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November 15, 2016

National Bureau of Economic Research

Dear Members of the Search Committee:

I am a Ph.D. candidate at the Wharton School, University of Pennsylvania and am writing to express my interest in the Post-Doctoral Fellowship on Innovation Policy with the NBER.

My research focuses on the management of highly skilled individuals and policies that influence the rate and direction of inventive activity. My job market paper utilizes administrative data from the National Institutes of Health and state-of-the-art text algorithms to quantify the costs and benefits of redirecting scientists with targeted resource allocations. In future work in this space, I hope to explore aspects of competition unique to highly specialized individuals and firms.

Other research in progress with Aaron Chatterji, Matt Grennan and Ashley Swanson investigates physician-industry ties and the nature of bias in medicine and science. Examining the pharmaceutical industry more broadly, a current project with Mark Pauly provides a demand-driven explanation for the substantial changes in R&D costs observed over the past two decades.

My application includes the following materials:

1. Curriculum Vitae
2. Research Proposal

Three letters of recommendation will be submitted separately by Matt Grennan (Dissertation Co-chair), David Hsu (Dissertation Co-chair), and Ashley Swanson. Please let me know if you would like any additional information. I look forward to hearing from you.

Sincerely,



Kyle Myers

Kyle R. Myers

Ph.D. Candidate
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Education

University of Pennsylvania, The Wharton School,
Ph.D. Candidate, Management Science & Economics; expected 2017

Pennsylvania State University, Schreyer's Honors College
M.S., Health Policy & Management; 2010
B.S., Biology; 2010

Research Interests

Economics and management of innovation; science policy; health economics

Working Papers

"Managing the Rate and Re-direction of Science", Dissertation
Received Kauffman Prize for Best Student paper at the 2016 Roundtable for Engineering Entrepreneurship Research Conference. Draft available at https://goo.gl/pr4Nnw.

Dissertation Committee:

Advisor & co-chair: Prof. Matt Grennan
Prof. Ashley Swanson
Co-chair: Prof. David Hsu
Prof. Dan Levinthal

"A Ricardian-Demand Explanation for Changing Pharmaceutical R&D Productivity", with Mark Pauly
NBER Working Paper No. 22720, available at www.nber.org/papers/w22720.

Research In Progress

"Physician-Industry Ties: Impacts on Innovation and Treatment Patterns", with Matt Grennan, Ashley Swanson and Aaron Chatterji

"Managing Innovation in Hospitals: The Rise of the Chief Innovation Officer", with John Kimberly

Grant Funding

"The Value of Managing Scientists", NBER-IFS Program on the Value of Medical Research Predoctoral Scholarship (2016).

"Technical Marginality and Differentiation in Contests for New Ideas", Kauffman Foundation Dissertation Fellowship Program (2015).

"Managing Innovation in Hospitals: The Rise of the Chief Innovation Officer", Co-PI with John Kimberly, Mack Center for Innovation (2014).

Awards and Fellowships

Kauffman Foundation Dissertation Fellow; NBER-IFS Predoctoral Scholarship on the Value of Medical Research; NBER Entrepreneurship Research Bootcamp; Leonard Davis Institute of Health Economics Fellow; NIH Biomedical Workforce Internship Program; Schreyer's Honors College Integrated Undergraduate/Graduate Program; Maryland State Distinguished Scholar; Maryland State Robert C. Byrd Scholarship

Presentations

"A demand-side explanation for changing R&D productivity." Presented at the 2016 Bates-White Life Sciences Symposium, May 2016.

"How do targeted grant contests work? Stimulating new research at the NIH." Presented at the Office of Extramural Research of the National Institutes of Health, March 2016.

Teaching Experience

Health Care Strategy and Management: the Business of Health Care [HCMG 213]; Teaching Assistant. Fall 2015, Fall 2016. Full-time T.A. responsible for five full lectures and managing student project groups throughout the semester.

Introduction to Diversity in Doctoral Education And Scholarship (IDDEAS); PhD Student Mentor . One-day seminar presentation; led group of undergraduate students to develop their own research proposals.

