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How to Keep Emerging Research Institutions From Slipping Through the Cracks

The CHIPS and Science Act advances equity by codifying an underserved group, but more must be done to correct the effects of skewed research funding.

The CHIPS and Science Act, which became law in August 2022, is a major legislative accomplishment, reflecting bipartisan support to strengthen the US science and engineering enterprise. The legislation aims to bolster domestic research capabilities in myriad ways, from combating sexual harassment, which hinders organizational performance and employee retention, to establishing regional innovation hubs, which will stimulate investment in underserved jurisdictions. One little-recognized provision in the bill, also designed to bring more equity and effectiveness to science, is a new designation within higher education called emerging research institutions, or ERIs.

The CHIPS and Science Act defines an ERI as "an institution of higher education with an established undergraduate or graduate program that has less than $50,000,000 in federal research expenditures." While the concept of ERIs is not new, its codification will bring new benefits—for ERIs, their students, and science overall. Practically overnight, ERIs have entered both the lexicon and authorizing legislation of federal research agencies, including the National Science Foundation (NSF), Department of Energy (DOE), and Department of Defense. A DOE list developed in November 2022 includes more than 2,700 institutions.

The CHIPS and Science Act will improve equity and support workforce development by helping ERIs gain capacity to perform more research and become better integrated into federal science, technology, engineering, and mathematics (STEM) research and education programs. Already, research agencies have begun to boost capacity at ERIs, such as through the new solicitations from NSF's initiative GRANTED—Growing Research Access for Nationally Transformative Equity and Diversity—and DOE's Funding for Accelerated, Inclusive Research.

We worked for years to craft the ERI definition that came to fruition in the act. As administrators at Northern Illinois University (NIU), we held extensive conversations with federal agency officials and members of Congress and their staff, as well as experts across the higher education and scientific community. (Our colleague Dr. Sally Blake, chair of NIU's Department of Curriculum and Instruction, was exceptionally helpful in grounding arguments in academic literature.) Key to our presentation was data showing that federal research dollars could be better deployed to foster diverse STEM talent.

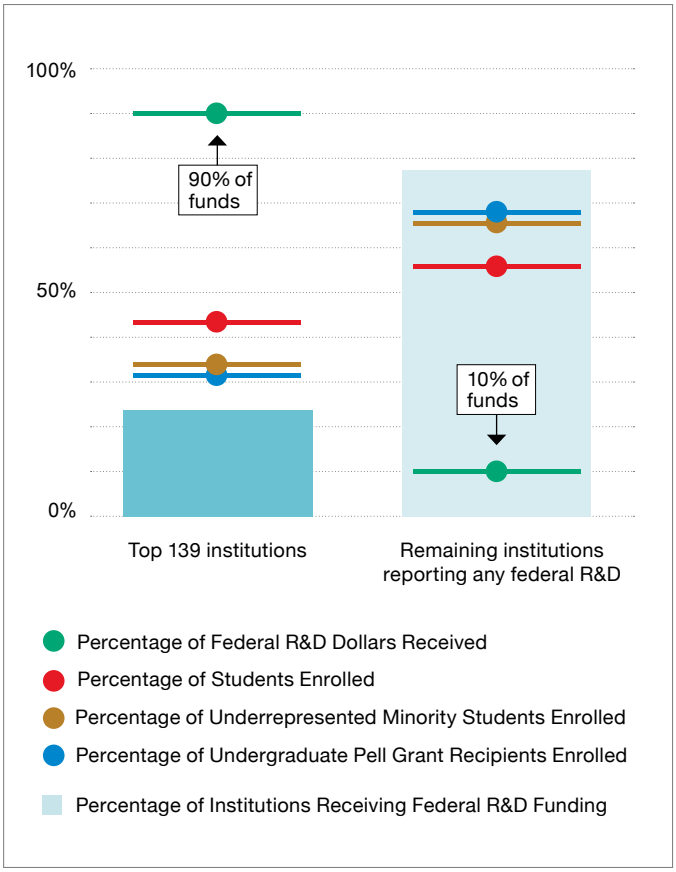
Our motivation is to redress the inequitable distribution of federal research funding, which has stark consequences: perpetuating regional imbalances and stymieing efforts to broaden participation in the STEM workforce. This

imbalance in the funding of ERIs particularly harms students of color, low-income students, and rural students.

Other programs and designations exist to correct for imbalances, but our experiences at NIU showed us that critical gaps remain. NIU is a public, doctoral-awarding university serving 15,600 students. Nearly 80% of undergraduates are first-generation college students, federal Pell Grant recipients (i.e., low-income students), or students of color, and over 90% of undergraduate students are from the state of Illinois. But NIU is not designated as a minority-serving institution, nor is it in a so-called EPSCoR state, eligible for dedicated funding programs because the state receives such a small fraction of NSF funding. (EPSCoR, an NSF program, stands for Established Program to Stimulate Competitive Research). Designating institutions like NIU as ERIs will help ensure that they, and their students, no longer slip through the cracks.

