**	**BA degree attainment in six years**
		Male		
Dell scholar	0.017	0.092	0.106*	0.158
	(0.069)	(0.065)	(0.058)	(0.149)
μ	0.472	0.384	0.204	0.447
N	624	624	624	175
		Female		
Dell scholar	0.056	0.077*	0.080**	0.159**
	(0.042)	(0.040)	(0.039)	(0.073)
μ	0.447	0.480	0.266	0.612
N	1590	1590	1590	468
Cohorts Included	2009-2011	2009 - 2011	2009 – 2011	2009

Source: The Dell Scholars Program database, Michael and Susan Dell Foundation, and the National Student Clearinghouse.

Notes: Robust standard errors are in the parentheses. The signs *, **, *** indicate significance at 10%, 5%, and 1% level, respectively. The impact coefficients of being selected as a scholar are estimated using an instrumental variable estimation, where scholar status is instrumented by the assignment rule. The coefficients μ below the impact estimates are the means of the outcome variables among applicants just below the threshold. Additional controls include age, scaled GPA, ACT equivalent score, and indicators for cohort, state of residence, gender, race / ethnicity, parental education, free / reduced lunch eligibility, receipt of food stamps, receipt of federal health insurance, and receipt of Medicaid. We impute zero values and include dummies for missingness where students are missing valid values for these covariates. All specifications use a first-order polynomial, a uniform kernel, and bandwidth selector of Calonico, Cattaneo, and Titiunik (2014).

Table 10. Impacts of scholar selection on bachelor's degree attainment, by race / ethnicity

	4th year persistence	**BA degree attainment**	**BA degree attainment, on time**	**BA degree attainment in six years**
			Black and Hispanic	
Dell scholar	0.0249	0.0731*	0.0591	0.154**
	(0.0419)	(0.0403)	(0.0381)	(0.0768)
μ	0.471	0.464	0.269	0.622
N	1553	1553	1553	443
			White and Asian	
Dell scholar	0.114*	0.164***	0.166***	0.209
	(0.0665)	(0.0617)	(0.0607)	(0.135)
μ	0.472	0.437	0.238	0.564
N	619	619	619	186
Cohorts Included	2009-2011	2009 - 2011	2009 – 2011	2009

Source: The Dell Scholars Program database, Michael and Susan Dell Foundation, and the National Student Clearinghouse.

Notes: Robust standard errors are in the parentheses. The signs *, **, *** indicate significance at 10%, 5%, and 1% level, respectively. The impact coefficients of being selected as a scholar are estimated using an instrumental variable estimation, where scholar status is instrumented by the assignment rule. The coefficients below the impact estimates are the means of the outcome variables among applicants just below the threshold. Additional controls include age, scaled GPA, ACT equivalent score, and indicators for cohort, state of residence, gender, race / ethnicity, parental education, free / reduced lunch eligibility, receipt of food stamps, receipt of federal health insurance, and receipt of Medicaid. We impute zero values and include dummies for missingness where students are missing valid values for these covariates. All specifications use a first-order polynomial, a uniform kernel, and bandwidth selector of Calonico, Cattaneo, and Titiunik (2014).