Research Design Fundamentals and Applications in Business [WH150]; Guest lecture. Presentation on quasi-experimental research design and an application to healthcare.

Teaching References:
Prof. John Kimberly, Management, The Wharton School.
e: kimberly@wharton.upenn.edu p: (215) 898-7937.

Prof. Catherine Schrand, Accounting, The Wharton School.
e: schrand@wharton.upenn.edu p: (215) 898-6798.

Work Experience

Centers for Disease Control
Dept. Health and Human Services Emerging Leader Fellow, 8/10 - 7/12

Booz Allen Hamilton Inc.
Research Assistant, Global Information Technology Team, 5/08 - 8/08

Dynport Vaccine Company
Assistant Senior Manager, Regulatory Affairs, 5/07 - 1/08

National Cancer Institute - Lab of Genomic Diversity at Ft. Detrick
Cancer Research Training Award Fellow, 7/04 - 8/05, 5/06 - 8/06

2016 NBER Post-Doctoral Fellowship: Research Proposal

Kyle R. Myers · The Wharton School, University of Pennsylvania · myersky@wharton.upenn.edu

Overview

The economic and social determinants of the rate and direction of innovation have long been of interest to scholars. These factors are relevant to many aspects of the economy from the management of specialists in laboratories and organizations, to national policies on the subsidizing and regulation of R&D. Initial work by Kenneth Arrow, Richard Nelson and Sidney Winter identified many of the major tensions in this field. Recent advents in data accessibility and the ability to quantify traditionally vague concepts, e.g. the "direction" of innovations, provide a unique opportunity to revisit and address these questions with robust empirical techniques.

In my dissertation and other on-going work, I have begun to use such detailed data to investigate how managers - be they firm executives or public policymakers - can influence influence how fast *and where* innovations occur. Specifically, I examine the NIH's attempts to indirectly steer biomedical scientists, how pharmaceutical R&D productivity responds to demand growth, and how physician-firm interactions influence treatment and research behaviors. The post-doctoral fellowship with the NBER would provide me with a wonderful opportunity to continue developing this work, and, more importantly, initiate new projects that build on these lines of inquiry. In particular, I am interested in more closely examining the "translational" stage of research where knowledge is converted into products, and how new firms are built around these new products. As a fellow, I would take full advantage of attending NBER events and seek out collaborations with affiliated faculty.

Job Market Paper: Summary

My job market paper[1] investigates the reallocation of scientists through the use targeted research competitions at the NIH. These contests embody the features of many "pull" (demand-side) levers used my managers to incentive individuals or firms to redirect their efforts to specific goals. Thus, in addition to being inherently relevant as a major public research organization, the NIH provides an empirically ideal setting to study the choices and outcomes of specialized agents as they are incentivized to adjust the direction of their work. I utilize the NIH's administrative grant application database and two state-of-the-art text algorithms to construct a novel dataset of roughly 900 of these targeted contests ($\approx$ \$10B in total awards) and 8 years of grant applications from more than 80,000 scientists. Together the data and algorithms allow me to examine within-science and within-scientist variation in treatments and outcomes providing causal evidence for the role of targeted contests in the management of science. Specifically, I focus on two main empirical questions: (1) did the targeted contests induce new research proposals and/or fund research that would not have been funded otherwise; and (2) did scientists require compensation (in the form of larger grants) in order to induce the level of redirection observed in these contests?

My first analyses traces the usage of scientific subjects over time as they appear in the abstracts of applications (successful and unsuccessful) and subsequent publications. Using a difference-in-difference research design, I find that being requested by these contests increases the rate of science proposed, funded and published on the order of 5-11%, with the largest effects among new investigators and scientific subjects most unlikely to have otherwise been funded. However, these patterns of

[1] Available at: https://hcmg.wharton.upenn.edu/profile/21733/research.

inducement are not apparent among contests soliciting commercial research involving private firms, suggesting significant barriers to scientific redirections at this stage of R&D.

