Abstract Title Page
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Title:

SMART Money: Do Financial Incentives Encourage College Students to Study Science?

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Abstract Body

Limit 4 pages single-spaced.

Background / Context:

Description of prior research and its intellectual context.

The U.S. federal government spends $60 billion annually on science research (Saha & Weinberg 2010). This investment is justified largely in terms of the economic benefits basic and applied research generates to keep our economy competitive in the global marketplace. The success of this investment inherently rests on the labor supply of human capital capable of conducting and consuming scientific research. By encouraging college students to invest in studying science, it may be possible to increase the domestic supply of technical expertise in the workforce. Incentives for college students can have two mechanisms. The first is to persuade students to select a science major, and the second promotes persistence to degree.

Although virtually no literature exists on financial aid's impact on major choice, there is a growing literature related to financial aid and college persistence.

By studying a state financial aid policy change in Ohio that shifted the distribution of state grant money, Bettinger (2010) estimates the winners and losers of the policy using state administrative data and a difference-in-differences approach. An average increase of $750 in aid is found to improve first to second year retention by two percentage points. Unfortunately, he is only able to follow students into their second year of college, so whether aid improves persistence rates in later undergraduate years and through graduation remains unknown.

A randomized experiment in Wisconsin offered Pell Grant recipients $1,750 per semester for up to 10 semesters (Goldrick-Rab & Harris 2010). The study covers students who started college in 2008 across 13 four-year public universities that are both selective and non-selective. By comparing the treatment group to the control group of Pell recipients who did not receive the additional money, they find that after four semesters of treatment, the additional financial aid increased persistence by three percentage points.

Using a random assignment design, the opening doors project administered by MDRC provided an additional $1,000 per semester on top of their federal financial aid to low-income single mothers at community colleges (Brock and Richburg-Hayes 2006). The study found that the treatment group's full-time enrollment level in the second semester was twenty percentage points higher than the control group and ten percentage points higher in the third term. Unfortunately, it only covers single mothers at two community colleges in LA, so the generalizability of the findings is questionable.

In summary, results indicate that financial aid does have some positive impact on student persistence, but evidence is weak on persistence measures in later years and to graduation. Additionally, these studies deal with lower amounts of financial aid than the SMART Grant, and we may not expect the impact of aid on persistence to be linear. The current study seeks to contribute specifically to these deficiencies in the literature.

On the important topic of financial incentives impacting major selection, there is no major study. There is a larger literature on why students choose certain majors which concludes they are driven predominately by predicted future earnings, but the current analysis may be the first to focus on how receiving an immediate grant affects major selection.

That major choice is driven in large part by future earnings raises a significant theoretical question about why financial aid incentives are necessary. Economic theory holds that the labor market should adjust compensation so that supply equals demand without intervention from the government to encourage human capital investment in certain fields. The intervention in this case may be justified because the labor market for high science skills falls victim to the cobweb model in which there is a substantial time lag between supply and demand decisions. Freeman (1975 & 1976) describes this issue in detail for the labor market for engineers and physicists. The decision to enroll in a certain major is made while looking at the current salary for science majors without anticipating future changes to the labor market.

Perhaps the government has a role in changing the investment decision if it can anticipate future market shortages. If so, there should be observable changes in the decision to major in science if the grant changes the investment decision.

Purpose / Objective / Research Question / Focus of Study:

Description of the focus of the research.

This research examines the short term success of a postsecondary federal financial aid program, the SMART Grant, designed to increase this stock of scientific human capital. An exploration of the success of this program provides the opportunity to address two critically important research questions. Do financial incentives encourage students to major in science? Does additional grant aid improve undergraduate persist at four-year colleges? By exploiting the GPA and Pell eligibility cutoffs to receive a SMART Grant, this paper employs a regression discontinuity analysis to answer both questions.

Setting:

Description of the research location.

Although the data relies on college students from the state of Ohio, the financial aid program is available nationally.

Population / Participants / Subjects:

Description of the participants in the study: who, how many, key features, or characteristics.

