From Students to Inventors: Talent and the Pathway to Invention

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A growing literature has shown persistent gender, racial and ethnic gaps in patenting, with underrepresented minority (URM) inventors comprising only a small share of U.S. patent holders (Bell et al., 2018; Cook et al., 2022). These disparities are costly to society and the economy, as "missing" inventors mean "missing" inventions and a narrower set of solutions to societal problems and needs, which stifles economic growth (Konings et al., 2021; Hofstra et al., 2020; Hsieh et al., 2019). Moreover, the economic returns to inventive activity, including patent-related wage premia, tend to be concentrated among inventors and senior executives, making unequal access to invention a mechanism that contributes to broader economic inequalities (Kline et al, 2019).

Most prior studies examining differences in innovative activities by demographic groups have focused on patenting, as this is often the first time individual inventive activity can be observed (Bell et al, 2018). These dynamics however may begin much earlier in the invention pathway, and typically well before ideas reach the patent office. Kozlowski et al. (2022) show that women and underrepresented minority scholars face disparities in scientific publishing that foreshadow later gaps in patenting. A key challenge has been the absence of demographic information in the patenting process itself, leaving little opportunity to look into earlier stages of innovation, when promising talent may still be nurtured or lost.

This paper uses a unique dataset from the Lemelson-MIT (LMIT) Student Prize to examine how diverse talent emerges at the collegiate stage, how it persists into patenting, and how institutional interventions impact involvement in these activities. The Student Prize data capture a rare population of over 2,000 student inventors from 2014 to 2021 who had already demonstrated inventiveness and had developed working prototypes. Importantly, the application process required students to self-report gender and race/ethnicity, providing a window into the demographic composition of potential future inventors. Prior research using these data shows that 14 percent of applicants identified as URM, compared to about five percent of U.S. patent holders overall, and that there are striking differences across race and gender in the types of inventions pursued (Burrage et al., 2022).

Our contribution is to extend this work by linking student inventors to long-term patenting outcomes, in order to assess whether early evidence of inventiveness persists later in the career and how the racial and ethnic gap evolves from the student stage to the patenting stage. We also exploit the expansion of outreach by the LMIT program, which began in 2017 to include Historically Black Colleges and Universities, minority-serving institutions, women's engineering programs, and later community colleges, as a natural experiment to evaluate whether

institutional interventions can reduce attrition of underrepresented groups at the earliest stages of the invention pipeline.

Background & Dataset

The Lemelson-MIT (LMIT) Student Prize honored promising student inventors in the United States between 2014 and 2021. The prize was open to teams of undergraduates and to individual graduate students who had developed technology-based inventions in categories representing major sectors of the economy: *Cure it!* (healthcare), *Move it!* (transportation and mobility), *Eat it!* (food, water, or agriculture), and *Use it!* (consumer devices and products). Eligibility required applicants to be full-time, degree-seeking students at any U.S. college or university.

The dataset includes over 2,000 applicants who self-reported their gender, race and ethnicity, institutional affiliation, and invention category. Importantly, applicants were required to present working prototypes, so these are students who had already demonstrated significant inventive potential. Approximately 14 percent of applicants identified as URM, a far higher share than the roughly 5 percent observed among U.S. patent holders. Women represented about 29 percent of applicants overall. Prior descriptive analysis reveals meaningful differences across demographic groups: URM men were disproportionately likely to develop consumer devices, while URM women were heavily represented in health-related technologies (Burrage et al., 2022).

Table 1 summarizes the demographic, institutional, and invention characteristics of the sample. These data allow us to examine the early composition of the innovation pipeline, and after matching to U.S. patents, provide a foundation for studying persistence into patenting and the evolution of disparities across the student-to-inventor pathway.

Table 1. Summary Statistics of Applicants (N=1,671)

	Mean	Std. Dev.
White	0.534	0.499
Asian	0.373	0.484
Hispanic	0.092	0.289
Black	0.042	0.200
Native American/Indig.	0.012	0.109
URM	0.141	0.348
Female	0.289	0.454
Undergrad	0.717	0.451
STEM Major	0.870	0.337
Public	0.487	0.500
Research Univ. (R1/R2)	0.876	0.330
Prize Category		

Cure it! (Health)	0.471	0.499
Eat it! (Food)	0.147	0.354
Move it! (Transport)	0.078	0.268
Use it! (Consumer)	0.304	0.460
Prize Year		
2014	0.081	0.274
2015	0.045	0.207
2016	0.098	0.297
2017	0.154	0.361
2018	0.199	0.400
2019	0.101	0.301
2020	0.166	0.373
2021	0.156	0.363

Research Design

In this paper, we will extend prior analysis of the LMIT data in two ways. First, we will look at longer run inventive activity of these student inventors by linking prize applicants to subsequent U.S. patents using an AI-assisted name-matching approach. Since we do have information from the LMIT applications on undergraduate institutions, we can also address issues with name ambiguity using other data sources like LinkedIn. This will allow us to track whether early promise among student inventors translates into persistence in the innovation pathway. Importantly, this will allow us to estimate whether the relatively smaller URM gap observed at the application stage widens as students move along their careers. In the future, beyond patenting, we will also explore broader educational and career trajectories using data from sources like LinkedIn, providing a more comprehensive picture of how inventive talent develops over time.