But more should be done. Here we lay out why the ERI designation is useful and what policymakers, science agencies, well-established research institutions, and ERIs can do so that this designation strengthens science and equity.

Figure 1: **SCHOOLS THAT RECEIVE THE BULK OF R&D FUNDS DO NOT SERVE THE BULK OF STUDENTS**



Inequitable distribution of federal research funding hurts US science

In keeping with a long-standing pattern, most federal research dollars go to relatively few institutions. Even considering only the few hundred that award doctoral degrees (466 according to the latest Carnegie Classification of Institutions of Higher Education), a small subset of schools receives the bulk of federal funds, with R&D expenditures at the top 10—or 2%—of these institutions making up about 20% of the total. Indeed, the Association of American Universities, which represents less than 7% of research-active institutions, boasted of their "outsized role" spending more than 58% of all university R&D funds during federal fiscal year 2021.

An analysis published by the American Physical Society (in which we participated) found that 90% of federal R&D dollars in 2018 went to only 22% of 637 research-active institutions. In fact, the actual percentage is lower because institutions receiving negligible research funds are not counted in the federal data we used. These 139 institutions receiving 90% of the funds enrolled 43% of all students, 34% of students from underrepresented minority groups, and 32% of Pell Grant recipients. (And those figures are overestimated since so many ERIs are not included.) A preliminary analysis of 2021 data confirms these findings.

We understand the value of funding centers of excellence, but the current structure perpetuates a lack of diversity and fails to build capacity across the spectrum of institutions. Again, these numbers do not include the nearly 2,000 ERIs (as identified by DOE) that do not report into federal surveys because they receive practically no research funding.

This disconnect is damaging because it restricts students' opportunities to gain research experience. Participation in research is established as a high-impact practice to boost student retention and graduation and to diversify the STEM workforce. Undergraduate research experiences have been shown to increase student engagement and interest, foster a sense of belonging and self-efficacy, and raise graduation rates. Participation in research also prepares students to think critically, communicate their ideas, and apply their knowledge to their field—skills that are highly relevant in the workforce. Yet students at institutions with fewer researchers often encounter limited or no opportunities to engage in research and are less likely to be exposed to cutting-edge work.

ERIs fill a gap unmet by other designations

Concerns about the skewed distribution of research funding were expressed as early as the inception of NSF nearly seven decades ago. A patchwork of programs does exist to try to increase participation in STEM, diversify the STEM workforce, and disseminate federal resources more broadly; and it succeeds in creating official designations to recognize

underserved populations and mobilize resources to their institutions. But, like any patchwork, it leaves out important segments of the targeted population.

For example, consider minority-serving institutions (MSIs). According to the National Science Board and the National Academies of Sciences, Engineering, and Medicine, MSIs can be defined historically, by legislation, by the percentage of minority student enrollment, or by other student body characteristics. Over several decades, new categories of MSIs were created to direct resources to institutions serving specific categories of minority students. According to a 2022 list, there are now seven different MSI distinctions and more than 860 MSIs.

Misconceptions abound regarding which institutions qualify as MSIs and which students are served by them. For example, historically Black colleges and universities (HBCUs, one MSI designation) are rightly lauded for their outsized role in educating Black scientists and engineers, especially doctorate recipients. Still, more than 85% of Black students who obtain bachelor's degrees do not attend HBCUs. This is not well known, and in fact we have been told by congressional staffers that they thought the exact opposite was true: that HBCUs enrolled up to 80% of Black college students. Although HBCUs are extremely important, equating HBCU enrollment with Black enrollment excludes the vast majority of Black students.

Other policymakers we've spoken with were shocked to learn that an institution could enroll over 50% students of color yet not qualify for federal MSI programs. According to our analysis of fall 2020 student enrollment data from the Department of Education, there are hundreds of institutions that fall into this category. NIU is one of them.

Another program that broadens the geographic distribution of federal research funding is EPSCoR, which is also a well-intentioned program where some institutions fall through the cracks. Institutions are eligible for EPSCoR support if they are in a state or territory that received 0.75% or less of NSF's budget for the last five years. Currently 25 states and three territories are eligible. But institutions that happen to be in the same state as highly funded research institutions lose out. For example, in Illinois, which is not an EPSCoR state, NSF data show that of the 16 Illinois institutions that received federal R&D funding, the top four institutions collectively received $1.6 billion while the remaining 12 institutions collectively received $178 million. In other words, 25% of Illinois research-active institutions received 90% of federal research funding directed to Illinois. In Michigan, the top three schools receive 93.7% of federal research funding for higher ed, and the remaining 17 research-active schools received 6.3%.

Nationwide, many institutions are, like NIU, neither MSIs nor in EPSCoR states and yet serve the same populations these programs target. Establishing ERIs as a category will help ensure that these institutions and their students are supported fairly.

Partnerships will strengthen ERIs and expand science

Lack of inclusion has hurt science by narrowing its workforce as well as its perspective. Promoting partnerships between ERIs and research-intensive institutions will broaden opportunity and diversity while doing more to serve the nation's research needs. Crucially, these partnerships must be structured to maintain the excellence of research-intensive institutions while also leveraging ERIs' ability to increase equity and build research capacities nationwide. Both aims can be achieved by requiring that high-research institutions create partnerships with ERIs when they host new initiatives, launch research centers, or receive large grants.