The study relies on institutional data on all entering public four-year college students in the state of Ohio. This administrative data is obtained directly from the Ohio Board of Regents. The initial results presented below are based only on freshman entering in 2009, but further analyses will include recently received panel data covering students entering in 2004 through 2009 throughout their academic careers as long as they remain in the Ohio public college system. The data enable the analysis to account for SMART Grant eligibility and major choice term by term.

The data for the entering class of 2009 include over 40,000 students and contain important academic and financial variables. The most important variables for the analysis are EFC which determines financial aid eligibility, GPA to determine SMART eligibility, major choice, retention, and degree completion. Because the initial analysis only includes entering student data, the descriptive statistics n Table 1 only contain initial major selection, whether students applied for financial aid via the FAFSA, their EFC, and whether the EFC enables them to be Pell Grant eligible.

(Insert Table 1 here.)

Nearly 74 percent of entering college freshman in Ohio filed a FAFSA, and over 31 percent were eligible to receive a Pell Grant. Nearly 22 percent selected a SMART eligible major upon arriving at the campus (it is typical in Ohio to choose a major upon application and matriculation).

Intervention / Program / Practice:

Description of the intervention, program, or practice, including details of administration and duration.

The purpose of the National Science and Mathematics Access to Retain Talent (SMART) Grant is to encourage low-income, postsecondary students to major in science. The program provides financial incentives of $4,000 per year to students in their third and fourth year of undergraduate study if they major in a qualified discipline. The additional eligibility requirements are a cumulative 3.0 college GPA and eligibility to receive a Pell Grant, the federal government's college grant program for low-income students. The grant began in the 2006-07 school year but was federally defunded so that the last grant was distributed in the spring semester of the 2010-11 school year. To the extent that financial incentives increase the number of students graduating with degrees in the sciences, the SMART Grant could be a valuable lever to encourage additional human capital investment in scientific knowledge.

Research Design:

Description of the research design.

This quantitative causal analysis employs a regression discontinuity design. Regression discontinuity relies on an exogenously determined cutoff along a continuous measure, the rating score. On one side of the cutoff, subjects are exposed to the treatment, but on the other side, the subjects do not receive the treatment. The causal identification assumption is that near the cut point, subjects are basically similar and randomly distributed; therefore, the only difference between treatment and control subjects is their exposure to treatment.

Specific to this study, the treatment is considered to be eligibility for the SMART Grant money, and the outcome variables of interest are whether or not the student chooses a SMART major, year to year persistence, and degree completion. There are two continuous rating scores and two cutoff thresholds that are used to measure the treatment effect. The first is college GPA. A 3.0 cumulative GPA is required to receive the SMART Grant. Examining students on either side of the GPA threshold that meet all of the other eligibility criteria will provide one estimate of the program's impact.

The second rating score is the Expected Family Contribution (EFC). To be eligible for a SMART Grant, students must be eligible to receive a Pell Grant. Pell Grant eligibility is determined by a student's EFC. The EFC is calculated using a complex, opaque formula that accounts for parental and student income and assets, family size, and number of siblings attending college. There is a strict cut point in EFC each year that determines eligibility for the Pell Grant. For example, students entering college in the fall of 2009 experienced a cut point of $4,616. This means that students with EFCs below that threshold were eligible to receive a Pell Grant (and therefore a SMART Grant), and students whose EFCs were above that threshold were ineligible.

Data Collection and Analysis:

Description of the methods for collecting and analyzing data.

Administrative data is provided by the Ohio Board of Regents.

The main estimation equation for the SMART major outcome is:

$$SMARTmajor_i = \beta_0 + \beta_1 pelleilg_i + \beta_2 EFC_i + \beta_3 pellelig_i * EFC_i \quad (1)$$

Similar equations are defined for the persistence outcome and GPA threshold. The equation forces linear specifications, but the interaction term allows for different slopes on either side of the discontinuity. The coefficient of interest is β_1 which estimates the difference in the intercept at the threshold once the rating score is recentered around the cut point. Similar equations are estimated using the GPA cut point and for the different outcomes of interest. The SMART major can be estimated at different phases of the undergraduate's career. Their initial major choice could plausibly be affected if they are anticipating receipt of the additional $4,000 per year in two years, but it is potentially more likely that they will shift majors during the first or second year into a SMART major once they learn about the possible grant award. Due to outcome variable's binary nature, the equation is estimated using a logit model. Because of the potential differences across universities, the estimation also employs campus fixed effects.