Second, we will exploit the expansion of LMIT outreach as a quasi-experimental setting to estimate the causal impact of this approach on the racial and ethnic gap. Beginning in 2017, LMIT expanded its recruitment strategy to include a wider range of institutions, including Historically Black Colleges and Universities, minority-serving institutions, women's engineering programs, and later community colleges. For this analysis, we will use a differences-in-differences approach, where we will compare the number and demographic composition of applicants for the universities where there was outreach beginning in 2017 compared to those without outreach efforts. This approach will allow us to provide causal evidence on whether such interventions successfully broaden participation and mitigate the attrition of underrepresented groups at an early stage of the innovation pipeline.

Initial descriptive patterns suggest that outreach may have played a role. Figure 1 shows the share of prize applicants reporting URM status by degree level between 2014 and 2021. There is a gradual increase of URM undergraduate applicants over time, with URM graduate student applicants showing an overall increase between the 2014 to 2021 applicant years, but a decline in graduate student applicants from the previous year in the applicant years of 2017,

2018, and 2019. More active outreach was conducted by LMIT starting with the 2018 prize cycle to identify promising student inventors, and the increase in undergraduate URM applications after 2017 appears to coincide with the introduction of expanded outreach, motivating our causal analysis. Descriptively, women were more likely to focus on health-related (Cure It!) topics, whereas underrepresented men applicants were more likely to focus on consumer goods (Use It!) (see Figure 2).

Figure 1. Share of Graduate and Undergraduate URM Prize Applicants, 2014–2021

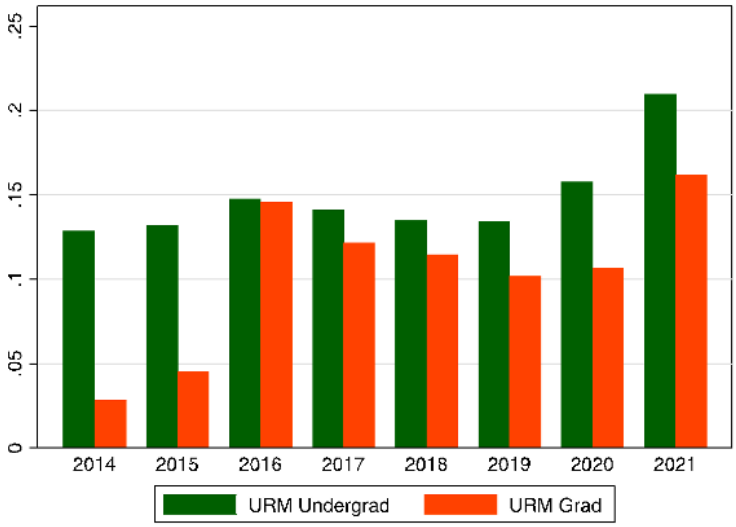
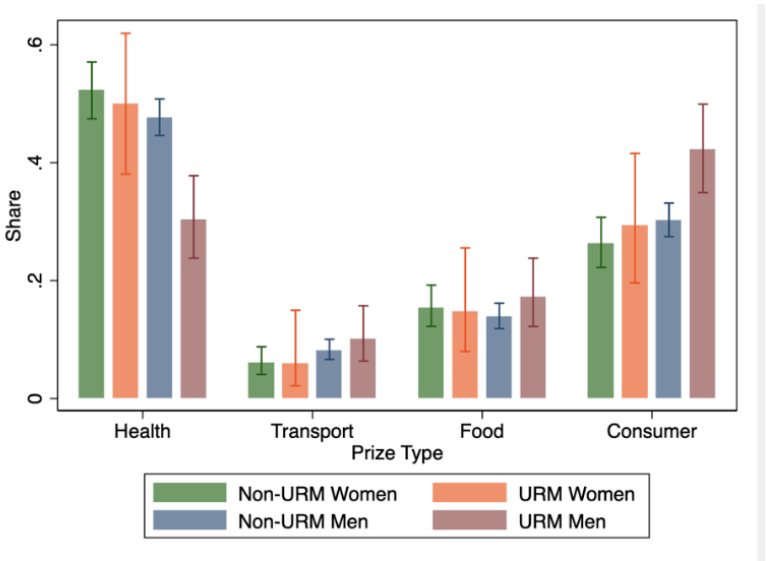


Figure 2. Share of Graduate and Undergraduate Prize Applicant Category, 2014 - 2021



Broader Implications and Discussion

Beyond documenting descriptive patterns, this project is designed to assess whether early exposure to invention opportunities shapes the long-term career trajectories of diverse student inventors. By following applicants over time, we can examine whether program participation increases the likelihood of patenting, entrepreneurship, or entry into invention-related careers. These results will provide evidence on how institutions and targeted programs can cultivate more inclusive pathways to innovation and help address persistent inequalities in the inventive workforce.

A central contribution of this research will be to identify the institutional and programmatic factors that encourage or discourage diverse students from persisting in inventive careers. Understanding the role of exposure to innovation in the early stages context is important for assessing how different environments foster access to invention pathways. The findings will contribute to literature that examines institutions of the design of programs that can better support the talent pipeline of inventors in transforming ideas into patented innovations.

The broader goal is to generate evidence for policies and practices that cultivate more inclusive pathways to innovation. By showing whether and how early invention experiences shape downstream inventive activity, this work will highlight opportunities for intervention at a formative stage in the innovation pipeline. In doing so, this paper underscores the importance of ensuring that promising talent is nurtured rather than lost before ideas reach the patent office, thereby expanding the pool of inventors and the range of solutions available to society.

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