Given evidence that new basic (non-commercial) science is induced, my second analysis identifies a key parameter underlying the responsiveness of scientists to these targeted interventions: the elasticity of the redirection. I frame this parameter as a compensating differential; essentially, what is the expected value of a grant competition such that a scientist is indifferent between it and a given level of redirection? My analysis builds on the following assumption, if scientists can costlessly adjust the trajectories of their research then all contests, regardless of the type of science requested by the manager, should see competition to the point that their expected values are equivalent. I use this logic to motivate a difference-in-difference design with scientist and grant-type fixed effects, and find that scientists are indifferent between a 1.6 s.d. increase in the expected payoff of a grant competition ($1.5M) and a 1 s.d. decrease in scientific similarity (performing less similar research) necessary to enter the competition. Sub-sample analyses indicate that this compensating differential is driven entirely by experienced scientists, further evidence that younger, less experienced scientists are most willing to change the direction of their research. Furthermore, the redirection premium associated with commercial science is 3-5 times the size of the average commercial grant, suggesting that the null effects estimated in the first analyses may be due to the large costs of scientific redirections at the commercial stages of R&D.

Job Market Paper: Extensions

I also plan to continue leveraging my unique data from the NIH in order to examine how the technological diversity of potential competitors may influence entry decisions. My data provides a unique opportunity to construct person-to-person relationships in geographic, organizational and "scientific" dimensions. Based on these relationships, it may be feasible to take a structural approach to estimating competitive interactions between these individuals in order to identify how specialized competitors respond to diverse competition, holding the size of the market reward fixed. In initial work on this topic, I have shown that my measure of scientific similarity is a strong predictor of entry and can be implemented as an instrumental variable to generate plausibly exogenous measures of expected competition. Expanding this analysis could inform the nature of competition in settings such as this where highly specialized individuals (e.g. entrepreneurs) face a large and diverse set of competitors each seeking a prize (e.g. patents).

My finding that small commercial ventures are not responsive to the NIH's incentives for redirections certainly warrants further investigation as well. Currently, I do not have data on the short- or long-term outcomes of these commercial grants, so I am unable to explore any variation in effects that may not be apparent in the null averages I estimate. By connecting my current data on grant successes and failures to other outcomes such as non-NIH investments, product development and patenting, and/or firm survival, I may be able to more specifically address why the costs of redirections are larger for commercial-stage R&D.

Another potential product of my dissertation is to document and standardize the text algorithms I employ. One of the algorithms - the Medical Text Indexer - is already publicly available, and provides an extremely useful way to extract biomedical subjects (units of science) from raw text en masse. However, there exists no standardized procedure for implementing this tool to create datasets for the social sciences. By highlighting its capabilities and providing sample implementation code, I would hope to make this wonderful tool more accessible to other researchers.

Ongoing Projects

Two ongoing projects I am involved with investigate the individual- and industry-level determinants of innovation. In a project with Aaron Chatterji, Matt Grennan and Ashley Swanson we are examining the extent to which industry-physician interactions may influence physicians' treatment and research behaviors. Using a panel of data on payments from pharmaceutical firms to physicians, we are currently exploring the use of both instrumental variables and a regression discontinuity design to test whether or not biases arise specifically due to these payments. Importantly, prior work in this space has not been able to overcome a large selection concern where, for instance, firms are more likely to fund research projects that are expected to have profitable implications. Thus, finding more firm-favorable results amongst firm-sponsored research may not be indicative of any real bias in the science performed. But thanks to advances in text processing, we can more rigorously quantify actual bias (e.g. p-value hacking, slant of wording) and overcome these selection issues. We hope to offer new insights into the causal effects of external, firm-sponsored activities.

Looking at the determinants of innovation at a more aggregated level, a working paper with Mark Pauly investigates the dramatic growth in the R&D costs per new drug. We draw insight from David Ricardo's theory of demand-driven productivity in settings of variable scarce resources - here, new drug ideas - and estimate the industry's responsiveness to exogenous changes in demand over the past three decades. In contrast to many critics of this industry, our results suggest that innovative new drugs have been brought to market remarkable consistency since the late-1980s, and rather than any major supply-side frictions, it appears that increased competition in drug development have effectively bid down excessive profits from decades past.