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The CHIPS and Science Act includes language to foster partnerships between ERIs and high-research institutions through NSF and the DOE Office of Science. For example, ERIs are designated as fulfilling a partnership requirement for the NSF Regional Innovation Engines program, also created by the CHIPS and Science Act. The only mandatory ERI partnerships, however, require NSF to establish a five-year pilot program to apply to all multi-institution collaboration proposals with budgets exceeding $1 million. In an attempt to mitigate longstanding imbalances, the pilot program requires that at least 35% of an award go to the ERI partner(s) and that partnerships be "substantive, meaningful, sustainable, and mutually beneficial." The DOE Office of Science is directed to develop programs to increase the research capacity of ERIs; among the suggested mechanisms is "enabling mutually beneficial and jointly managed partnerships between research intensive institutions and ERIs."

The devil is in the details: meaningful partnerships must ensure that expertise is shared and sustained. For example, a quantum science center established at a large, research-intensive university could provide fellowships for faculty members from their ERI partners—who would then return to their home universities and engage students in their research.

Another example involves creating paid research opportunities for undergraduates from partnering ERIs. Paid research positions, which can last a full academic year or span the summer break, have been shown to increase student retention rates in STEM, help students develop a sense of scientific identity and provide students with needed financial support. However, many NIU students cannot leave home for 10 weeks or more to do undergraduate research at a far-off campus due to jobs, caregiving responsibilities, and other ties. These place-bound students are especially impacted by highly concentrated federal research funding elsewhere.

Boost support for ERIs beyond CHIPS and Science

To get the most from ERIs and partnerships involving ERIs, several lines of follow-on action beyond the CHIPS and Science Act are needed. While the legislation includes authorizing language to benefit ERIs, strong annual appropriations are also necessary. The act includes more than 15 references to ERIs as priority recipients of federal funds, but this will do little to build research capacity at ERIs unless those funds are actually made available. Similarly, federal agencies and policymakers must fully consider implications when federal funding is directed to particular groups of higher education institutions. Most ERIs don't have dedicated employees working in government relations, so only a handful of professionals are focused on educating policymakers or looking out for ERIs as policy is crafted. The ERI Coalition, which one of us (Anna Quider) will co-run, will help meet these needs.

Beyond appropriation and authorization is the need to ensure that ERIs are represented across the wide array of authoritative advisory and evaluation bodies that chart the course for the US scientific enterprise. One simple step is auditing committee memberships. Publicly available membership lists (as well as our own experience) make it clear that affiliates from R1 universities, the most research-intensive institutions, dominate federal advisory bodies such as those convened at federal agencies (for example, NSF and the National Institutes of Health) and at federally-sponsored organizations (for example, the independent scientific advisory group JASON and the National Academies of Sciences, Engineering, and Medicine). Getting exact numbers is difficult, but we did access a publicly available database (maintained by the US General Services Administration) that tracks committees governed by the Federal Advisory Committee Act. Our analysis of NSF data from 2018 showed that, of the over 15,000 committee members affiliated with US institutions, 73% were from R1s. Minimizing inequities across federal research demands inclusion of ERIs from the beginning, when problems are defined, and all the way downstream, when recommendations are made and implementation assessed.

Assessment also needs more granular attention. Agencies should design grant processes to mitigate biases, such as blinding reviewers to both name and institution. NASA has seen great success with dual-anonymous peer review, which increased awards to female and early-career scientists. Another encouraging step in this direction is the National Institute of Health's recent move to change how grant applications are scored, "thus mitigating the undue influence of the reputation of the institution or investigator," according to a Center for Scientific Review description of the change. In a similar direction, the National Science Board voted at its February 2023 meeting to create a commission to assess NSF's grant review criteria and implementation.

Next year brings a broad, potentially transformative opportunity to revise metrics that have made the concentration of prestige and resources self-perpetuating. The R1 designation itself comes from the Carnegie Classification system deployed in 1970, which has tremendous reputational significance for universities offering doctoral degrees. R1, the most prestigious, is "very high research activity," followed by "high research activity" or R2, with all other doctoral universities designated "doctoral/professional universities" or R3. These classifications are based predominantly on the numbers of doctoral degrees awarded and the value of research expenditures. The American Council on Education is planning to update these research classifications for 2024. A de-emphasis on metrics that consider only the size of an institution's portfolio and an embrace of metrics to build and diversify the nation's research as a whole would have tremendous impact.

To truly achieve research equity, efforts to support ERIs must become incorporated into the fabric of the research ecosystem. As the CHIPS and Science Act moves into appropriation and implementation phases and beyond, all the key players will need to be on board. The concrete efforts we've seen so far are encouraging. We urge policymakers, along with agencies and universities, to lean into these new provisions for ERIs to form a more diverse, more equitable, and altogether stronger research enterprise.

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