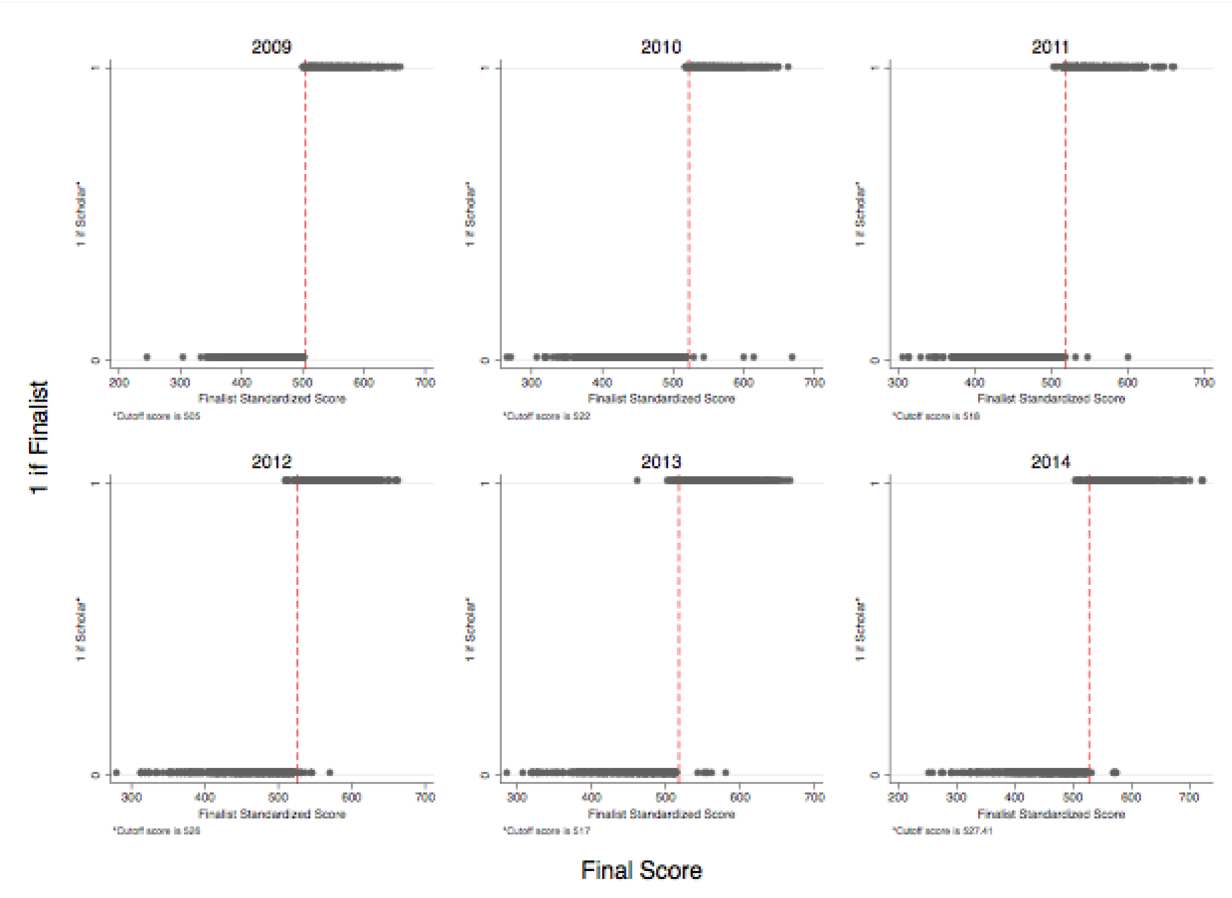
Table 11. Impacts of scholar selection on bachelor's degree attainment, by first-generation status

	4th year persistence	**BA degree attainment**	**BA degree attainment, on time**	**BA degree attainment in six years**
		First-generation college goers		
Dell scholar	0.0590	0.0898**	0.0760**	0.172**
	(0.0403)	(0.0387)	(0.0370)	(0.0746)
μ	0.476	0.438	0.228	0.593
N	1654	1654	1654	468
		Non first-generation college-goers		
Dell scholar	0.0147	0.0532	0.159**	0.182
	(0.0828)	(0.0769)	(0.0731)	(0.150)
μ	0.436	0494	0.293	0.599
N	521	521	521	160
Cohorts Included	2009-2011	2009 - 2011	2009 – 2011	2009

Source: The Dell Scholars Program database, Michael and Susan Dell Foundation, and the National Student Clearinghouse.