Findings / Results:

Description of the main findings with specific details.

This section focuses on the initial results when estimating Equation (1) using the EFC rating score and SMART major outcome. Further work will focus on the GPA rating score and additional persistence outcomes. Figure 1 demonstrates that for the EFC rating score, bunching on one side of the discontinuity does not exist. This ensures that students are not gaming their EFC in order to be eligible for the treatment and suggests students are actually randomized around the cut point thereby satisfying the regression discontinuity identifying assumption.

(Insert Figure 1 here.)

Figure 2 shows the graphical relationship of SMART Grant major selection around the EFC cutoff. The y-axis is the probability of choosing a SMART grant major and the point represent the average value of all students in bins of various EFC widths as noted by the Band number of each graph. Because the conclusions from regression discontinuity only apply to observations around the cut point, the analysis is limited to a range of $500 of EFC on either side of the threshold.

(Insert Figure 2 here.)

Regardless of bin width, those to the left of the cut point and thereby eligible to receive the SMART grant have a higher probability of choosing a SMART major than non eligible students immediately to the right of the EFC eligibility threshold. Estimation of Equation (1) confirms the visual results providing positive point estimates a high as 4.4 percentage points. However, the regression results are not statistically significant. When the newly received additional years of data are included in the analysis, the precision of the regression estimates will improve.

Conclusions:

Description of conclusions, recommendations, and limitations based on findings.

With only one year of data currently available, it is hard to reach definitive conclusions about the impact of the SMART Grant. However, initial results suggest that students eligible to receive the SMART Grant may have higher probability of selecting a science major. Forthcoming data will enable more precise estimation of these impacts as well as permit an analysis of college persistence.

Appendices
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Appendix A. References
References are to be in APA version 6 format.

Bettinger, E. P. (2010). Need-based aid and student outcomes: The effects of the Ohio College Opportunity Grant. *Working paper.*

Brock T. & Richburg-Hayes L. (2006). Paying for persistence: Early results of a Louisiana scholarship program for low-income parents attending community college. New York: MDRC.

Freeman, R. B. (1975). Supply and salary adjustments to the changing science manpower market: Physics, 1948-1975. *American Economic Review,* 65(1), 27-39.

Freeman, R. B. (1976). A cobweb model of the supply and starting salary of new engineers. *Industrial & Labor Relations Review,* 29(2), 236-48.

Goldrick-Rab, S. & Harris D. (2010). Can need-based aid increase college persistence? Evidence from a randomized trial. Presentation at APPAM, Boston.

Saha, S. S. & Weinberg B. A. (2010). Estimating the indirect economic benefits from science. Paper presented at the Workshop on the Science of Science Measurement. Washington DC: Executive Office of the President, Office of Science and Technology Policy.

Appendix B. Tables and Figures

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Table 1: Descriptive Statistics for Entering Students in 2009

Variable	N	Mean	Std. Dev.
SMART Major	42104	0.218934	0.413529
Completed FAFSA	42104	0.73993	0.438678
EFC	31154	12915.93	16511.93
Eligible for Pell	42104	0.313058	0.463743

