Federal Research Funding and STEM Education

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Abstract

We examine how federal science and engineering research funding——though intended to advance research——affects degree production and programs offered in STEM. Using data from 1971–2016, we implement a triple-difference design that exploits variation across colleges, time, and fields of study. We find that federal grants generate 27.4% of doctorates and 14.7% of undergraduate STEM degrees, as well as 6.3% of doctoral programs and 3.7% of undergraduate programs in STEM annually across 200 U.S. research universities. Impacts are concentrated in biology and engineering, aligning with the priorities of major funders such as HHS, NSF, and DOD. These findings suggest that research grants to universities may generate a "double dividend," simultaneously expanding the supply of skilled labor in targeted fields while also advancing scientific discovery.

Keywords: federal research funding, higher education, STEM, major choice, innovation

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1 Introduction

Government research grants constitute a major source of support for academic research worldwide.[1] In the United States, federal funding constitutes the primary source of support for academic research, with federal agencies spending over $60 billion annually on university research and development, largely motivated by the goal of advancing scientific discovery.[2] Yet universities jointly produce research and education, raising a central question: do policies designed to stimulate research and innovation also shape the supply of skilled workers trained in the fields they support?

Concerns about the supply of STEM workers have long shaped policy debates over how government policies can help expand the supply of skilled labor (Atkinson 1990; PCAST 2012; Bloom et al. 2020). While public research funding promotes innovation (Babina et al. 2023), research support and educational access are often viewed as competing priorities for scarce public funds (Akcigit, Pearce, and Prato 2025). Yet federal research support played an important role not only in promoting technological innovation, but also in training students—an effect that was suggested by the National Research Council in the 1990s (National Research Council 1999). If research funding expands educational capacity, investments in research need not come at the expense of education, as the two objectives may be more complementary than commonly perceived.

This paper studies whether federal science and engineering (S&E) research funding—the most prominent form of government research support—affects the production of human capital in STEM fields, measured through changes in the number of STEM graduates and degree programs at the doctoral, master's, and bachelor's levels in U.S. universities. While research grants directly finance faculty research, laboratories, and graduate researchers, universities may respond more broadly by expanding instructional capacity, attracting students toward funded disciplines, and introducing new academic programs. If so, research funding may influence not only innovation outcomes but also the long-run composition of the skilled workforce.

We address this question by linking degree completion data from the National Center for Educa-

[1] In 2021, G7 countries spent between 0.34% (Italy) and 0.66% (Canada) of GDP on R&D in the higher education sector, with U.S. spending at approximately 0.36% (Statistics Canada 2024).

[2] Source: `https://ncses.nsf.gov/pubs/nsf26305`

tion Statistics (NCES) with agency-university-year funding data from the NSF's NCSES, creating a panel that extends back to 1971. Our empirical strategy uses a triple-difference design, comparing STEM and non-STEM (control) outcomes within the same university over time as federal research funding changes. This approach controls for university-level factors that vary over time and may be correlated with research funding and educational outcomes, relying instead on the comparison between funded fields (STEM) and non-funded fields over time and across colleges.

A potential concern with the triple-difference method is spillovers across fields—either positive, if S&E funding indirectly benefits other fields through universities reallocating resources internally, or negative, if students switch fields. The availability of multiple non-STEM fields as controls allows identification to draw on alternative comparison groups, mitigating concerns that spillovers affecting any single field drive the results. We also address potential concerns about spillovers by estimating the effect of S&E research funding on non-STEM fields using two-way fixed-effects regressions with extensive controls. We find little evidence of meaningful spillovers for most fields. Further, to address time-varying confounders—for example, STEM-specific trends correlated with grant funding increases—we conduct placebo tests by regressing outcomes on future federal funding. Finally, to assess the possibility of heterogeneity in treatment effects, we perform separate analyses for multiple time periods and for universities with above- or below-median enrollment, and above- or below-median grants at baseline.

We document two main findings. First, increases in federal research funding substantially expand STEM degree production at all levels of university education. Funding increases raise doctoral and master's degree completion and generate sizeable spillovers to undergraduate education—even though undergraduate students are rarely directly supported by research grants. On average, the aggregate annual federal S&E research funding to universities supports roughly 4,400 doctoral, 9,700 master's, and 18,400 bachelor's degrees over the award year and the following six years, accounting for 27.4 percent, 22.5 percent, and 14.7 percent of STEM degrees awarded in our sample.[3] These magnitudes indicate that federal research funding accounts for a substantial

[3]We allow for the grants to have an effect up to six years in the future, accounting for the possibility that a grant takes some time to spend, affect instruction, and then show up in graduation numbers. The timeframe is chosen to reflect the typical duration of a PhD program.

share of STEM human capital formation in the United States.

Second, universities respond along the extensive margin by expanding educational capacity in funded fields. Aggregate annual S&E funding to universities leads to the creation of roughly 161 doctoral programs across research universities within seven years of funding—about 6.3 percent of the average number of doctoral programs offered. Similar effects emerge at other degree levels, with approximately 136 additional master's programs and 135 undergraduate programs, representing 4.3 percent and 3.7 percent of the corresponding programs. These results indicate that research funding induces persistent institutional expansion rather than only temporary enrollment adjustments. Introducing a new program could involve developing entirely new coursework and/or formalizing existing clusters of courses into new programs. For example, a university with an existing program in "Computer and Information Sciences" or "Electromechanical Engineering Technology" may establish more specialized programs such as "Artificial Intelligence" or "Robotics Technology".

Disaggregating the overall STEM effect by subfield— Engineering including Computer Science, Biology, Physics, Mathematics, and Economics — shows that the effects are primarily driven by Engineering and Biology. This reflects the funding composition: throughout most of our panel, over half of total S&E funding came from the Department of Health and Human Services (HHS), which is more likely to support research in Biological Sciences. Other large funders, such as the NSF and the Department of Defense (DOD), allocate a substantial share of their funding to Engineering and Computer Science. In contrast, the physical sciences, mathematics, and economics receive comparatively less federal research support.

Two considerations help interpret these results. First, federal research funding is primarily intended to support scientific research—not student education—with most spending directed toward salaries, subcontractors, and equipment (NCSES 2024). Thus, our estimates reflect indirect spillovers on educational outcomes. These spillovers, however, represent an important channel through which government support for university-based research can shape student skill acquisition and, ultimately, the labor supply. Second, federal grants may crowd in additional private or institutional funding (Lanahan, Graddy-Reed, and Feldman 2016). To the extent that federal sup-

port triggers such complementary investment, our estimates capture the broader impact of research funding on university expansion.

While our analysis focuses on estimating the effects of federal research funding on educational outcomes, several mechanisms may underlie these responses. Research funding can attract graduate students through expanded research opportunities and assistantships, while at the undergraduate level it may increase instructional capacity by supporting graduate teaching and research personnel. More broadly, research activity may alter student demand and departmental resources in funded fields. While our analysis does not identify the underlying mechanisms, we discuss several plausible channels in Section 6.

Broadly, our results underscore that government research funding directed to universities does more than generate scientific output: it simultaneously expands the supply of human capital in the targeted fields. Because universities jointly produce research and education, they can leverage complementarities across these activities, allowing research support to translate into increased degree production and new program creation. In this way, federal research funding shapes not only innovation but also the structure of the STEM talent pipeline.

Previous work on the effects of federal research funding at universities has primarily focused on research, innovation, and entrepreneurship (Payne and Siow 2003; Jacob and Lefgren 2011; Åstebro and Bazzazian 2011; Corredoira, Goldfarb, and Shi 2018; Myers 2020; Myers and Lanahan 2022; Babina et al. 2023). Most studies find a positive effect on these outcomes. More closely related to our work are studies that examine graduate student outcomes in response to interruptions in federal grants at the lab-level (Tham 2023; Tham et al. 2024), and to grants awarded directly to graduate students (Chandler 2018; Graddy-Reed, Lanahan, and D'Agostino 2021; Graddy-Reed, Lanahan, and Ross 2018; Shvadron et al. 2025).[4] We contribute to this literature by examining the effect of federal funding awarded to faculty—the predominant form of funding—on STEM education at all levels.

Our work also contributes to the broader discussion on R&D and education (see Biasi, Deming,

[4] Shvadron et al. 2025 uses data on organizations listed in dissertation acknowledgments, which are more likely to capture support from grants or fellowships awarded directly to students.

and Moser 2022 for a review). Prior research suggests that when the supply of scientific talent is inelastic, government R&D funding may primarily raise scientists' wages with little effect on research output (Goolsbee 1998). Therefore, expanding R&D activity might require increasing the pool of potential researchers (Romer 2001), in which education plays an important role (Bianchi and Giorcelli 2020; Akcigit, Pearce, and Prato 2025). We add to this discussion by showing that federal R&D funding to universities can directly expand the pipeline of relevant human capital through spillovers on education.

Finally, our work contributes to the literature on universities' incentives to offer different courses and programs (Conzelmann 2024; Thomas 2024) and the associated cost differences (Altonji and Zimmerman 2019; Hemelt et al. 2021), by showing that increases in federal research funding to S&E departments can expand program offerings in related fields of study.

2 Historical Background: Federal Research Funding and STEM Education in the U.S.

Federal research funding to universities expanded significantly during World War II (Gross and Sampat 2023). Before the war, most university research was funded by private foundations and states, while the federal government contributed to national R&D primarily through work conducted in its own separate laboratories (National Research Council 1995). This shifted during the war toward extramural funding, with universities receiving the largest contracts (Gross and Sampat 2023). Throughout the 20th century, the U.S. government substantially increased its support for STEM fields and has remained a major funder of university-based S&E research, with its share averaging around 61% from 1953 to 2023 (U.S. NSF 2025).