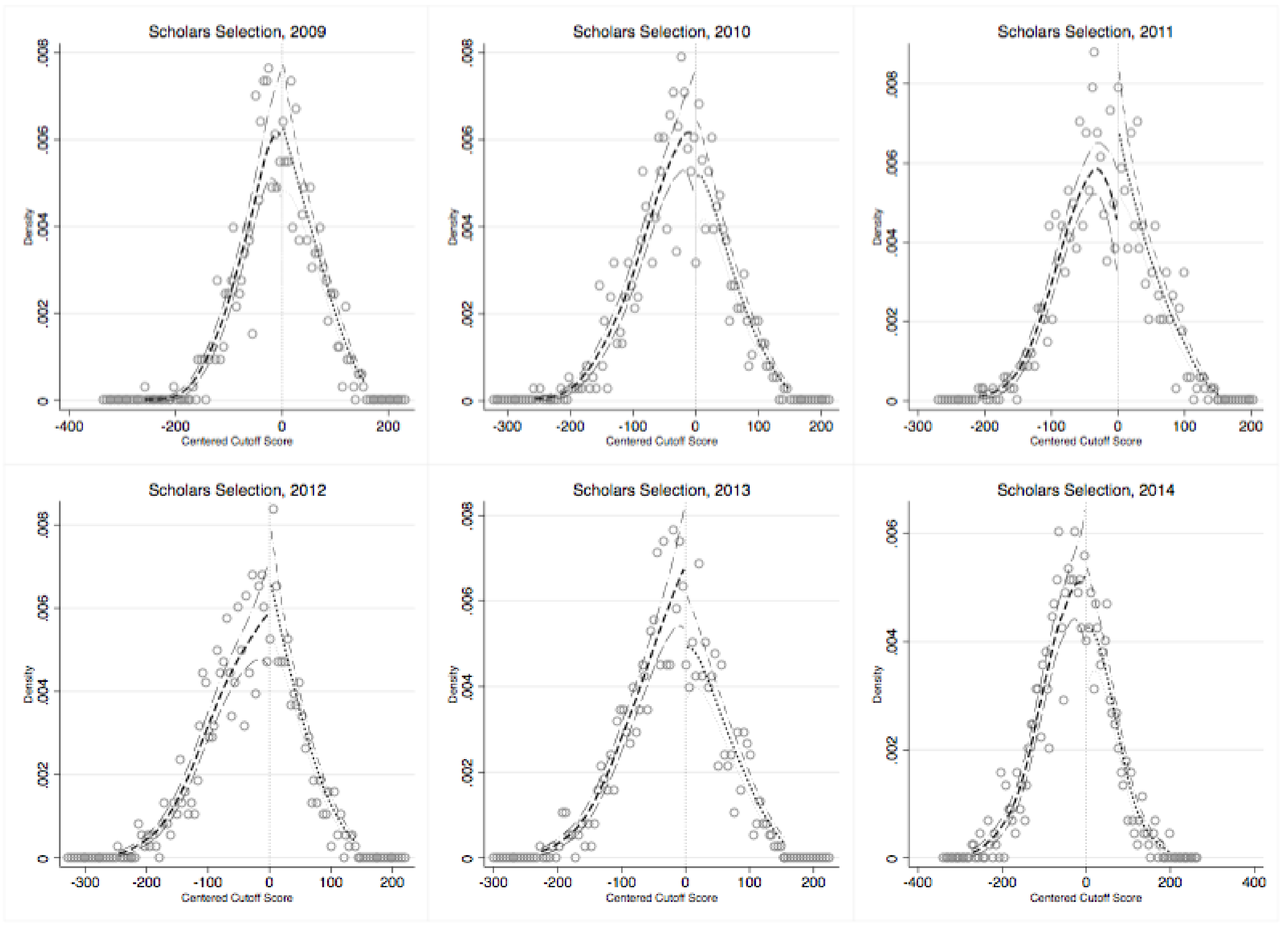
Notes: Robust standard errors are in the parentheses. The signs *, **, *** indicate significance at 10%, 5%, and 1% level, respectively. The impact coefficients of being selected as a scholar are estimated using an instrumental variable estimation, where scholar status is instrumented by the assignment rule. The coefficients below the impact estimates are the means of the outcome variables among applicants just below the threshold. Additional controls include age, scaled GPA, ACT equivalent score, and indicators for cohort, state of residence, gender, race / ethnicity, parental education, free / reduced lunch eligibility, receipt of food stamps, receipt of federal health insurance, and receipt of Medicaid. We impute zero values and include dummies for missingness where students are missing valid values for these covariates. All specifications use a first-order polynomial, a uniform kernel, and bandwidth selector of Calonico, Cattaneo, and Titiunik (2014).

