Ryan Hill
2146 West View Building
Provo, UT 84602

January 19, 2022

Dear committee,

Enclosed is my application to the NBER Innovation Research Boot Camp, including an updated CV and research statement. Heidi Williams at Stanford University will forward a letter of recommendation. Thank you for your consideration.

Sincerely,
Ryan Hill

ryan_hill@byu.edu
801-422-8796
ryanreedhill.com

Updated: January 2022

Ryan Hill

CONTACT

ryan_hill@byu.edu
ryanreedhill.com

EMPLOYMENT

Brigham Young University (BYU) 2021-
Assistant Professor of Economics

Kellogg School of Management - Northwestern University 2020-2021
Postdoctoral Researcher

EDUCATION

Massachusetts Institute of Technology (MIT)
PhD in Economics, 2020
Essays on the Economics of Science and Innovation
Committee: Heidi Williams (chair), Amy Finkelstein,
Joshua Angrist, Pierre Azoulay

Brigham Young University (BYU)
BS in Economics, Mathematics, and Political Science, 2014
Magna Cum Laude

RESEARCH FIELDS

Economics of Innovation, Labor Economics, Public Finance

PUBLICATIONS

"Internalizing Externalities: Designing Effective Data Policies," (with Carolyn Stein and Heidi Williams)
AEA Papers and Proceedings, (2020) 110, 49-54.

"Inside Job or Deep Impact? Using Extramural Citations to Assess Economic Scholarship," (with Joshua Angrist, Pierre Azoulay, Glenn Ellison, and Susan Feng Lu)
Journal of Economic Literature, (2020) 58:1, 3-52.

Economics Research Evolves: Fields and Styles (with Joshua Angrist, Pierre Azoulay, Glenn Ellison, and Susan Feng Lu)
AEA Papers and Proceedings, (2017) 107, 293-97.

WORKING PAPERS

"Scooped! Estimating Rewards for Priority in Science" (with Carolyn Stein)

"Race to the Bottom: Competition and Quality in Science" (with Carolyn Stein)

"Searching for Superstars: Research Risk and Talent Discovery in Astronomy"

"Adaptability and the Pivot Penalty in Science" (with Yian Yin, Carolyn Stein, Dashun Wang, and Benjamin Jones)

WORK IN PROGRESS

"On-Ramps and Off-Ramps to Science Careers: The Undergraduate Experience" (with Benjamin Jones and Heidi Williams)

"Childhood exposure to new careers" (with Michael Andrews and Joseph Price)

AWARDS, GRANTS, AND FELLOWSHIPS

National Science Foundation Graduate Research Fellowship	2014 – 2019
Wheatley Endowed Leadership Scholarship, BYU	2013 – 2015
Phi Beta Kappa, BYU	2013 – 2014

PROFESSIONAL ACTIVITIES

Refereeing:
American Economic Review; Quarterly Journal of Economics; American Economic Review: Insights; The Review of Economics and Statistics; Journal of Economic Literature; Journal of Law, Economics, and Organizations; Economic Letters.

Seminar and Conference Presentations:

American Economic Association Annual Meeting, Econometric Society North American Winter Meeting (Co-author)	2022
Montana State University, Iowa State University, Northwestern University – Kellogg, PDB50 – American Society of Biochemistry and Molecular Biology, NBER Summer Institutes – Innovation (Co-author)	2021
Northwestern University – Kellogg, University of Utah – Eccles, Brigham Young University, Brown University, NBER Summer Institutes – Innovation, EPFL Virtual Innovation Seminar, Rutgers Institute for Quantitative Biomedicine	2020
MIT Kavli Institute for Astrophysics and Space Research, BYU Graduate Student Conference, MIT Applied Microeconomics Seminar, NBER Productivity Lunch	2018-2019

TEACHING

BYU:

Econ 382: Intermediate Microeconomics II	2022

MIT:

14.32: Econometrics (undergraduate) TA to Professor Joshua Angrist	2020
14.33: Research and Communication in Economics (undergraduate) TA to Professor Sara Ellison	2019
15.S57: Platform Strategy (short MBA course) TA to Professor Pierre Azoulay	2019
15.S64: Competitive Strategy Bootcamp (short MBA course) TA to Professor Pierre Azoulay	2018
14.03: Microeconomic Theory and Public Policy (undergraduate) TA to Professor David Autor	2018
14.473: Public Policy in Health Economics (graduate) TA to Professor Heidi Williams	2017
14.73: The Challenges of World Poverty (undergraduate) TA to Prof. Esther Duflo and Prof. Frank Schilbach	2016

Ryan Hill
BYU Economics

Research Statement

My research focuses on two major questions: What drives the pace and direction of scientific research? How does the world get new scientists? I use causal inference and other applied methods to study new and non-traditional data sources such as administrative data from astronomy and structural biology. The empirical analyses are grounded in economic theory, focusing on how scientists make decisions under the incentives and constraints they face in academic science.