In parallel with efforts to support S&E research at universities, there has long been interest in federal policies to strengthen STEM education. The National Defense Education Act of 1958 provided federal funding to strengthen science, math, and foreign language education, recognizing their strategic importance to national security. From the 1960s to 1980s, federal agencies, especially the Defense Advanced Research Projects Agency (DARPA) of the DOD, played a key

role in establishing major computer science departments (Aspray 1985). In the 2000s and 2010s, concerns about STEM workforce shortages gained prominence, with multiple reports from the National Academies and US President's advisory bodies calling for greater investment in STEM education (Carnevale, Smith, and Melton 2011; Mervis 2014). While direct federal funding for STEM education remains small compared to research support, these initiatives continue.[5]

More recent policies focus on education in artificial intelligence (AI) and semiconductors, reflecting current demand for STEM talent driven by the rise of AI, competition with China, and efforts to onshore critical R&D-intensive industries (West 2023; Zwetsloot et al. 2021; Cohen 2024). For example, in 2023, DARPA allocated $9 million to establish master's programs in AI and machine learning at multiple universities (Government Technology 2023). These initiatives showcase policymakers' interest in expanding educational offerings in STEM fields considered important for growth and innovation, as well as from a national security perspective. While assessing whether U.S. STEM graduation rates should be increased through policy intervention lies beyond the scope of this paper, we highlight that federal *research* funding indirectly expands STEM training and program offerings, despite these not being its primary objectives. Recognizing these spillover effects is important when considering how government funds should be allocated.

3 Data

Data on university characteristics, programs, and degree completions come from the NCSES Integrated Postsecondary Education Data System (IPEDS) and its predecessor, the Higher Education General Information Survey (HEGIS), which report completions by level, field, and gender. Information on federal grants and contracts is drawn from the NCSES Federal Science and Engineering Support Survey, which collects data from federal agencies. Our analysis focuses on research universities, which receive the majority of federal grant funding. Specifically, we include all institutions with a doctoral or research designation in the 1987 Carnegie Classification.

We measure the number of programs and degrees completed by field using the Classification

[5]For instance, in 2010, 13 federal agencies invested approximately $3 billion (or $3.39 billion in 2017 dollars) in STEM education programs, compared to $34 billion (in 2017 dollars) in federal support for university R&D (Scott 2013; U.S. NSF 2025).

of Instructional Programs (CIP), introduced by NCES in 1985. Prior to CIP, HEGIS used a different classification system. CIP was significantly revised in 1990 and 2000, and NCES provides crosswalks to link versions over time. Our program classifications are listed in Table A.10. The programs in our analysis are defined by six-digit CIP codes (and their earlier HEGIS equivalents).

Our data cover the years 1971–2016, though some variables are missing in specific years. Most notably, data on graduations and programs by field are unavailable for the academic years 1974-75, 1982-83, and 1985–86. Tables 1 and 2 present summary statistics for selected years between 1975 and 2015.[6] Over this period, both the average number of programs and degrees awarded increased substantially. The most pronounced growth in degrees occurred in fields like Business and Communications, Health, and STEM.[7] Within STEM, growth was driven primarily by Engineering, with additional contributions from Biological Sciences and, for degrees, Mathematics.

Panel B in Table 2 highlights the evolution of university-level characteristics and our primary treatment variable: the annual Federal S&E research funding obligated to universities.[8] The average S&E funding rose from $70 million in 1975 to $137 million in 2015, driven largely by funding from the Department of Health and Human Services (HHS), which allocates research funds through agencies like the National Institutes of Health (NIH). HHS funding alone increased by 149%, and its share of total S&E funding grew from just under 50% in 1975 to over 60% by 2015.

4 Empirical Strategy

Our empirical strategy relies on a triple-differences framework that exploits variation across fields, universities, and time. Specifically, we compare outcomes in STEM fields to outcomes in non-STEM fields within the same university, as federal science and engineering research funding to that university changes over time. This design differences out (i) time-invariant differences across fields within a university, (ii) common time shocks affecting all fields within a university,

[6] Throughout, we use "BA" and "MA" to refer broadly to all bachelor's and master's degrees, including BS/MS degrees. At the doctoral level, most degrees are PhDs. We exclude professional degrees such as JDs and MDs.

[7] The fields are constructed by aggregating multiple 2-digit CIP codes, as detailed in Table A.10. Biological Sciences and Bioengineering are included under STEM. The Health field predominantly includes professional programs, such as, for example, "Dentistry" or "Health and Medical Administrative Services".

[8] We include only R&D expenditures, excluding spending on instruction, training, and other non-research activities.

and (iii) common national field-specific time shocks, allowing us to isolate the differential response of STEM outcomes to changes in federal research funding. We classify non-STEM fields into five categories, each of which can serve as a control group. In Section 4.1, we discuss our approach using each field separately, as well as our preferred specification, which averages the estimates across these field-specific regressions.

In this section, we also describe methods to address two potential threats to identification. The first investigates the possibility of spillovers across fields,which would render non-STEM fields an invalid control group. We provide some reassurance on this point by using multiple different non-STEM fields separately as controls in the main triple-difference specification, but we also test directly for spillovers using a difference-in-differences approach that leverages variation across time and universities. We present this model in Section 4.2. The second potential concern is the possibility that our estimates capture field-university-specific trends over time—or relatedly, reverse causality, which could occur if having more students leads to more grants. Either of these mechanisms could cause current graduation to be correlated positively with future funding. In Section 4.3, we show our specification for testing this pattern.

4.1 Baseline specification

To study the effect of federal science and engineering grant funding on the number of degree programs and graduates in STEM, we estimate the following triple-difference regression:

$$Y_{jft} = \sum_{\tau=0}^{k} \beta_{1,t-\tau} \mathbb{1}\{f = \text{STEM}\} \times FSE_{j,t-\tau} + \beta_2 X_{jft} + \delta_{jt} + \gamma_{jf} + \nu_{ft} + \varepsilon_{jft} \tag{1}$$

where Y_{jflt} is the outcome for university j, field f, in year t for one of the three degree levels: bachelor's, master's, or doctoral (we estimate this regression separately for each degree level l). In our baseline specification, fields f include STEM and a Non-STEM control field: $f \in \{\text{STEM}, \text{Non-STEM}\}$. Our classification includes five non-STEM fields: Arts and Architecture, Business and Communications, Education and Vocational Training, Health, and Social

Sciences and Humanities (see Tables 1 and 2 for details). Because several non-STEM fields are available as controls, the specification can be estimated using alternative comparison groups, ensuring that results do not depend on any single control field. Our preferred specification averages the effects across these field-specific regressions.

Outcomes analyzed using the model described in equation (1) include the number of degrees awarded and the number of programs offered in a given field. The variable $FSE_{j,t-\tau}$ represents the total amount of federal science and engineering research grants received by university j in year $t-\tau$. University-by-year fixed effects δ_{jt} absorb institution-wide shocks such as changes in overall enrollment, resources, or university-specific trends over time. University-by-field fixed effects γ_{jf} control for persistent differences across fields within universities, which may be related to a university's comparative advantage or institutional mission, for example. Field-by-year fixed effects ν_{ft} flexibly capture national time-shocks affecting specific fields, such as changes in aggregate demand for STEM education. Together, these fixed effects ensure that identification comes from differential changes in STEM outcomes relative to non-STEM fields within the same university as federal research funding varies over time.

In addition to the fixed effects, we include additional controls X_{jft} to account for changes to the CIP system in 1985, 1990, and 2000, which introduced new program codes and reclassified some of the existing programs. We include dummy variables indicating the "after" period for each of these changes and interact them with university-field fixed effects. This captures potential interactions between CIP changes and universities' curricula (which we allow to differ between STEM and non-STEM fields). For instance, universities offering more programs in fields where the updated CIP introduced more detailed classifications may be more affected by the classification adjustments.

A priori, it is unclear whether research funding affects graduation outcomes within the same academic year it is obligated or if the effects are lagged. For example, research funding could have an immediate effect by enabling PhD students to complete their research and graduate. Additional funding may also allow departments to hire more graduate teaching assistants and acquire lab equipment, thereby creating more opportunities for undergraduates to enroll in required field-

specific courses during their final years of study. Conversely, the effects may be lagged if the benefits of funding are primarily experienced by incoming students, for example, due to enhanced teaching assistant support in foundational first- or second-year science courses that are prerequisites for continuing in a STEM field. It is also plausible that funding has both current and lagged effects. The timing of the effect is similarly uncertain for programs.[9]

To account for this ambiguity, we estimate the impact of current and up to six years of lagged federal funding, allowing for immediate effect as well as delayed impact on future incoming cohorts at each degree level.[10] This approach enables us to flexibly estimate the effect of grant funding without imposing strong assumptions about how these effects are distributed across years. While we do estimate individual effects for each year, we note that we lack statistical power to clearly differentiate the effects in one year from the effects in adjacent years. For this reason, our main results present the summation $\left(\sum_{\tau=0}^{k} \beta_{1,t-\tau}\right)$, which captures the total (current and lagged) effects of federal funding.

Finally, recent literature on DiD methods highlights potential issues that might arise when treatment effects are heterogeneous across groups or over time (De Chaisemartin and d'Haultfoeuille 2023). A key concern is the possibility of sign reversal—estimating positive regression coefficients even when the true effects are negative for many groups or periods. While no adjusted estimator has yet been developed for settings like ours (e.g., with a continuous treatment variable and potential lagged effects within a triple-difference framework), we assess treatment effect heterogeneity by splitting the sample and conducting our analysis on the subsamples. To explore heterogeneity across time, we run separate regressions for each period between CIP system updates. We also examine heterogeneity by university characteristics, estimating effects separately for institutions above and below the median in baseline enrollment (in 1971) and baseline grant funding (based on total grants received between 1965 and 1971).

[9] We observe a university introducing a new program only when at least one student graduates with that program designation.

[10] There is typically a delay between when funds are obligated and when they are disbursed. Taking that into account, the inclusion of up to six lags allows us to capture the typical duration of the longest programs across degree levels—specifically, six-year doctoral studies.