Figure 1: Distribution of the EFC rating score

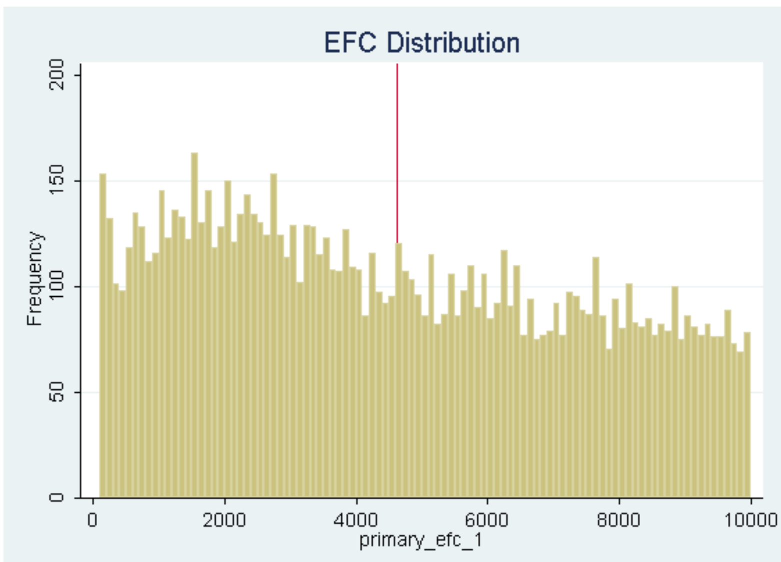
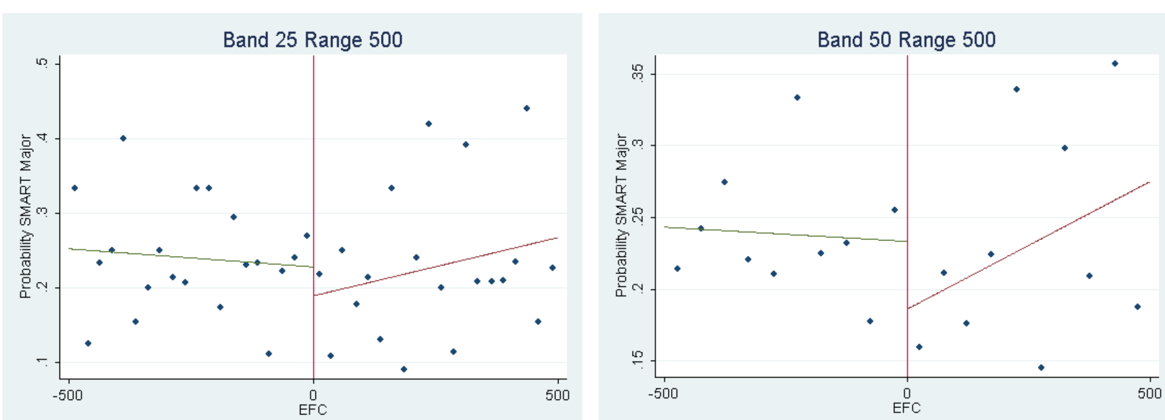
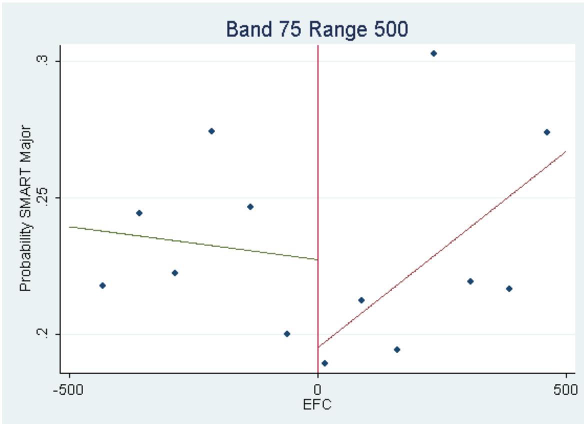
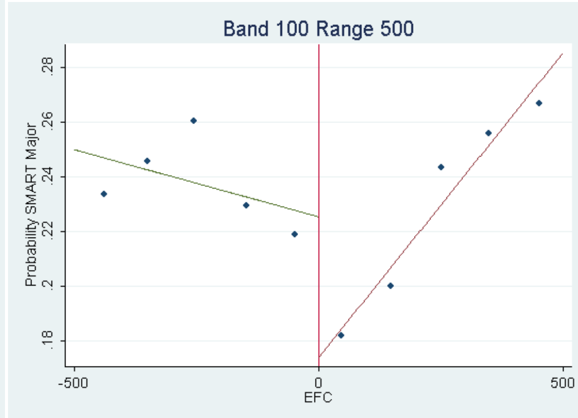


Figure 2: Graphing the discontinuity at different bin widths




Band 75 Range 500
Probability SMART Major
.2
.25
.3
-500
0
500
EFC


Band 100 Range 500
Probability SMART Major
.18
.2
.22
.24
.26
.28
-500
0
500
EFC