Other Future Research: Experiments & Translation

My current work is based in the healthcare sector given its inherent importance, but also because it is a source of large, high-quality datasets that can inform many questions of general interest to innovation scholars. Undertaking studies of other industries is certainly an avenue I wish to pursue, as I am interested in exploring the fundamental questions posed in my dissertation in other high-technology, commercial settings, where the use of high-turnover, multidisciplinary allocation schemes (see, for example Google X), has become increasingly popular. I am especially interested in employing an experimental design to examine the tradeoffs of allowing innovators to self-select their own projects and partners. Recent research by Karim Lakhani and Kevin Boudreau suggests that scientists may face cognitive constraints when evaluating the prospects of new ideas, and it would be my goal to connect phenomena, such as this bias, to actual production/commercialization outcomes in a real-world setting.

In general, I would like to investigate the process of translating basic science to viable products. For some time, national policy discussions of the translational "bottleneck" have argued for increased investments at this stage; however, these investments have largely been treated only as inputs - not incentives - assuming that innovators are willing to undertake the adjustments necessary to utilize these new resources and generate new products with a fixed set of opportunities. Given the results of my JMP, which highlight the significant costs of redirections, particularly for commercial science, I hope to identify more research settings that would allow me to identify the costs and benefits of incentivizing scientists to traverse the spectrum of basic and commercial science.

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October 14, 2016

To Whom It May Concern:

It is my pleasure to enthusiastically recommend Kyle Myers for a position in your department. He has written an excellent job market paper on the management of innovation using targeted vs. open prizes. The paper required an immense amount of data work and substantial creativity in modeling, and I believe it will be published in a very good economics or management journal. I recommend Kyle highly to economics departments, business schools, public and health policy schools, and other research organizations seeking an applied micro-economist with focus on health economics or innovation.

My first interaction with Kyle was when he was a student in my course on cost benefit and cost effectiveness analysis (a required course in our doctoral program). I was thoroughly impressed with Kyle's performance in that course. While he developed a strong facility with the "nuts and bolts" of CBA and CEA, he went above and beyond in engaging with the deeper welfare economic reasoning underlying such analyses. For the final project in the course, which is typically a proposed CEA crafted around a specific health intervention or technology, he even went so far as to request permission to do a more difficult evaluation: of CEA policy itself. I see this as being emblematic of several aspects of Kyle's intellect and personality: his creativity, his inquisitiveness, and his willingness to work hard in order to squeeze the most value out of any intellectual exercise. It was also an early indicator of Kyle's keen interest in innovation strategy and policy. Based in part on this experience, I later enthusiastically hired Kyle on as a research assistant (for joint work with Matt Grennan and Ronnie Chatterji, described in more detail below) and recommended him as the teaching assistant in my undergraduate course on health care management and strategy during my teaching sabbatical. Since then, I have been discussing Kyle's work with him regularly.

In Kyle's job market paper, he examines the role of resource targeting in the management of science, using grant contests at the National Institutes of Health (NIH) as his empirical setting. In doing so, he contributes to the broader management and economics literatures on incentive schemes and innovation, focusing on how scientists' subject specificity impacts the traditional information-control tradeoff. A manager or social planner with resources to allocate may have a different set of objectives than an informed scientist charged with doing the actual work of innovation, and a targeted incentive scheme may strike an appropriate balance in directing scientists' effort while deferring to their greater subject expertise. Implicit in this balance is the fact that targeted schemes will incentivize scientists to redirect their efforts away from innovative activities in which they'd otherwise be engaged. Thus, determining whether a targeted incentive scheme is appropriate requires quantifying both the benefits of targeting (i.e., the extent to which targeted incentives result in greater productivity in the relevant subject area, and the value of that increased productivity) and the costs of redirecting scientists away from their preferred activities. Kyle approaches this issue in an important and relevant context, and uses unique data and clever empirical modeling to get at each question: he uses data on applications and publications to determine the effects of targeted (as opposed to open) contests in the NIH on subject-specific productivity; and he uses data on applying scientists' past work to estimate the compensation required to induce a given amount of redirection.