4.2 Spillovers across fields

One concern with our triple-differences specification is that S&E funding may affect not only outcomes in STEM fields (the treatment group) but also outcomes in the control fields. Spillovers to non-STEM fields could be negative—for example, if federal S&E funding induces students to switch from non-STEM to STEM fields, reducing degree attainment in the former. Alternatively, spillovers could be positive if universities reallocate internal resources toward non-STEM fields following S&E funding increases, which may lead to expanding educational capacity and degree attainment. Finally, the CIP classification that we use to define fields may not perfectly separate programs that directly benefit from S&E funding from those that do not. For instance, a joint business and computer science program classified under Business and Communications may benefit from resources or teaching assistant support from the Computer Science department.[11] The availability of multiple non-STEM fields as controls allows identification to draw on alternative comparison groups. Consistent results across fields help mitigate the spillover concern, as some fields are less likely to have spillover effects with STEM than others. It also helps address the concern that results are driven by the choice of control group.

We also test directly for the importance of these spillovers using a difference-in-differences framework. We assess whether S&E funding has a significant effect on outcomes in other fields by estimating a two-way fixed-effects regression model using non-STEM degrees and programs as outcome variables. Specifically, we estimate the following specification:

$$Y_{j,t}^{\text{non-STEM}} = \sum_{\tau=0}^{k} \beta_{1,t-\tau} FSE_{j,t-\tau} + \beta_2 X_{jt} + \delta_t + \gamma_j + \varepsilon_{jt} \tag{2}$$

where $Y_{j,t}^{\text{non-STEM}}$ is the outcome (degrees or programs) for university j at one of the three degree levels: bachelor's, master's, or doctoral in year t (the regression is again estimated separately for each degree level). The terms γ_j and δ_t denote university and year fixed effects, respectively, and

[11] Another example is certain Health programs, such as "Pharmaceutics and Drug Design," which may directly or indirectly benefit from HHS funding.

$X_{j,t}$ is a vector of additional controls.[12]

In this regression, fixed effects control for cross-sectional differences in university characteristics and for time-varying shocks common to all institutions (e.g., rising interest in a particular field across time). To address concerns that universities historically larger or more prominent in specific fields may exhibit different trends in funding and graduation outcomes, we include additional controls in $X_{j,t}$. Specifically, we interact (1) a university's 1971 size—measured by total enrollment—with year fixed effects, and (2) the 1971 value of the outcome variable with year fixed effects. These interactions help account for differential trends by baseline characteristics. Finally, consistent with our baseline specification, we account for changes in the CIP system by including post-revision indicator variables for each CIP update and interacting them with university fixed effects.

4.3 Placebo

In this section, we introduce a placebo specification designed to assess whether our baseline results could be driven by field-university-specific trends over time or by reverse causality. If university-field specific trends generate a pattern wherein universities both attract more S&E federal funding and produce more STEM graduates due to factors not accounted for in our regressions, then funding should be correlated not only with future STEM bachelor's graduations, but also with *past* STEM graduations or changes in program offerings. Reverse causality may also cause the same problem, especially at the graduate level; graduate students may assist in preparing and submitting grant applications, potentially creating a link between current degree completions and future funding. If neither of these mechanisms are driving our results, we should observe no correlation between federal funding and past STEM graduations or changes in the number of programs. To test this, our placebo specification augments Equation 1 by including three lead years of federal funding as follows:

[12] We also run equation 2 with STEM outcomes as dependent variables and show that effects persist for STEM outcomes, unlike their non-STEM counterparts.

$$Y_{jft} = \sum_{\tau=3}^{1} \pi_{1,t+\tau} \, \mathbb{1}\{f = \text{STEM}\} \times FSE_{j,t+\tau} \; + \; \sum_{\tau=0}^{k} \beta_{1,t-\tau} \, \mathbb{1}\{f = \text{STEM}\} \times FSE_{j,t-\tau} \qquad (3)$$
$$+ \; \beta_2 X_{jft} \; + \; \delta_{jt} + \gamma_{jf} + \nu_{ft} + \varepsilon_{jft}.$$

The vector $X_{j,f,t}$ includes the same controls as in our baseline specification. The coefficients on the three funding leads capture whether funding predicts outcomes before it occurs. Our placebo estimate is the sum of the lead coefficients, $\sum_{\tau=3}^{1} \pi_{1,t+\tau}$. Under the null that university-specific trends are not driving our results, we expect this placebo estimate to be close to zero and not statistically significant.[13]

5 Results

In this section, we present the results from our baseline specification and extensions. In subsection 5.2, we discuss the results of the robustness exercises and placebo checks. In subsection 5.3, we present the results of the heterogeneity analysis.

5.1 Main Results

We begin by examining how federal research funding affects STEM degree production within universities. Across specifications, increases in federal science and engineering (S&E) funding lead to economically meaningful expansions in degrees awarded at all levels of higher education. Figure 1 presents the main results by degree level, with detailed regression estimates in Tables A.1 and A.2.

At the institutional level, a $10 million increase in federal S&E funding—roughly 8 percent of average annual university funding—generates about two additional doctoral degrees, four master's

[13] When choosing the number of leads for this test, we trade-off the ability to capture trends over a longer horizon with the loss of sample size as we require a longer pre- and post-treatment window. Since any pattern of reverse causality or pre-trends is most likely to be strongest within a short range of the treatment timing, we view the three-lead specification as providing a reasonable test. We have also run this check with more leads, and the results are similar while the leads continue to be largely statistically insignificant. The lead estimates using years 1 through 6 are available in Appendix Table A.5 and the estimated effects from these regressions are in in Appendix Tables A.8 and A.9.

degrees, and eight bachelor's degrees annually in funded fields over the award year and the subsequent six years.[14] These effects represent increases of roughly 1–2 percent relative to average graduation levels, indicating that research funding meaningfully expands educational output even though most federal grants are not directly intended to finance student instruction.[15]

While the effect for a single university appears modest, federal research funding operates at a large scale. Aggregating estimated effects across institutions implies that federally funded research activity supports approximately 4,400 doctoral degrees, 9,700 master's degrees, and 18,400 bachelor's degrees each year. These correspond to 27.4 percent of STEM doctorates, 22.5 percent of master's degrees, and 14.7 percent of bachelor's degrees awarded by universities in our sample.[16] Taken together, these magnitudes indicate that federal research funding constitutes a major contributor to STEM human capital formation in the United States. Importantly, these effects extend beyond graduate education. Undergraduate degree production rises despite undergraduate students rarely receiving direct support from research grants. This pattern suggests that research funding affects education indirectly, for example through expanded departmental resources, increased instructional capacity, or heightened student demand for funded fields, which we discuss in more detail in section 6.

Universities respond to research funding not only by graduating more students but also by expanding educational capacity. Increases in federal S&E funding lead institutions to introduce new academic programs in funded disciplines, indicating persistent institutional adjustment rather than temporary enrollment fluctuations. On average, S&E funding is associated with the creation of approximately 161 doctoral programs across research universities within seven years of funding disbursement, equivalent to about 6.3 percent of the existing doctoral program stock. Comparable

[14] Note that these results reflect our preferred specification, which averages estimates from regressions that use each of the five control fields separately. Tables A.3 and A.4 report the coefficients from each of these field-specific regressions. Reassuringly, the estimated coefficients tend to be very similar across control fields.

[15] Our estimates represent the sum $\left(\sum_{\tau=0}^{6} \beta_{1,t-\tau}\right)$, which can be reinterpreted as the effect of STEM-S&E funding over the seven-year period spanning the award year and the six preceding years on STEM graduation.

[16] This aggregation assumes that the regression coefficients capture average treatment effects and that grants are allocated equally across universities. Moreover, these estimates likely understate the true impact since they do not account for general equilibrium effects. If federal research funding to universities were eliminated (without being replaced by private funding), incentives to pursue STEM education could decline further due to reduced innovation and lower overall economic activity.

responses arise at other degree levels, with funding supporting roughly 136 additional master's programs and 135 undergraduate programs, corresponding to increases of 4 percent relative to baseline program availability. These results indicate that research funding reshapes universities' long-run educational structure by encouraging expansion into federally supported fields.

Breaking down the overall STEM-funding effects by field, we find that they are primarily driven by Engineering and Biology (see Figure 1 and Tables A.1 and A.2). This pattern aligns with the funding priorities of major federal agencies: HHS predominantly supports research in the biological sciences, while NSF and DOD—the second and third largest funders—allocate substantial portions of their grants to Engineering and Computer Science.[17] Effects in Biology are the most consistent across outcomes, while Engineering shows comparable increases in degree production but weaker expansion in academic program offerings. Aggregated across universities, federal S&E funding supports a large share of degree production in heavily funded fields. In Biology, funding accounts for roughly 43 percent of doctoral degrees and 18 percent of bachelor's degrees, compared with 24 percent and 8 percent, respectively, in Engineering. Funding also contributes to institutional expansion in Biology, supporting about 15 percent of doctoral programs and 10 percent of master's programs offered annually.

Finally, we estimate that the effects on other STEM fields (Physics, Mathematics, and Economics) are close to zero, and in some cases marginally negative at the graduate level. This pattern likely reflects the relatively small share of federal S&E funding directed to these fields.[18] The marginally negative estimates may reflect some degree of within-STEM reallocation, as federal funding shifts students toward better-funded disciplines (e.g. biology or engineering), reducing enrollment in others (e.g Physics or Mathematics) and potentially contributing to program closures.

[17] In 2023, 87% of HHS-funded R&D was in the life sciences with Engineering and Computer Science a distant second at 4.6%; Engineering and Computer Science made up over 60% of DOD and 38% of NSF R&D spending, while life sciences accounted for 18% and 13% at these agencies, respectively (NCSES 2024)

[18] In 2023, physical sciences accounted for just 7.7% of federal R&D spending, and mathematics for only 1.1%, compared to 56.9% for life sciences and 22.4% for engineering and computer science.