Figure 1. Relationship between scholar status and finalist score, by year



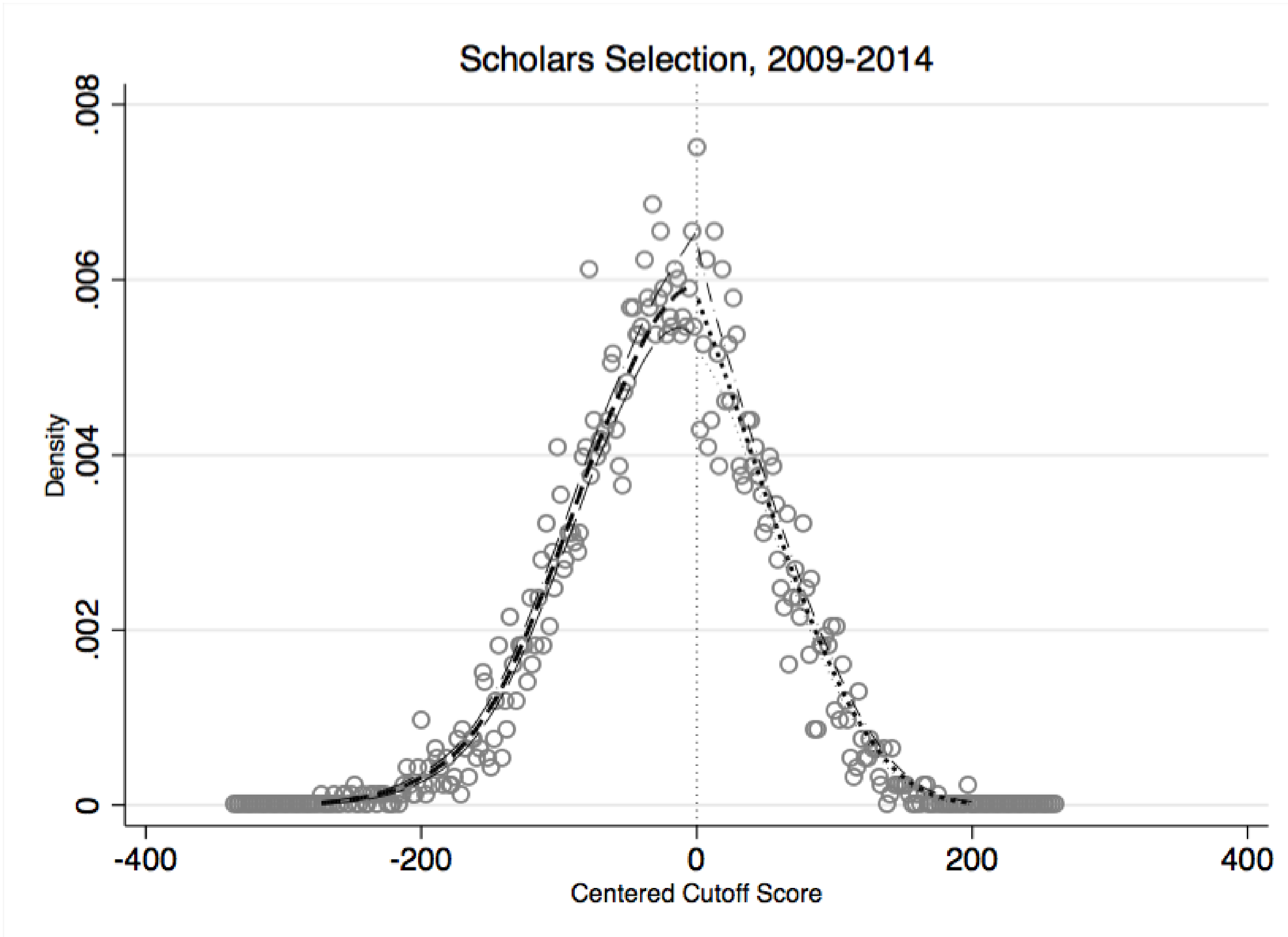
Source: The Dell Scholars Program database, Michael and Susan Dell Foundation.

Figure 2. Graphical representation of the McCrary density tests by year for the scholar selection