It bears noting that Kyle's empirical work on this project began with a formidable effort accessing, combining, and processing data. Kyle got access to the NIH's confidential administrative applications data during an internship at the NIH's Office of Extramural Research – Kyle obtained the internship himself after a series of conversations with individuals at NIH regarding their requirements on data access and confidentiality. The data are quite detailed regarding application content, quality, and outcomes. He augmented the data with scraped historical data on the associated funding announcements from the NIH's website, and with data on scientists' publication histories from PubMed. He researched and implemented medical text processing algorithms to assign subjects to funding announcements, applications, and publications, and to classify similarity between paired bodies of text (e.g., between scientists' publication histories and current funding announcements). Creating the ultimate analytic dataset required a tremendous amount of work, organization, and tenacity. Kyle reached out independently to data resources, designers of the medical text indexing algorithms, and experts on NIH funding. These relationships greatly expanded the set of analyses Kyle can perform for this and future projects. This data effort allowed Kyle to develop a great deal of human capital in the area of medical innovation; it also demonstrates his impressive ability to gather data, insights, and empirical tools from a wide variety of sources.

Kyle draws thoughtfully on the existing theoretical literature to come up with a tractable framework for quantifying the costs and benefits of targeted vs. open contests. In his productivity analysis, he estimates the effect of targeting on applications, awards, and publications using a differences-in-differences framework that controls for subject-grant and application round fixed effects. Kyle has thought carefully about identification challenges in this framework. He shows clean evidence that there are no differential pre-trends between targeted and open contests. He also separately examines subjects that were and were not highlighted in Congressional appropriations bills in order to determine whether his productivity treatment effect estimates would be biased due to factors that simultaneously impact productivity and contest targeting (as evidenced by target subjects' political capital). He then uses additional differences-in-differences analyses to estimate the effect of targeting on the scientific similarity of (submitting) scientists' prior applications and on the expected value of the contests. He uses the latter analyses to estimate a compensating differential measuring the additional expected grant value required to induce a given amount of redirection.

Kyle finds that targeted contests increase applications, funding, and, ultimately, publications in the targeted subject areas. Interestingly, he does not find that this increase in targeted subject productivity significantly displaces applications or publications in other subjects. However, it does come at some cost: the average scientist requires an additional $200,000 in expected grant funds to compensate for the average redirection necessary to compete in a targeted, rather than open, contest. Thus, in one empirically important setting, Kyle is able to place a bound on the value of innovations (here, proxied by publications) required to justify the underlying costs of inducing experts to redirect their work.

To sum up, Kyle has written an impressive job market paper on an important topic on the economics and management of innovation, and has shed new light on the tradeoffs embodied in incentive design in the area of medical research. He has also collaborated on several other projects during his graduate career. To cite one such example, in joint work with Matt Grennan, Aaron Chatterji, and myself, we estimate the causal effects of payments from industry on physicians' prescribing behavior and research productivity, using unique panel data pre-dating the implementation of the Physician Payment Sunshine Act. Our causal identification strategies rely on panel data methods, changes in conflict of interest policies at academic medical centers, and geographic proximity of pharmaceutical firm locations to physician-researchers. Kyle joined the project as a research assistant originally, but was made a co-author shortly thereafter because of his substantial contributions in cleaning and merging data, conceptualizing and estimating linear and count data models, and managing undergraduate research assistants' efforts.