5.2 Robustness and Placebo Results

We first examine the potential importance of spillovers across fields—e.g., whether our control group may be contaminated by indirect effects of STEM funding. To assess this, we estimate the effect of S&E grant funding on outcomes in non-STEM fields. Figure 3 presents the results of this test. We find small and statistically insignificant effects on non-STEM degree completion at all levels. For degree programs, however, we observe a significant positive effect on PhD programs in the Social Sciences and Humanities and on master's programs in Health. These estimates are substantially smaller than those for STEM fields and may reflect positive spillovers to interdisciplinary programs, as discussed above. Overall, these findings suggest that cross-field spillovers are unlikely to drive our main results; if anything, our estimates for PhD programs in the Social Sciences and Humanities and master's programs in Health likely constitute lower bounds.[19] In Appendix Figure B.1 we show that the results from the DiD specification using STEM outcomes, on the other hand, are largely consistent with our main triple-difference estimates in terms of both direction and overall magnitudes.[20]

Finally, we test whether university-field trends could be driven our results, as described in Section 4.3. We do this by examining whether future funding is positively correlated with current outcomes. Table 3 shows no significant correlation for all degree levels, providing reassurance that university-field trends are not driving our results.[21]

5.3 Heterogeneity Analysis

The results of the heterogeneity analysis presented in Table 4 indicate that the effects are generally positive across subsamples, with the exception of a few negative but small and statistically insignificant estimates in the pre-2000 subsamples. This alleviates concerns about potential sign reversal—when positive average effects might mask negative effects for many groups or periods.

[19] From the perspective of degree production, this pattern suggests that increases in S&E funding may expand admissions for students interested in STEM fields (or double majors), rather than inducing students to switch away from non-STEM fields.

[20] For bachelor's degree completion, our DiD specification yields more conservative estimates compared to the results from our baseline specification.

[21] We can also calculate the effects of the lagged funding from this regression to compare to the main estimates. These are shown in Tables A.6 and A.7. The results are similar to our main estimates, which are calculated from the regression with no leads.

We find little evidence of heterogeneity by baseline enrollment, suggesting similar effects across larger and smaller universities. However, we find substantially stronger effects among universities with below-median baseline grant levels. Using these estimates, we can reassess the contribution of federal research funding to STEM graduates and programs in our sample. Accounting for heterogeneity between universities with below- and above-median baseline grants, we estimate that annual S&E funding supports approximately 4,147 doctorates, 10,773 master's degrees, and 19,232 bachelor's degrees awarded —representing 25.7% doctorates, 24.9% master's degrees, and 15.4% bachelor's degrees of annual STEM degrees awarded.

Similarly, for programs, annual federal S&E funding supports 180 doctoral programs, 137 master's programs, 154 bachelor's programs that account for 7.1% doctoral programs, 4.3% master's programs, and 4.3% bachelor's programs in STEM. On aggregate, these estimates are comparable to our baseline model.

6 Discussion

The previous section documented that federal research funding has a positive effect on graduate and undergraduate STEM education. This section discusses the magnitude of the effects and the potential mechanisms driving them.

While the effect for a single university appears modest, federal research funding operates at large scale. Aggregated nationally, these estimates imply that federal research funding accounts for a sizable share of STEM human capital formation—approximately 27 percent of doctorates, 23 percent of master's degrees, and 15 percent of bachelor's degrees awarded over the period we study. Two considerations help interpret these results. First, education is not the primary goal of this funding—these gains come alongside the intended R&D outcomes explored in other studies. Second, the same increase in federal funding boosts not only doctoral but also master's and bachelor's degrees, as well as programs.

While we do not analyze the mechanisms behind the effects we document directly, we can offer some intuition. Broadly, research funding may affect both the supply side and student preferences.

First, it may reduce the cost of educating additional students and help alleviate capacity constraints, especially in fields with growing demand (Curtis 1982). Second, it may increase the attractiveness of STEM programs, either directly or by lowering the cost of offering higher-quality education.

At the doctoral level, funding can directly support students through research assistantships or attract students interested in working on funded projects. At the undergraduate level, funding may also affect both costs and student preferences, but the overall effect is a priori uncertain. Funding may increase teaching resources by supporting graduate students and faculty who serve as instructors,[22] and it may attract undergraduates seeking to join departments at the forefront of cutting-edge research. However, research funding could also have negative effects. Faculty may use grants to reduce teaching loads or shift PhD students from teaching to research, which can cut instructional capacity and lower teaching quality through larger class sizes and less feedback. Together, these factors could reduce undergraduate degree completion in STEM.[23] At the master's level, both effects likely play a role. For students pursuing a master's en route to a PhD, mechanisms resemble those at the doctoral level; for stand-alone master's programs, they are more similar to undergraduate dynamics.[24] Overall, our findings suggest that the positive effects of research funding on degree production outweigh potential negative effects at all levels.

Research grants can also support more specialized coursework by funding equipment, teaching assistantships, and instructional time from faculty specializing in grant-funded areas. This coursework can be formalized into new degree programs, which can further shape student preferences and boost STEM enrollment.

7 Conclusion

This paper shows that federal science and engineering research funding plays a central role in shaping STEM human capital formation at U.S. universities. Increases in federal research support

[22] Doctoral students are funded through a mix of research assistantships (mainly from federal grants), fellowships, and teaching assistantships (*Academic Research and Development* 2023), which suggests that research and teaching funding may jointly expand teaching capacity.

[23] For example, Mumford, Patterson, and Yim 2025 shows that being unable to enroll in a specific course due to capacity constraints during the first year of study significantly reduces the probability that an undergraduate student takes any subsequent courses in that subject.

[24] George, Elchert, and Pierson 2019 suggest that about a quarter of master's degrees are "en route".

expand degree production at the doctoral, master's, and undergraduate levels and lead universities to create new academic programs in funded disciplines. Aggregated nationally, federal research funding accounts for between one-sixth and about one-third of STEM degrees awarded across degree levels over the period we study. By encouraging the creation of new academic programs, research funding also produces lasting institutional expansion rather than just temporary increases in enrollment.

These findings highlight an important but previously underappreciated channel through which research funding affects education outcomes. Although federal grants are designed to support scientific research, they also expand educational capacity within universities, influencing both the scale and direction of skill formation. Because universities jointly produce research and education, investments in research translate into persistent changes in the composition of the skilled labor force. From a policy perspective, evaluating public research funding solely through its effects on research output may therefore understate its broader economic impact. Research funding not only advances knowledge creation but also shapes the pipeline of scientists and engineers needed to sustain technological progress.

While this study takes an important first step in quantifying the indirect effects of federal research grants on STEM graduation rates and new academic program introductions, it has two limitations. First, we lack detailed data on research spending, limiting analysis of underlying mechanisms. Second, we cannot track student trajectories, so we cannot assess how funding affects skills or careers—for example, via research assistantships (Blume-Kohout and Adhikari 2016). Tracking student paths would also help understand the characteristics of marginal students whose decisions—whether to pursue STEM at a research university, another institution, or not at all—are influenced by funding. Together, this would help clarify how federal research funding affects not only the quantity but also the composition of the STEM talent pipeline. These important questions remain topics for future research.

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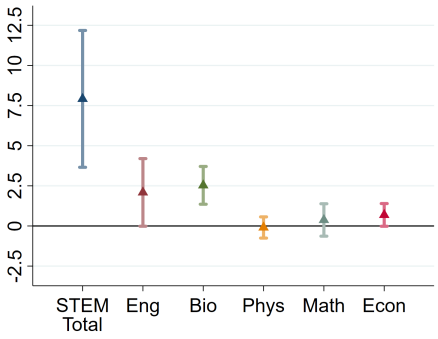
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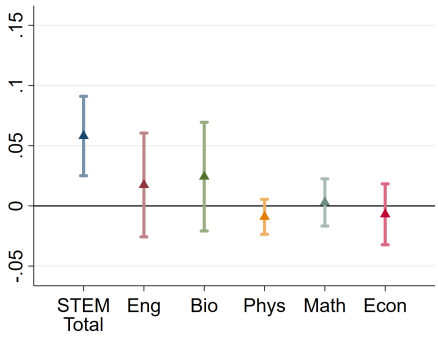
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Figure 1: Triple-Difference Estimates of the Effects of Federal S&E Funding on STEM Degrees Awarded and Programs Offered