One of the key contributions of my recently completed dissertation research is the role of priority racing in science. There is a long literature in the sociology and economics of science that theorizes that priority incentives affect the pace, direction, and quality of research, but these ideas had not previously been tested empirically. We have two papers currently under review for publication that explore priority incentives in the context of structural biology using the Protein Data Bank.

The first paper, "**Scooped! Estimating Rewards for Priority in Science**," (with Carolyn Stein) analyzes how scientists are rewarded for novel innovations through top journal placements and citations. Using detailed project-level data from structural biology, we examine the outcomes of priority races, and estimate the cost to researchers of getting scooped. We link similar or identical projects of independent academic teams that are near publication and find that when teams are scooped they are less likely to publish their findings, their work appears in a lower-ranked journal, and they receive fewer citations. We augment our analysis with a survey of structural biologists and find that scientists are more pessimistic about the probability and cost of getting scooped than we find in the data.

In the next paper, we consider how these racing incentives might affect the pace and quality of academic research. One concern with uneven priority rewards is that they could shift incentives toward speed and away from the quality of research. In equilibrium, findings may be less reliable than a social planner's optimum. In **"Race to the Bottom: Competition and Quality in Science,**" (with Carolyn Stein) we present a model of academic racing where scientists choose whether to enter new projects and how long to work on the research while trading off quality improvements with the threat of being scooped. We document evidence that the highest-potential projects in structural biology are the most competitive, are completed faster, and are produced at a lower quality on average. We measure quality with objective markers of scientific accuracy unique to structural biology and consider the optimal distribution of rewards between racing teams.

In "**Adaptibility and the Pivot Penalty in Science"**, (with Yian Yin, Carolyn Stein, Dashun Wang, and Benjamin Jones), we study the returns to pivoting toward new research directions. Here we study historical publishing and patenting data as well as a recent case study, the COVID-19 pandemic. We develop a new metric of "pivot size" and document a consistent negative relationship between pivot size and impact. Even during the pandemic, when there were strong demand-side incentives for researchers to pivot to COVID-specific research, the scientists who moved the farthest in topic space experienced the lowest probability of impact.

In the future, we hope to expand this agenda about the pace and direction of research into new questions: How do priority incentives affect collaboration and the free sharing of ideas between scientists? Does the priority reward system push people to over- or under-explore new topic areas

and methods? How can scientists be better compensated for their contributions to downstream applied innovation?

The second line of research that I am actively working on examines the career pipeline into research and innovation careers. I currently have new projects that study this process at various points along the pipeline, including children, undergraduate students, and graduate students.

In **"Childhood Exposure to New Careers,"** (with Joe Price and Mike Andrews) we plan to use historical census data to examine how childhood exposure to the high-skill careers of their neighbors affects future career choice. Building on the "moving to opportunity" literature, we hope to exploit natural experiments in proximity and social networks to study peer influence on career choice, including toward research and innovation-oriented careers. Moving along the pipeline to undergraduate students, my next work in progress is called **"On-ramps and Off-ramps to Science Careers: The Undergraduate Experience."** (with Benjamin Jones and Heidi Williams). We analyze administrative data from a prominent research university to study how undergraduate research experiences might push students toward research and STEM careers. In particular, we are interested in whether research exposure and information about the PhD path might be particularly important for students from under-represented backgrounds.

Finally, I study early career dynamics of novice scientists in "**Searching for Superstars: Research Risk and Talent Discovery in Astronomy**." I analyze a unique source of project-level risk in science: weather conditions during viewing sessions at large ground-based telescopes. I study how weather-induced project failure affects the career dynamics of young astronomers. I find that bad-weather shocks have negative effects on future publications, citations, and science opportunities for novices, but that these effects are transient. After about four years, lucky and unlucky astronomers return to having similar outcomes. These findings have implications for the Matthew Effect, a theory of cumulative advantage in science.