Finally, I have received extremely positive reports regarding Kyle's performance as a teacher. My co-teacher, John Kimberly, who has been leading our undergraduate health care strategy course during my teaching sabbatical with Kyle acting as TA, noted: "Kyle is a pro in the classroom. Connects well with students - effective lecturer - has all the tools. Unlike many coming out of a doctoral program, he will hit the ground running on the teaching side and will be able to handle MBA and doctoral-level teaching as well as undergrad." This is consistent with my assessment of Kyle's broader teaching potential. He is an excellent communicator, able to translate complex concepts for a variety of audiences and always ready with real-world examples. I have no doubt that Kyle would do well in front of any management, economics, or policy classroom.

Kyle is a promising and productive applied researcher, an organized and collegial collaborator, and a talented teacher. He also has a proven track record in seeking outside grant funding to support his research. I recommend him very highly, and would be happy to talk more about him and his research if that would be helpful (contact information above).

Best,



Ashley Swanson

MATTHEW R. GRENNAN
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October 13, 2016

Dear Recruitment Committee Member:

I am writing to recommend Kyle Myers for an Assistant Professor position at your Institution. Kyle is a current PhD student in Health Care Management and Economics at the Wharton School, University of Pennsylvania. His research focuses on innovation and entrepreneurship, with empirical work in the context of health care and the biological sciences. David Hsu and I are Kyle's advisors, and I have come to know Kyle well over the last two years while he has worked with me as a research assistant and now co-author.

Through my interactions with him, I have been particularly impressed with Kyle's ability and initiative in obtaining data, developing institutional knowledge, and performing independent and thoughtful data analysis. These attributes are especially evident in his work with the NIH. He spent much of the spring of 2015 working hard to develop contacts at the NIH, was able to convince them to award him a summer internship to work with the NIH confidential administrative data. Kyle has proceeded to turn this opportunity into an impressive job market paper and preliminary results on several promising future papers.

Kyle's job market paper addresses a question that is central for anyone who cares about innovation, whether it be a government policy maker or young entrepreneur: How can the incentives provided by central "management" affect the rate and direction of innovation generated by a population of scientists? This is a difficult question to answer because it faces two fundamental challenges: (1) it requires knowledge of difficult-to-measure variables that capture researcher preferences and productivity; and (2) real world incentives are typically chosen with these parameters in mind, so in most cases even a data set with the necessary measures would provide biased estimates of the true effects of incentives on innovation.

Kyle addresses both of these challenges by examining the effects of "targeted" NIH grants on the community of researchers working in related areas. First, combining the NIH confidential data, researcher publication data, and machine learning algorithms, he is able to measure researcher and project level characteristics (and outcomes) in more detail than is typically possible. Second, he combines this detailed data with a difference-in-differences research design that leverages the political nature of the NIH funding process to identify areas of contest funding that is unlikely to be correlated with unobserved drivers of scientific incentives or opportunity.

Kyle's primary findings are that: (1) targeted contests increase the amount of research output in their subject areas by 8-12 percent, but (2) this is costly, with the average relevant researcher requiring an additional $200,000 in expected grant funds to compensate for the redirection of scientific effort towards the targeted area vs. the area on which she would have otherwise worked. Kyle also performs a number of analyses to explore heterogeneity in these effects, adding richness and robustness to his findings, and making an important contribution to our understanding of the extent to which innovation can be "managed".

To be clear about the challenges Kyle overcame to generate this research, and the promise it shows for future research, I want to note in more detail his work on "data wrangling" and relationship building. The NIH administrative data Kyle obtained are large and detailed but also raw and incomplete compared to the final data set that makes his job market paper possible. He also scraped historical data on funding announcements from the NIH's website and scientist publication records from PubMed. He used machine learning text analysis tools to classify similarity between the text in the funding announcements, grant applications, and publication records. Along the way, Kyle reached out independently to data resources, designers of the medical text indexing algorithms, and experts on NIH funding. The data and relationships Kyle has developed will serve as a strong foundation for several future research projects he has planned in this area.