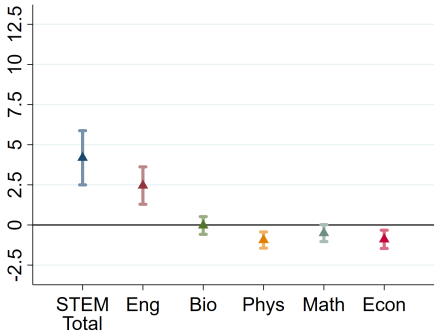
(a) BA Graduates



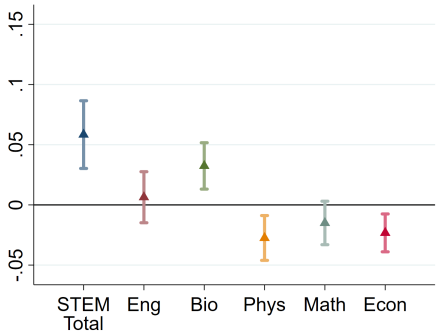
(b) BA Degree Programs



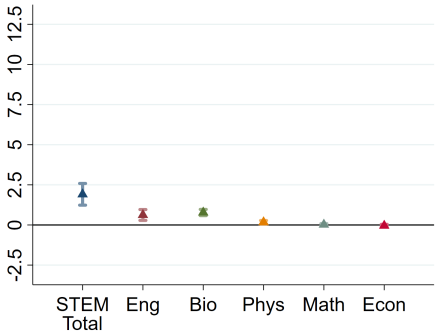
(c) MA Graduates



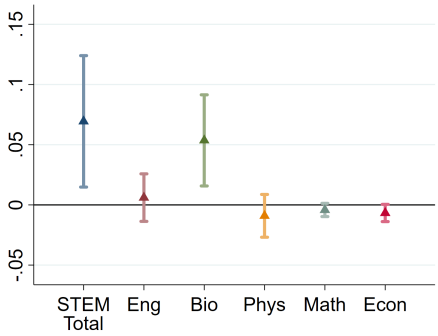
(d) MA Degree Programs



(e) PhD Graduates



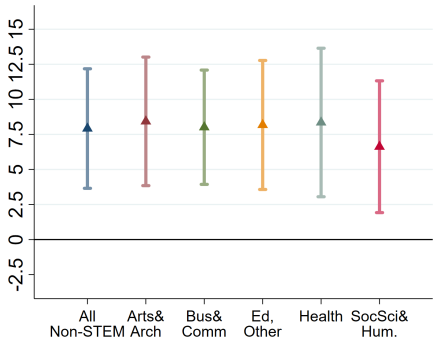
(f) PhD Degree Programs



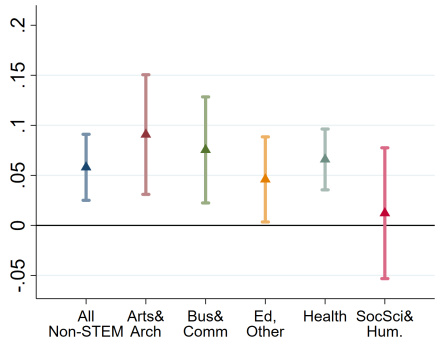
The graph shows the estimated effect of federal S&E funding (in $10 million 2022 dollars) on bachelor's, master's, and doctoral degrees awarded and degree programs, using the regression specification in Equation 1. The coefficients and their corresponding standard errors can be found in Table A.1 and Table A.2.

Figure 2: Robustness: Triple-Difference Estimates of the Effects of Federal S&E Funding on STEM Degrees Awarded and Programs Offered (STEM Total vs Non-STEM Fields Separately)

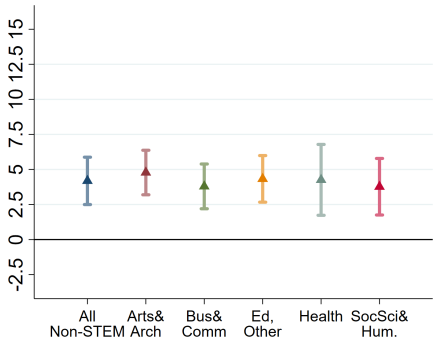
(a) BA Graduates



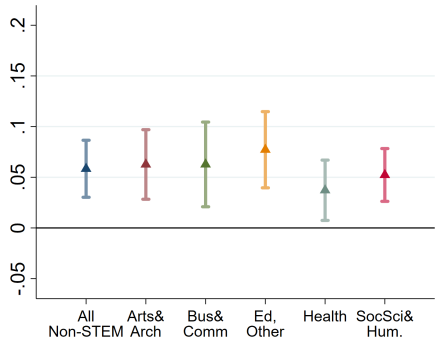
(b) BA Degree Programs



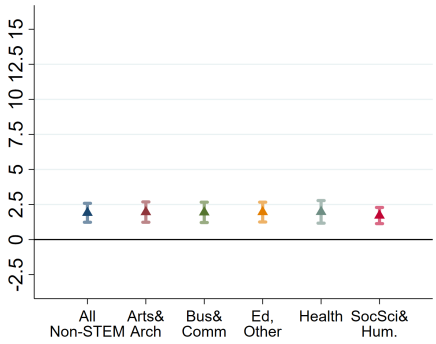
(c) MA Graduates



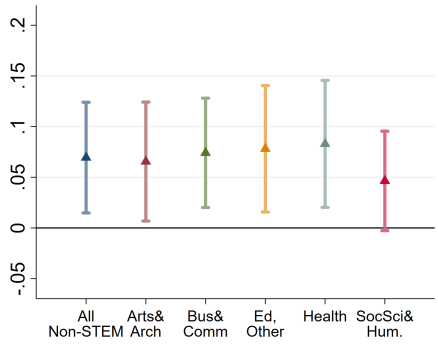
(d) MA Degree Programs



(e) PhD Graduates



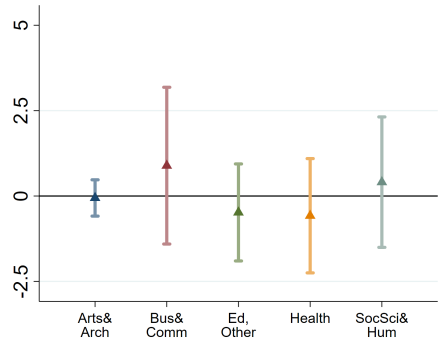
(f) PhD Degree Programs



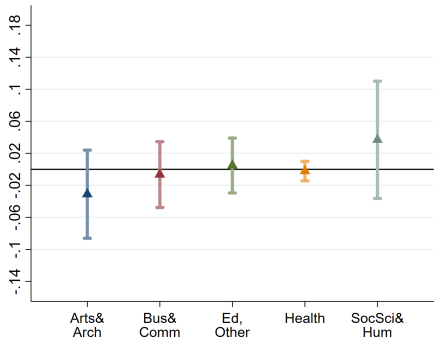
Notes: The graph shows the estimated effect of federal S&E funding (in $10 million 2022 dollars) on bachelor's, master's, and doctoral degrees awarded and degree programs, using the regression specification in Equation 1, but varying the comparison field. The estimates are relatively stable regardless of the chosen comparison field. The full regression output is available in Appendix Table A.3 and Table A.4.

Figure 3: Estimated Effects of S&E Funding on Non-STEM Outcomes: DiD Design

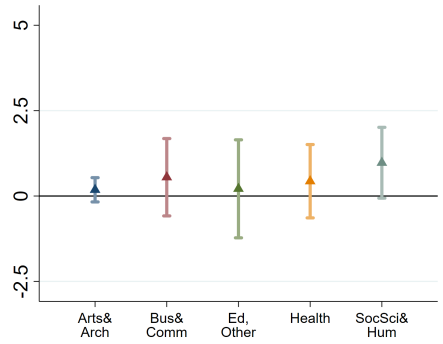
(a) BA Graduates



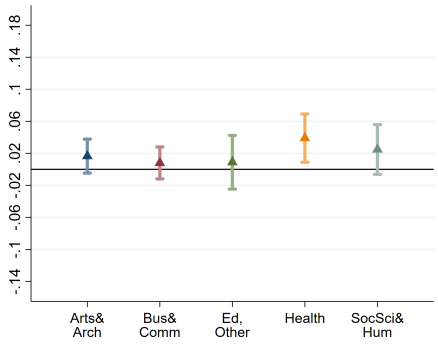
(b) BA Degree Programs



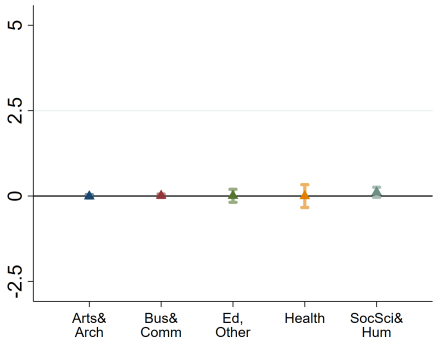
(c) MA Graduates



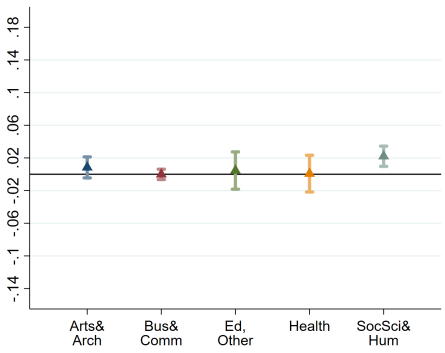
(d) MA Degree Programs



(e) PhD Graduates



(f) PhD Degree Programs



Notes: The graph shows the estimated effect of federal S&E funding (in $10 million 2022 dollars) on bachelor's, master's, and doctoral degrees awarded and degree programs by non-STEM field, using the regression specification in Equation 2.