I am applying for the NBER Innovation Research Boot Camp because it is an exciting opportunity to meet and interact with young and experienced economists studying innovation. Innovation research is often scattered across a variety of traditional economic fields, including IO, labor, macro, and other sub-disciplines. I welcome the opportunity to meet other researchers with various backgrounds who are working on these critical topics. I hope to be able to get feedback on new ideas, make connections with researchers that might want to collaborate in the future, and meet senior economists who have experience in a variety of topics and methods. The pandemic started at the tail-end of my job market year, and I unfortunately missed many opportunities to network in person during my post-doc and first year as an assistant professor. I think the bootcamp would be an excellent chance to meet colleagues and get a stronger foothold in the profession for my future research pursuits. Being two years removed from my PhD will also give me an opportunity to mentor and encourage graduate students who attend. I think I can offer useful feedback and suggestions for thesis-writers that are still generating and testing ideas for their dissertation research. I look forward to actively participating in the program if I am accepted.

Cover letter

I am writing letters for several PhD students and recent PhDs for the Innovation Research Boot Camp. So far, 2022 has been a bit of a disaster as our kids' school delayed their opening and has then been remote due to COVID. Given my reduced work hours, I hope that you will forgive me for sending letters when available that I have written for other purposes, or short letters when I have not previously written a letter for the student previously. This in no way reflects on the students, but rather just reflects the disaster of my 2022 schedule. Thank you for your understanding.

Heidi Williams (hlwill@stanford.edu)

Stanford University

HEIDI L. WILLIAMS
Professor of Economics

Dear Sir or Madam,

I am writing on behalf of **Ryan Hill**, a PhD student in economics at MIT who is on the academic job market this year. Ryan is an exceptionally smart, creative, mature, and hard-working applied microeconomist whom I expect to have a very successful career. I give Ryan my highest recommendation and encourage you to give his application packet a careful read.

Let me first give some background on Ryan. I first met Ryan when he visited MIT as a prospective PhD student. I remember being quite impressed with him at the time: in a very calm, modest, and understated way he communicated a real passion for research. Once at MIT, Ryan took courses across a wide variety of fields including development economics, health economics, industrial organization, labor economics, and public finance. I had Ryan as a student in my PhD labor economics class as well as as a listener in my PhD course in health economics, for which he later served as a teaching assistant. Ryan also worked with me as a part-time research assistant in 2014-2015. I mention all of this to say, I feel like I know Ryan quite well in a variety of contexts, not just in advising his dissertation as a one-off activity. The breadth of these interactions makes me feel even more confident saying that I think Ryan will be an exceptional colleague to whatever group is lucky enough to hire him.

Ryan is pursuing a very creative and original research agenda aimed at understanding issues in what one might call “the economics of science” – that is, how economic factors shape scientific research investments and outcomes. Several of his projects have involved making extremely deep dives into understanding particular scientific fields – astronomy and structural biology in particular – and Ryan has done an exceptionally good job of taking seriously his task of really understanding the scientific disciplines his work focuses on.

In my view, it is very rare to have a strong student on the job market who was trained as an economist (for example, Ryan has excellent training in econometrics) who also has a genuine, deep intellectual interest in the economics of science and innovation. I expect Ryan to become quickly integrated into the group of economists working in this area (for example, I would hope to have him join the NBER Productivity group within a few years), and expect him to quickly become a highly sought-after collaborator. For groups or departments looking for someone in the area of innovation, Ryan is a truly exceptional candidate. For a broader set of groups or departments looking broadly in applied microeconomics, or in labor economics, I think Ryan is also an excellent candidate that deserves a very close look.

Ryan has several papers, but I’d like to focus in particular on two projects which I think exemplify his entrepreneurial nature and the maturity of his research process. For each, Ryan did a fantastic job of identifying novel and economically interesting questions, worked quickly but carefully to pull together the relevant institutional knowledge needed to construct data measuring the relevant economic phenomena, and thought extremely clearly about how to design appropriate empirical tests. These two papers, as well as follow-on work he is already

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pursuing, define a clear research agenda that I expect to be very productive in the coming years. I know that I already plan to teach both of these papers to my graduate students at Stanford!