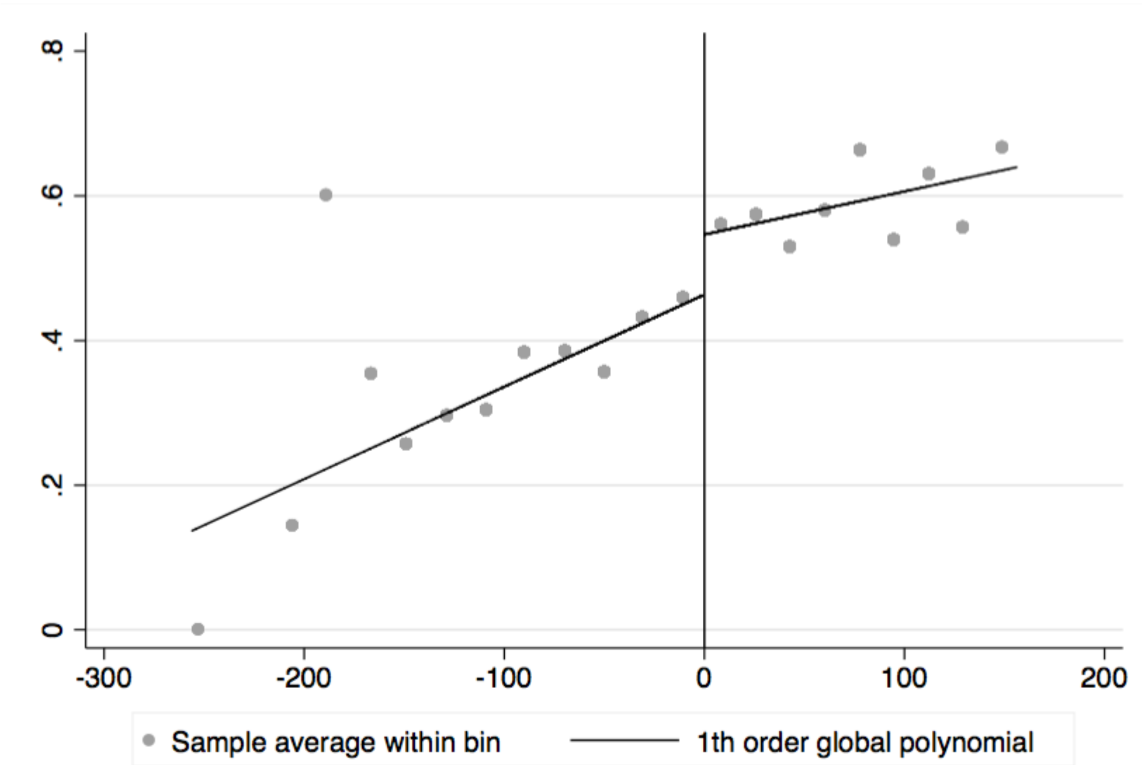
Source: The Dell Scholars Program database, Michael and Susan Dell Foundation.

Figure 3. Graphical representation of the McCrary density tests for the scholar selection, 2009-2014



Source: The Dell Scholars Program database, Michael and Susan Dell Foundation.

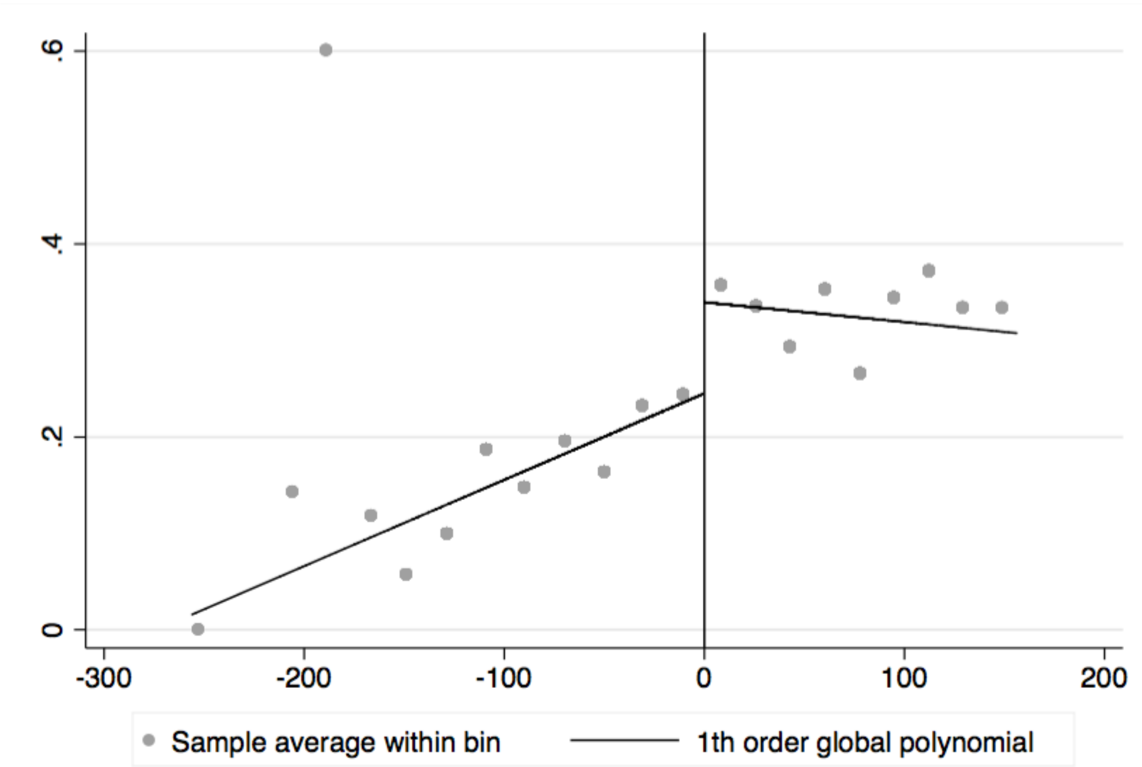
Figure 4. Regression Discontinuity Plot: BA Degree Attainment, 2009-2011