Table 1: Summary Table: Degree Programs

		1975		1995		2015	
		mean	sd	mean	sd	mean	sd
BA	Arts and Architecture	4.8	(2.7)	6.4	(4.2)	10.1	(5.8)
	Business and Communications	5.9	(4.3)	7.0	(5.0)	12.8	(8.7)
	Education and Vocational	10.8	(7.4)	13.0	(11.3)	16.8	(11.6)
	STEM	14.3	(6.7)	16.3	(6.9)	25.6	(11.2)
	Engineering	5.6	(4.1)	7.3	(4.5)	10.2	(5.2)
	Bio-Sciences	2.9	(2.4)	3.0	(2.2)	5.6	(4.2)
	Physical Sciences	3.6	(1.3)	3.5	(1.5)	5.1	(2.4)
	Mathematics	1.3	(0.6)	1.5	(0.7)	2.8	(1.9)
	Economics	0.9	(0.3)	0.9	(0.4)	1.8	(1.1)
	Health	2.6	(2.2)	3.3	(2.8)	4.4	(3.5)
	Social Science and Humanities	16.0	(6.5)	17.0	(7.7)	31.3	(16.2)
MA	Arts and Architecture	3.3	(2.6)	4.2	(3.5)	5.5	(4.6)
	Business and Communications	3.2	(3.3)	4.2	(3.5)	6.1	(4.5)
	Education and Vocational	11.3	(8.1)	13.6	(9.7)	14.8	(8.4)
	STEM	14.6	(8.3)	15.9	(8.4)	20.1	(10.0)
	Engineering	5.4	(4.5)	6.5	(4.6)	8.8	(5.6)
	Bio-Sciences	3.9	(3.5)	3.8	(3.2)	5.1	(4.1)
	Physical Sciences	3.2	(1.6)	3.2	(1.6)	3.4	(1.6)
	Mathematics	1.3	(0.6)	1.7	(1.0)	1.8	(1.0)
	Economics	0.7	(0.5)	0.7	(0.5)	0.9	(0.7)
	Health	1.9	(2.2)	3.9	(4.1)	6.2	(5.7)
	Social Science and Humanities	11.5	(6.4)	11.8	(7.0)	13.9	(8.0)
PhD	Arts and Architecture	0.8	(1.3)	1.2	(1.7)	1.6	(2.2)
	Business and Communications	1.1	(2.0)	1.3	(1.7)	1.6	(1.8)
	Education and Vocational	5.0	(5.6)	6.5	(6.3)	6.7	(5.4)
	STEM	11.1	(8.8)	13.4	(9.5)	16.9	(10.7)
	Engineering	3.4	(3.7)	4.7	(4.2)	5.9	(4.5)
	Bio-Sciences	3.8	(3.8)	4.3	(4.0)	5.9	(5.1)
	Physical Sciences	2.6	(1.9)	2.7	(1.8)	3.1	(2.0)
	Mathematics	0.9	(0.8)	1.2	(1.0)	1.3	(1.0)
	Economics	0.5	(0.5)	0.5	(0.5)	0.6	(0.6)
	Health	0.6	(1.0)	1.5	(2.4)	2.4	(2.9)
	Social Science and Humanities	6.8	(6.1)	7.4	(6.3)	8.8	(6.8)
Number of Universities		198		197		196	

Note: The table shows the average and standard deviation of the number of degree programs awarded by field among the research universities in our sample. The STEM category is broken down into four subcategories: Engineering, Biological Sciences, Physical Sciences, Mathematics, and Economics. Statistics are divided by degree level of the program.

Table 2: Summary Table: Degrees Awarded and University Characteristics

		1975		1995		2015	
		mean	sd	mean	sd	mean	sd
Panel A: Degrees Awarded							
BA	Arts and Architecture	125.8	(112.5)	128.2	(113.1)	186.7	(171.5)
	Business and Communications	376.3	(331.5)	490.6	(400.9)	846.4	(660.1)
	Education and Vocational	461.0	(419.4)	433.8	(428.8)	608.5	(512.2)
	STEM	433.8	(324.6)	565.2	(451.3)	1112.4	(900.4)
	Engineering	167.7	(178.1)	285.0	(288.3)	524.9	(488.3)
	Biological Sciences	143.1	(122.2)	158.0	(147.8)	306.7	(280.6)
	Physical Sciences	52.1	(37.3)	45.5	(34.4)	80.4	(68.0)
	Mathematics	34.0	(27.2)	28.1	(29.2)	73.3	(81.7)
	Economics	36.9	(48.3)	48.5	(57.1)	127.0	(146.8)
	Health	121.3	(128.9)	145.3	(134.1)	295.2	(366.5)
	Social Science and Humanities	509.8	(400.4)	657.9	(513.9)	853.0	(633.5)
MA	Arts and Architecture	43.4	(58.9)	49.1	(66.3)	75.9	(106.6)
	Business and Communications	134.8	(171.9)	235.4	(245.1)	398.6	(412.9)
	Education and Vocational	379.3	(341.7)	321.9	(259.6)	384.8	(313.8)
	STEM	143.3	(142.4)	208.9	(190.4)	428.4	(447.3)
	Engineering	79.3	(108.6)	141.2	(160.8)	300.7	(370.4)
	Biological Sciences	21.7	(21.4)	20.3	(18.9)	51.7	(76.3)
	Physical Sciences	21.1	(18.4)	22.8	(17.7)	27.1	(23.5)
	Mathematics	12.6	(11.7)	14.1	(12.6)	32.3	(49.8)
	Economics	8.7	(10.2)	10.5	(12.9)	16.6	(26.3)
	Health	43.5	(67.4)	86.5	(102.8)	178.8	(202.6)
	Social Science and Humanities	120.0	(119.0)	132.1	(130.4)	164.2	(183.0)
PhD	Arts and Architecture	3.4	(6.7)	5.8	(10.0)	9.3	(14.0)
	Business and Communications	5.6	(9.3)	7.6	(9.5)	9.6	(10.8)
	Education and Vocational	38.3	(46.0)	40.9	(46.5)	46.0	(47.6)
	STEM	54.9	(66.8)	86.7	(95.2)	134.1	(129.6)
	Engineering	15.1	(25.0)	34.2	(47.6)	57.0	(69.7)
	Biological Sciences	14.9	(19.0)	20.0	(23.8)	33.6	(36.5)
	Physical Sciences	16.9	(20.2)	22.1	(22.7)	28.8	(26.9)
	Mathematics	4.2	(6.3)	5.9	(7.2)	9.1	(9.2)
	Economics	3.8	(5.7)	4.4	(7.0)	5.6	(7.5)
	Health	2.4	(5.7)	8.2	(15.7)	16.9	(30.2)
	Social Science and Humanities	45.7	(55.0)	43.0	(40.5)	50.9	(43.9)
Panel B: University Characteristics							
	BA % Female	41.8	(11.9)	51.1	(9.6)	53.6	(7.9)
	MA % Female	41.8	(14.1)	51.6	(11.7)	53.7	(10.1)
	Doc % Female	21.7	(11.8)	40.4	(13.0)	48.1	(10.3)
	Federal S&E Funding (2022 $10M)	7.0	(9.1)	10.1	(15.7)	13.7	(18.6)
	Federal HHS Funding (2022 $10M)	3.5	(5.5)	5.2	(9.2)	8.6	(15.0)
	Total Revenue (2022 $10M)	39.9	(29.5)	70.5	(56.1)	122.4	(113.8)
	Tuition and Fees (2022 $1,000s)			14.7	(13.0)	26.3	(20.2)
	Number of Universities	198		197		196	

Notes: Panel A shows the mean and standard deviation of the number of degrees awarded by field among the research universities in our sample. The STEM category is broken down into four subcategories: Engineering, Biological Sciences, Physical Sciences, Mathematics, and Economics. Statistics are presented by degree level of the program. Panel B shows means and standard deviations of university-level covariates.

Table 3: Lead S&E-Funding Years 1-3

	(1) Degrees	(2) Degree Programs
Bachelor's		
Estimate	0.1201	-0.0025
	(0.6665)	(0.0108)
Master's		
Estimate	0.1905	0.0090
	(0.5250)	(0.0115)
Doctoral		
Estimate	-0.0387	-0.0070
	(0.2117)	(0.0112)
Obs	44,526	44,526

*** p<0.01, ** p<0.05, * p<0.1. The table shows summed estimates of the leads of STEM-funding in years 1-3 after the outcome variable is observed. The estimates are obtained using the regression specification in Equation 3. Standard errors are clustered at the university level. The null results indicate that current outcomes are not correlated with future funding.

Table 4: Effects Heterogeneity

	Degrees			Programs		
	Bachelor's	Master's	Doctoral	Bachelor's	Master's	Doctoral
By CIP System						
pre-1985	-0.477	2.040***	0.199	0.030	0.050**	0.049
	(1.409)	(0.549)	(0.254)	(0.018)	(0.025)	(0.041)
1985–1989	-5.604	2.811	5.850***	-0.001	0.163	0.522***
	(5.105)	(2.972)	(1.510)	(0.059)	(0.110)	(0.188)
1990–1999	4.213**	-1.115	0.312	-0.025	-0.024	0.008
	(2.033)	(0.802)	(0.249)	(0.034)	(0.054)	(0.042)
2000–2015	11.822***	5.977***	2.779***	0.086***	0.075***	0.083**
	(2.315)	(1.368)	(0.421)	(0.022)	(0.020)	(0.039)
By Baseline Enrollment						
Below Median	6.400	4.874***	1.755**	0.053*	0.044**	0.062*
	(4.573)	(1.072)	(0.752)	(0.029)	(0.021)	(0.035)
Above Median	7.941***	3.971***	1.820***	0.057***	0.069***	0.072*
	(1.774)	(1.216)	(0.223)	(0.022)	(0.023)	(0.037)
By Baseline Grants						
Below Median	22.175**	11.833**	4.176***	0.175	0.164**	0.306***
	(8.543)	(4.818)	(0.870)	(0.132)	(0.076)	(0.067)
Above Median	6.435***	3.683***	1.468***	0.052***	0.045***	0.047*
	(2.178)	(0.879)	(0.303)	(0.018)	(0.014)	(0.026)

The table shows estimated effects of federal S&E funding using our baseline specification, but run separately on subsamples defined by time period, baseline enrollment, or baseline grants. Standard errors are clustered at the university level. Federal S&E funding is measured in $10 million 2022 dollars.

Online Appendix

A Supplementary Tables

Table A.1: Triple-Difference Estimates of the Effects of Federal S&E Funding on STEM Degrees Awarded

(1) STEM Total	(2) STEM: Eng.	(3) STEM: Bio	(4) STEM: Phys	(5) STEM: Math	(6) STEM: Econ
Bachelor's					
7.9173***	2.0897*	2.5306***	-0.0948	0.3734	0.6883*
(2.1620)	(1.0682)	(0.5969)	(0.3352)	(0.5122)	(0.3585)
Master's					
4.1860***	2.4546***	-0.0323	-0.9401***	-0.5074*	-0.8959***
(0.8566)	(0.5911)	(0.2794)	(0.2566)	(0.2674)	(0.2889)
Doctoral					
1.9095***	0.6225***	0.7754***	0.1694***	0.0200	-0.0474
(0.3427)	(0.1718)	(0.0984)	(0.0546)	(0.0341)	(0.0442)
Obs					
48,234	48,234	48,234	48,234	48,234	48,234

*** p<0.01, ** p<0.05, * p<0.1. The table shows the estimated effect of federal S&E funding (in $10 million 2022 dollars) on bachelor's, master's, and doctoral degrees awarded, using the regression specification in Equation 1.