The first project I'd like to talk about is a very creative and novel idea Ryan came up with for investigating whether small shocks to research productivity may have long-lasting effects on researchers' career trajectories. The key idea is the insight that while established, veteran researchers tend to have a large portfolio of research projects which insure them against bad shocks, younger novice researchers tend to have smaller portfolios which offer much less insurance against the risk of any given project failing. This conceptual idea relates to – among other things – the economics literatures on tournaments, returns to skill, and talent discovery, as well as the sociology literature on the so-called Matthew Effect. Ryan's empirical setting is the field of astronomy, where he uses an as-good-as-random source of variation in research productivity: bad weather shocks, which disrupt scarce fixed time slots for viewing on large public telescopes. Essentially, researchers wanting time on a telescope apply and are assigned a time slot very far in advance, but bad weather on the day of your assigned viewing can render your time slot essentially useless. Ryan was extremely creative and entrepreneurial in diving into this project: he has an extremely good ability to sort out complicated institutional details, and to discern which datasets will be useful in testing and quantifying the economic behavior of interest. His primary data ended up being drawn from the European Southern Observatory – ESO – one of the largest ground-based observatories in the world (but he pursued a number of other data sources before settling on that one). Ryan then figured out how to link the ESO records to both short-term outcomes (e.g. publications) and longer-term outcomes (e.g. proxies for exiting academia). He very quickly produced a set of preliminary results for this project which were quite promising, and his draft is now (in my view) essentially complete and close to ready for journal submission.

The second project I'd like to talk about is Ryan's job market paper, which is co-authored with another MIT PhD student (Carolyn Stein, who I expect will be on the job market next year). Ryan and Carolyn came up with the idea of thinking about priority races in science (a topic I think is *great*, and one with very little existing work on it). They originally dug in to a general analysis across scientific fields, but in the course of doing that a fortunate conversation with a scientist led them to switch to focus on the field of structural biology. Two things are fantastic about structural biology for the purpose of this project. First, a publicly available database catalogs essentially all research projects in the field (including projects that never result in a publication), and does so in a way that naturally allows them to identify priority races – different scientific teams aiming to solve the same problem. Second, detailed data that is available for this scientific field allows them to reconstruct historical timelines to be able to observe cases where more than one team was – unbeknownst to each other – working on the same problem at the same time. I had never even *heard* of the field of structural biology when Ryan and Carolyn came to me with this idea, but it immediately became quite clear that this was exactly the right case study for them to focus on. The project subsequently developed in a number of fantastic directions. They constructed a very compelling empirical design which allows them to estimate the causal effect of being "scooped" (losing a priority race): they estimate that scooped projects

are somewhat modestly less likely to be published, and those that are published appear in lower-ranked journals and generate fewer citations. They developed a simple statistical discrimination model which provides a framework for interpreting heterogeneity in their estimated effects: for example, the cost of being scooped is much smaller when a high-profile team is scooped by a low-profile team, relative to the reverse situation. They executed a survey of scientists to ask what scientists *think* the costs of being scooped are, to be able to compare and contrast those beliefs with their actual empirical estimates. In my view, the paper is just fantastic – I see it as something that will be very high-impact, and which will inspire subsequent work on this topic, but also on other related topics.

Ryan and Carolyn are also working on a second joint project, an applied theory paper, thinking about the welfare effects of priority races in science (specifically, whether races cause researchers to rush and under-invest in project quality at the margin), and analyzing counterfactual distributions of credit that could be achieved e.g. through adjusting journals' publication policies and the welfare consequences of those. These two papers are evidence of what I expect to be a very productive collaboration in the future, and – knowing the details of the situation quite well, as I am also one of Carolyn's advisers – I want to state quite clearly and strongly that both students should receive equal intellectual credit for the two manuscripts.

Zooming out from these specific projects, which each focus on a single scientific field (astronomy and structural biology), Ryan also pursued work that aimed to understand the economics of science from a broader perspective. Specifically, Ryan co-authored a collaborative paper with my former MIT colleagues Joshua Angrist, Pierre Azoulay, and Glenn Ellison together with Susan Feng Lu of Purdue University which used the Web of Science data to explore the impact of academic research in different fields of study. While I feel that in many cases, involvement in co-authored collaborations with faculty can distract students from the "critical path" of making progress on their dissertation, in this case Ryan's experience has been exactly the opposite: this collaboration has been an excellent opportunity for Ryan to get to know a dataset (the full historical Web of Science records, which MIT recently purchased a license to) which Ryan will re-use in many of his own research projects going forward, and the work is very much in the scope of Ryan's research agenda. This collaboration resulted in one short paper publication in the May 2017 *American Economic Review Papers and Proceedings*, as well as a second longer paper that is forthcoming in the *Journal of Economic Literature*.

On a personal level, Ryan is a really wonderful person. He exemplifies a form of "quiet leadership" that is hard to summarize in a letter, but that I think will make him an incredibly valued colleague. In sum, I think Ryan is an excellent student, and I hope you will give him your most serious consideration. Please do not hesitate to contact me if I can be of further assistance.

Sincerely,



Heidi L. Williams