Source: The Dell Scholars Program database, Michael and Susan Dell Foundation, and the National Student Clearinghouse.

Notes: all specifications use a first-order polynomial, a uniform kernel, and bandwidth selector of Calonico, Cattaneo, and Titiunik (2014). We use an intermediate bandwidth of 100 to calculate the number of bins for the plot.

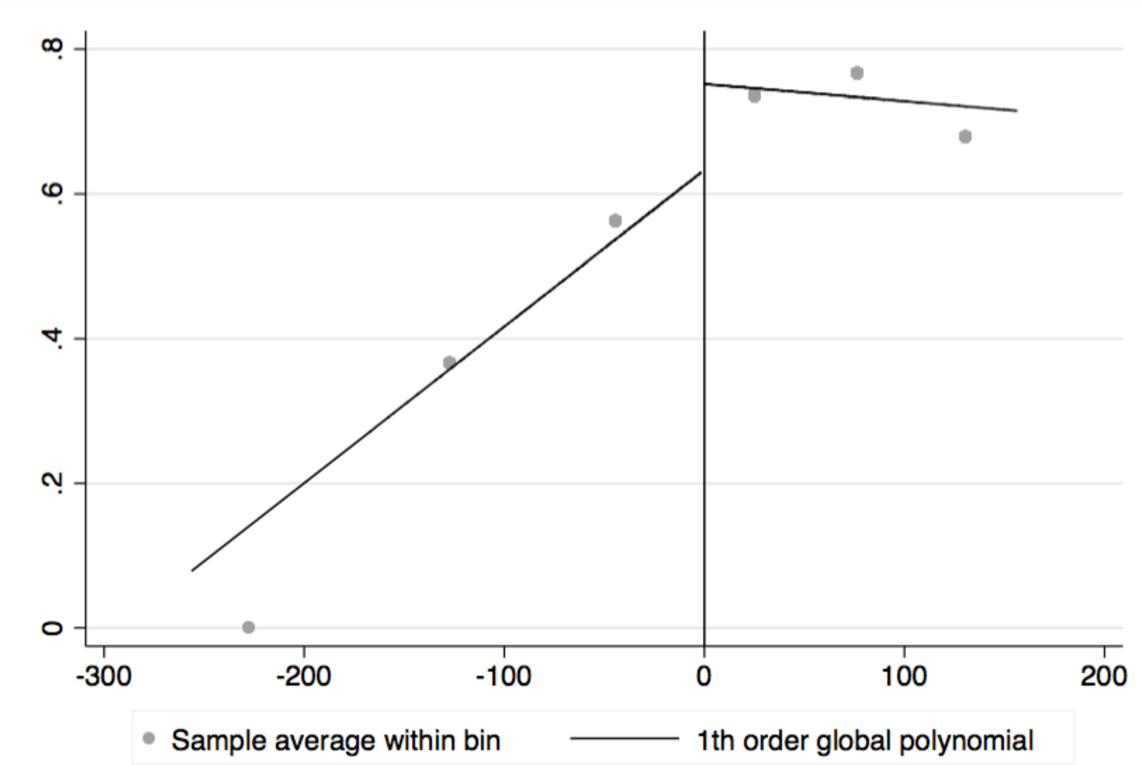
Figure 5. Regression Discontinuity Plot: On-Time BA Degree Attainment, 2009-2011



Source: The Dell Scholars Program database, Michael and Susan Dell Foundation, and the National Student Clearinghouse.