Table A.2: Triple-Difference Estimates of the Effects of Federal S&E Funding on STEM Degree Programs

(1) STEM Total	(2) STEM: Eng.	(3) STEM: Bio	(4) STEM: Phys	(5) STEM: Math	(6) STEM: Econ
Bachelor's					
0.0581***	0.0174	0.0243	-0.0091	0.0029	-0.0070
(0.0167)	(0.0219)	(0.0229)	(0.0074)	(0.0099)	(0.0128)
Master's					
0.0584***	0.0064	0.0324***	-0.0275***	-0.0150	-0.0232***
(0.0143)	(0.0108)	(0.0098)	(0.0094)	(0.0092)	(0.0080)
Doctoral					
0.0694**	0.0060	0.0536***	-0.0091	-0.0042	-0.0067*
(0.0277)	(0.0100)	(0.0192)	(0.0090)	(0.0028)	(0.0036)
Obs					
48,234	48,234	48,234	48,234	48,234	48,234

*** p<0.01, ** p<0.05, * p<0.1. The table shows the estimated effect of federal S&E funding (in $10 million 2022 dollars) on bachelor's, master's, and doctoral degree programs, using the regression specification in Equation 1.

Table A.3: Robustness: Triple-Difference Estimates of the Effects of Federal S&E Funding on STEM Degrees Awarded (STEM Total vs Non-STEM Fields Separately)

(1) Arts & Arch.	(2) Bus. & Comm.	(3) Educ., Voc., Other	(4) Health	(5) Soc. Sci. & Hum.
Bachelor's				
8.4303***	8.0116***	8.1731***	8.3500***	6.6216***
(2.3247)	(2.0666)	(2.3330)	(2.6856)	(2.3835)
Master's				
4.7825***	3.7927***	4.3288***	4.2572***	3.7688***
(0.8052)	(0.8091)	(0.8428)	(1.2816)	(1.0227)
Doctoral				
1.9601***	1.9397***	1.9603***	1.9755***	1.7122***
(0.3677)	(0.3678)	(0.3580)	(0.4090)	(0.2923)
Obs				
16,078	16,078	16,078	16,078	16,078

The table shows the estimated effect of federal S&E funding (in $10 million 2022 dollars) on bachelor's, master's, and doctoral degrees awarded, using the regression specification in Equation 1 but varying the comparison field. The estimates are generally stable regardless of the chosen comparison field. Standard errors are clustered at the university level.

Table A.4: Robustness: Triple-Difference Estimates of the Effects of Federal S&E Funding on STEM Programs Offered (STEM Total vs Non-STEM Fields Separately)

(1) Arts & Arch.	(2) Bus. & Comm.	(3) Educ., Voc., Other	(4) Health	(5) Soc. Sci. & Hum.
Bachelor's				
0.0908***	0.0754***	0.0460**	0.0659***	0.0122
(0.0303)	(0.0269)	(0.0216)	(0.0154)	(0.0331)
Master's				
0.0626***	0.0627***	0.0772***	0.0372**	0.0523***
(0.0174)	(0.0212)	(0.0191)	(0.0151)	(0.0132)
Doctoral				
0.0655**	0.0741***	0.0781**	0.0829***	0.0464*
(0.0298)	(0.0274)	(0.0316)	(0.0318)	(0.0249)
Obs				
16,078	16,078	16,078	16,078	16,078

The table shows the estimated effect of federal S&E funding (in $10 million 2022 dollars) on bachelor's, master's, and doctoral degree programs, using the regression specification in Equation 1 but varying the comparison field. The estimates are generally stable regardless of the chosen comparison field. Standard errors are clustered at the university level.

Table A.5: Lead STEM-Funding Years 1-6

	(1) Degrees	(2) Degree Programs
Bachelor's		
Estimate	1.8216*	0.0043
	(1.0585)	(0.0153)
Master's		
Estimate	0.5554	0.0165
	(0.7817)	(0.0176)
Doctoral		
Estimate	-0.0706	0.0156
	(0.2574)	(0.0172)
Obs	40,841	40,841

*** p<0.01, ** p<0.05, * p<0.1. The table shows summed estimates of the leads of STEM-funding in years 1-6 after the outcome variable is observed. The estimates are obtained using the regression specification in Equation 3. Standard errors are clustered at the university level. The generally null results indicate that current outcomes are not correlated with future funding.

Table A.6: Triple-Difference Estimates of the Effects of Federal S&E Funding on STEM Degrees Awarded (Including Three Years of Leads)

(1) STEM Total	(2) STEM: Eng.	(3) STEM: Bio	(4) STEM: Phys	(5) STEM: Math	(6) STEM: Econ
Bachelor's					
5.7711**	0.0630	1.9229**	-0.6468	-0.2675	0.2003
(2.5066)	(0.9084)	(0.8366)	(0.4335)	(0.5846)	(0.4030)
Master's					
3.2001***	1.5112**	-0.1176	-0.9577***	-0.6619**	-1.0753***
(0.9418)	(0.7620)	(0.3167)	(0.2988)	(0.3187)	(0.3272)
Doctoral					
1.8677***	0.5396**	0.7703***	0.0962	-0.0127	-0.0849
(0.5640)	(0.2243)	(0.1823)	(0.0815)	(0.0465)	(0.0521)
Obs					
44,526	44,526	44,526	44,526	44,526	44,526

*** p<0.01, ** p<0.05, * p<0.1. The table shows the estimated effect of federal S&E funding (in $10 million 2022 dollars) on bachelor's, master's, and doctoral degrees awarded, using the regression specification in Equation 3. Standard errors are clustered at the university level.

Table A.7: Triple-Difference Estimates of the Effects of Federal S&E Funding on STEM Degree Programs (Including Three Years of Leads)

(1) STEM Total	(2) STEM: Eng.	(3) STEM: Bio	(4) STEM: Phys	(5) STEM: Math	(6) STEM: Econ
Bachelor's					
0.0585***	0.0084	0.0149	-0.0070	0.0010	-0.0104
(0.0187)	(0.0188)	(0.0196)	(0.0093)	(0.0106)	(0.0125)
Master's					
0.0552***	-0.0027	0.0326**	-0.0254*	-0.0162	-0.0233**
(0.0166)	(0.0151)	(0.0139)	(0.0135)	(0.0110)	(0.0108)
Doctoral					
0.0764**	0.0060	0.0561**	-0.0080	-0.0017	-0.0062
(0.0318)	(0.0077)	(0.0261)	(0.0081)	(0.0044)	(0.0052)
Obs					
44,526	44,526	44,526	44,526	44,526	44,526

*** p<0.01, ** p<0.05, * p<0.1. The table shows the estimated effect of federal S&E funding (in $10 million 2022 dollars) on bachelor's, master's, and doctoral degree programs, using the regression specification in Equation 3. Standard errors are clustered at the university level.

Table A.8: Triple-Difference Estimates of the Effects of Federal S&E Funding on STEM Degrees Awarded, from Regression that Includes Six Years of Leads

(1) STEM Total	(2) STEM: Eng.	(3) STEM: Bio	(4) STEM: Phys	(5) STEM: Math	(6) STEM: Econ
Bachelor's					
4.6152*	-0.0928	1.0497	-0.6675	-0.4057	0.6050
(2.3990)	(0.9761)	(0.8455)	(0.4626)	(0.5184)	(0.5015)
Master's					
2.3385***	1.0877	-0.2290	-0.7532**	-0.6851**	-1.0692***
(0.7897)	(0.6912)	(0.3076)	(0.3242)	(0.3285)	(0.3061)
Doctoral					
1.3979**	0.4217*	0.5695**	0.0597	-0.0730	-0.0914
(0.6005)	(0.2226)	(0.2384)	(0.1082)	(0.0716)	(0.0666)
Obs					
40,841	40,841	40,841	40,841	40,841	40,841

*** p<0.01, ** p<0.05, * p<0.1. The table shows the estimated effect of federal S&E funding (in $10 million 2022 dollars) on bachelor's, master's, and doctoral degrees awarded, using the regression specification in Equation 3, except that it is augmented with six years of leads of funding, rather than three years. Standard errors are clustered at the university level.

Table A.9: Triple-Difference Estimates of the Effects of Federal S&E Funding on STEM Degree Programs, from Regression that Includes Six Years of Leads

(1) STEM Total	(2) STEM: Eng.	(3) STEM: Bio	(4) STEM: Phys	(5) STEM: Math	(6) STEM: Econ
Bachelor's					
0.0442**	-0.0005	-0.0044	-0.0132	-0.0041	-0.0182
(0.0192)	(0.0194)	(0.0152)	(0.0104)	(0.0114)	(0.0132)
Master's					
0.0575**	0.0082	0.0192	-0.0201	-0.0113	-0.0195
(0.0228)	(0.0212)	(0.0194)	(0.0164)	(0.0156)	(0.0154)
Doctoral					
0.0816**	0.0153	0.0457*	-0.0053	-0.0018	-0.0067
(0.0342)	(0.0106)	(0.0263)	(0.0109)	(0.0068)	(0.0082)
Obs					
40,841	40,841	40,841	40,841	40,841	40,841

*** p<0.01, ** p<0.05, * p<0.1. The table shows the estimated effect of federal S&E funding (in $10 million 2022 dollars) on bachelor's, master's, and doctoral degree programs, using the regression specification in Equation 3, except that it is augmented with six years of leads of funding, rather than three years. Standard errors are clustered at the university level.

Table A.10: CIP Classification

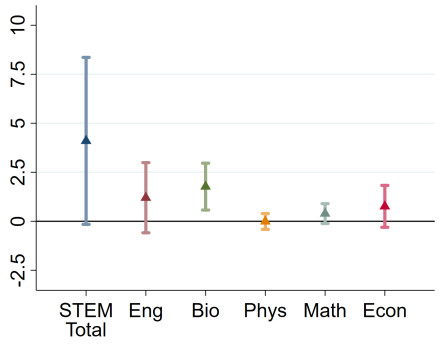
Classification	2-Digit CIP Code	CIP Title
Arts and Architecture	4	ARCHITECTURE AND RELATED SERVICES
Arts and Architecture	50	VISUAL AND PERFORMING ARTS
Business and Communications	9	COMMUNICATION, JOURNALISM, AND RELATED PROGRAMS
Business and Communications	10	COMMUNICATIONS TECHNOLOGIES/TECHNICIANS AND SUPPORT SERVICES
Business and Communications	52	BUSINESS, MANAGEMENT, MARKETING, AND RELATED SUPPORT SERVICES
Education and Vocational	1	AGRICULTURE, AGRICULTURE OPERATIONS, AND RELATED SCIENCES
Education and Vocational	3	NATURAL RESOURCES AND CONSERVATION
Education and Vocational	12	PERSONAL AND CULINARY SERVICES
Education and Vocational	13	EDUCATION
Education and Vocational	19	FAMILY AND CONSUMER SCIENCES/HUMAN SCIENCES
Education and Vocational	21	TECHNOLOGY EDUCATION/INDUSTRIAL ARTS
Education and Vocational	25	LIBRARY SCIENCE
Education and Vocational	28	MILITARY SCIENCE, LEADERSHIP AND OPERATIONAL ART
Education and Vocational	29	MILITARY TECHNOLOGIES AND APPLIED SCIENCES
Education and Vocational	31	PARKS, RECREATION, LEISURE, AND FITNESS STUDIES
Education and Vocational	33	CITIZENSHIP ACTIVITIES
Education and Vocational	36	LEISURE AND RECREATIONAL ACTIVITIES
Education and Vocational	43	HOMELAND SECURITY, LAW ENFORCEMENT, FIREFIGHTING AND RELATED
Education and Vocational	44	PUBLIC ADMINISTRATION AND SOCIAL SERVICE PROFESSIONS
Education and Vocational	46	CONSTRUCTION TRADES
Education and Vocational	47	MECHANIC AND REPAIR TECHNOLOGIES/TECHNICIANS
Education and Vocational	48	PRECISION PRODUCTION
Education and Vocational	49	TRANSPORTATION AND MATERIALS MOVING
STEM: Engineering	11	COMPUTER AND INFORMATION SCIENCES AND SUPPORT SERVICES
STEM: Engineering	14	ENGINEERING
STEM: Engineering	15	ENGINEERING TECHNOLOGIES AND ENGINEERING-RELATED FIELDS
STEM: Biological Sciences	26	BIOLOGICAL AND BIOMEDICAL SCIENCES
STEM: Physical Sciences	40	PHYSICAL SCIENCES
STEM: Physical Sciences	41	SCIENCE TECHNOLOGIES/TECHNICIANS
STEM: Mathematics	27	MATHEMATICS AND STATISTICS
STEM: Economics	45	ECONOMICS
Health	34	HEALTH-RELATED KNOWLEDGE AND SKILLS
Health	51	HEALTH PROFESSIONS AND RELATED PROGRAMS
Social Science and Humanities	5	AREA, ETHNIC, CULTURAL, GENDER, AND GROUP STUDIES
Social Science and Humanities	16	FOREIGN LANGUAGES, LITERATURES, AND LINGUISTICS
Social Science and Humanities	22	LEGAL PROFESSIONS AND STUDIES
Social Science and Humanities	23	ENGLISH LANGUAGE AND LITERATURE/LETTERS
Social Science and Humanities	24	LIBERAL ARTS AND SCIENCES, GENERAL STUDIES AND HUMANITIES
Social Science and Humanities	30	MULTI/INTERDISCIPLINARY STUDIES
Social Science and Humanities	38	PHILOSOPHY AND RELIGIOUS STUDIES
Social Science and Humanities	39	THEOLOGY AND RELIGIOUS VOCATIONS
Social Science and Humanities	42	PSYCHOLOGY
Social Science and Humanities	45	SOCIAL SCIENCES
Social Science and Humanities	54	HISTORY

The table shows the 2010 Classification of Instructional Programs Codes that we use to create our major categories. STEM fields are listed according to the sub-category we assign. Economics (4506) is separated from Social Sciences (45).

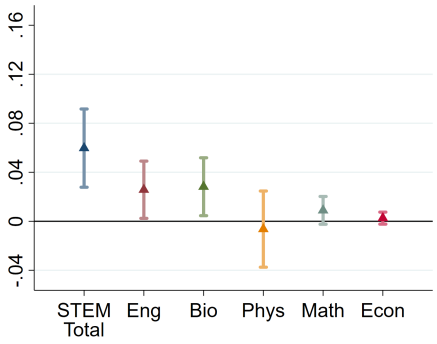
B Supplementary Figures

Figure B.1: DiD Estimates of the Effect of S&E funding on STEM Outcomes

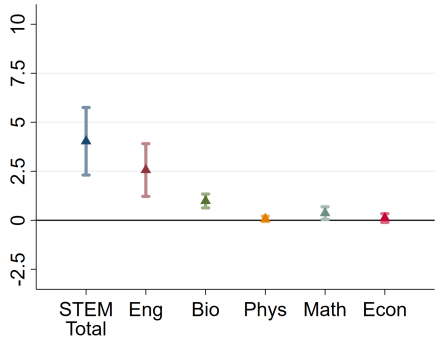
(a) BA Graduates



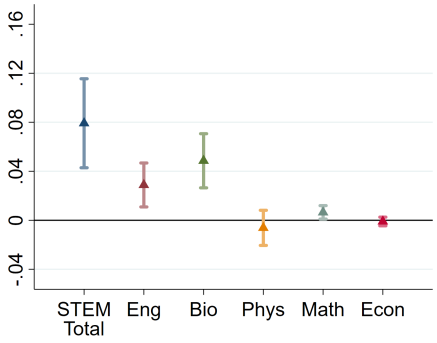
(b) BA Degree Programs



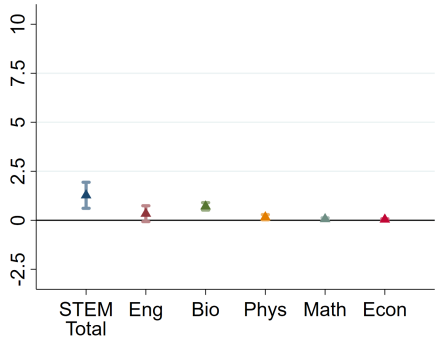
(c) MA Graduates



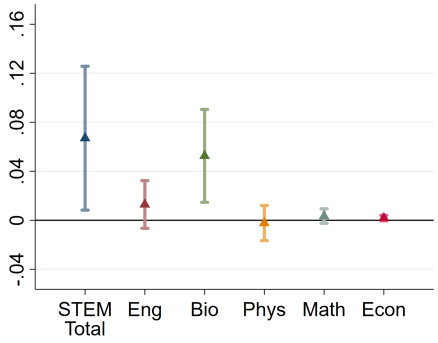
(d) MA Degree Programs



(e) PhD Graduates



(f) PhD Degree Programs



Notes: The graph shows the estimated effect of federal S&E funding (in $10 million 2022 dollars) on bachelor's, master's, and doctoral degrees awarded and degree programs by STEM field, using the regression specification in Equation 2.

Table A.11: Robustness: Sensitivity of the DiD Estimates to Controls

	(1)	(2)	(3)	(4)
Panel A: Bachelor's				
Graduates	4.1001*	4.1878*	4.8097**	5.2036*
	(2.1601)	(2.1453)	(2.3812)	(2.7893)
Degree Programs	0.0597***	0.0593***	0.0584***	0.0602***
	(0.0162)	(0.0163)	(0.0179)	(0.0212)
Obs	8,039	8,039	6,561	5,449
Panel B: Master's				
Graduates	4.0300***	4.0016***	3.8771***	3.8637***
	(0.8735)	(0.8507)	(0.9445)	(1.0750)
Degree Programs	0.0792***	0.0794***	0.0778***	0.0734***
	(0.0184)	(0.0184)	(0.0202)	(0.0228)
Obs	8,039	8,039	6,561	5,638
Panel C: Doctoral				
Graduates	1.2745***	1.2739***	1.3738***	1.5531***
	(0.3372)	(0.3348)	(0.3486)	(0.4235)
Degree Programs	0.0670**	0.0668**	0.0686**	0.0745**
	(0.0298)	(0.0296)	(0.0318)	(0.0358)
Obs	8,039	7,995	6,528	5,205
Controls Included:				
Year FE x 1971 Total Graduates	Y	Y	Y	Y
Year FE x 1971 Outcome	Y	Y	Y	Y
Gender Ratio	N	Y	Y	Y
Tuition	N	N	Y	Y
Admissions Selectivity	N	N	N	Y

*** p<0.01, ** p<0.05, * p<0.1. The table shows the estimates from the regression equation 2, except with total STEM degrees awarded and programs offered as the outcome variables. All of the regressions include university FEs, year FEs, University x CIP System FEs, Year FEs x 1971 Degree Programs in Field. Standard errors are clustered at the university level. FSE funding is measured in $10 million 2022 dollars. The admission selectivity measure was obtained from IPEDS/HEGIS after 2000 and manually collected from College Board handbooks for earlier years. To address changes in SAT and ACT scoring over time, we standardized each test score within each year across institutions. We then combined the two standardized scores into a single variable by assigning each institution the score from the test taken by more of its students. This variable reflects how selective a university was relative to the average in a given year. Gender Ratio, Tuition, and Admissions Selectivity are not available in every year; therefore, the sample size changes as we add these controls.