Notes: all specifications use a first-order polynomial, a uniform kernel, and bandwidth selector of Calonico, Cattaneo, and Titiunik (2014). We use an intermediate bandwidth of 100 to calculate the number of bins for the plot.

Figure 6. Regression Discontinuity Plot: BA Degree Attainment in 6 Year



Source: The Dell Scholars Program database, Michael and Susan Dell Foundation, and the National Student Clearinghouse.

Notes: all specifications use a first-order polynomial, a uniform kernel, and bandwidth selector of Calonico, Cattaneo, and Titiunik (2014). We use an intermediate bandwidth of 100 to calculate the number of bins for the plot.

7. Appendix A: Semifinalist Selection Algorithm

7.1. Semifinalist selection algorithm

The semifinalist algorithm consists of three sub-algorithms: a sub-category scoring algorithm, a calibration algorithm, and a final score algorithm. The first algorithm identifies responses for each question in a particular sub-category and computes the score for the sub-category. The calibration algorithm standardized the sub-category scores and computes adjusted weights for each sub-category. The final score algorithm use the adjusted weights and the standardized sub-category scores to calculate the category score. The program uses the category scores and repeats the algorithms to compute the final score.[26]

Table A1 summarizes the main categories and the corresponding weights in the old and new semifinalist algorithm. The main categories for the semifinalist algorithm are academics, an index of disadvantage, and responsibility. The structure of the main categories is relatively similar between the old and new algorithm. A notable change is the simplified responsibility indices in the new algorithm. In both the new and old algorithm, the Dell Scholar Team assigns relatively higher weights on the academics and the index of disadvantage categories. The weights are larger in the new algorithm, making up about a three quarter of the total score.

7.2. Scholar scoring and selection algorithm

Selected semifinalists provide additional materials that are added to their application portfolio. A selection committee member reviews this portfolio and a second scoring algorithm is used to generate a final application composite score. The finalist algorithm is, in principle, similar to the semifinalist algorithm. The finalist algorithm also consists of three sub-algorithms: a sub-category scoring algorithm, a calibration algorithm, and a final score algorithm. However, there are several notable differences between the semifinalist and finalist algorithms. First, the categories and the corresponding weights are different, as summarized in Table A2. Second, the calibration algorithm in the scholar selection process computes score adjustments before it standardized each score. The calibration routine in the finalist algorithm has this extra step

[26] During the life of the Dell Scholars Program, the semifinalist-scoring algorithm changed. The original scoring algorithm was used from 2009 to 2013 after which it was updated. This description reflects the current algorithm. The original algorithm grouped the scoring into the main categories, academics, disadvantage, and responsibility, while the current algorithm groups the scoring into subcategories. The score adjustment and standardization algorithm remains unchanged.

because two selection committee members review each application. Specifically, the algorithm adjusts a committee's score for a sub-category if the score difference with her partner lies outside of a specific computed interval.[27]

The last difference is the computation of the final score. In the finalist algorithm, a category score is included in the computation of the final score if the score lies within a program-specified interval. The final score can include only one category score if the other scores lie outside of the interval.

[27] Starting in 2014, the finalist algorithm does not normalize category scores anymore. Instead, the finalist algorithm normalizes each question individually.

Table A1. The Categories and Corresponding Weights in the Semifinalist Algorithm

Category	**Semifinalist Algorithm**	
	2010	**2014**
Academics	0.28	0.38
Disadvantage index	0.28	0.38
Responsibility: home	0.18	0.12
Responsibility: work	0.18	0.12
Responsibility: community	0.08	

Source: The Dell Scholars Program database, Michael and Susan Dell Foundation.

Table A2. The Categories and Corresponding Weights in the Finalist Algorithm

Category	**Finalist Algorithm**	
	2010	**2014**
Academics	0.34	0.34
Disadvantage index	0.34	0.26
Responsibility: home	0.16	
Responsibility: work	0.16	
Responsibility*		0.32
Personal achievement		0.08

Source: The Dell Scholars Program database, Michael and Susan Dell Foundation.

Note: Home and work responsibilities are integrated into one responsibility category in the new algorithm.