In addition to his dissertation work, Kyle has been extremely productive as a doctoral student, working on projects including: demand and supply effects on pharmaceutical innovation with Mark Pauly; the role of the public sector in scientific productivity and commercialization with David Hsu; the management of innovation with John Kimberly; and the aforementioned physician-industry innovation paper with Ronnie Chatterji, Ashley Swanson, and myself. These projects demonstrate the high esteem with which the Wharton faculty hold Kyle as well as his own energy and enthusiasm for research.

Kyle is graduating with a solid toolkit in healthcare and economics that all of our doctoral students obtain, but he has also developed a broader knowledge of the management, entrepreneurship, and innovation community of scholars through PhD courses with Dan Levinthal and David Hsu and the *NBER Entrepreneurship Research Boot Camp*. The quality of his ideas and research have been rewarded with a *Kauffman Dissertation Fellowship* and an *NBER ``Measuring the Impact of Health Care Innovation"* grant.

During his time at Wharton, Kyle has also demonstrated his aptitude for teaching and professional service. He has spent two years co-teaching a course on healthcare innovation with John Kimberly and one year TA'ing my healthcare entrepreneurship course. According to John, "Kyle is a pro in the classroom. Connects well with students - effective lecturer - has all the tools. Unlike many coming out of a doctoral program, he will hit the ground running on the teaching side and will be able to handle MBA and doctoral-level teaching as well as undergrad." Kyle has also served the community by co-founding and running a cross-Wharton doctoral seminar series for research on innovation. This teaching and service were completely unrequired, but Kyle saw needs, and he willingly contributed.

More generally, I think you will find Kyle to be an excellent colleague who will be an asset to your faculty and reflect well on your Institution. He is smart, friendly, and mature. His toolkit, grit, and energy are those of a promising young academic. I enthusiastically recommend Kyle to any group looking for an empirical researcher in innovation with a deep knowledge of health care.

Sincerely yours,



Matt Grennan

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David H. Hsu
Richard A. Sapp Professor of Management

October 5, 2016

Dear Faculty Recruiting Committee:

I write this letter to support **Kyle Myers**' application to your department for a faculty position. Kyle is a highly promising 5th year doctoral student in Wharton's Health Care Management area. My colleague Matt Grennan and I are co-advisors on Kyle's thesis committee. The other members of the committee are Dan Levinthal and Ashley Swanson. I first got to know Kyle two years ago when he took my PhD class on the topic of Innovation and Entrepreneurship. He actively engaged in the material, and was a terrific contributor to the class learning environment. Complementing his Wharton training in analytic and economic methods, Kyle sought out further opportunities to enhance his training specifically in the domain of innovation and entrepreneurship by attending the National Bureau of Economic Research summer workshop on entrepreneurship. When I was contacted about a research opportunity that fell in the domain of program evaluation of a public initiative in the health sciences space, I immediately thought about Kyle as a potential co-author. Unfortunately, that research opportunity did not materialize due to data access issues, but through my doctoral course, work on the potential research project, and serving on Kyle's dissertation committee, I feel well-equipped to evaluate Kyle's potential, which I believe is considerable.

Kyle's job market paper examines an exciting new area: redirecting scientists' research efforts. There is a long tradition in the economics and management of science of analyzing organizational and institutional mechanisms which impact the *rate* of scientific output. Much less frequently have researchers examined influences on the *direction* of scientific efforts. This is an interesting arena because we know from the human resource and management literatures that particularly in research and development domains, some degree of scientific autonomy can be important in the recruiting, retention, and productivity of technical personnel. At the same time, particularly in private sector R&D, there often needs to be a balance between more basic and more applied efforts, thus raising the importance of studying instruments to incentivize scientific redirection. Scientific trajectory redirection efforts also play out at the society-level as well, as public efforts sometimes are enacted to address emergent areas which might not otherwise receive as much scientific attention. Many think that the management of knowledge workers will only become more important for firms and societies over time.

Empirically studying scientific redirection is difficult because it requires designing a way to estimate counterfactual scientific trajectories in the absence of any intervention. And of course interventions are (usually) not undertaken at random. Kyle addresses these challenges by assembling data from the National Institutes of Health (NIH) on scientist-level grant proposals, and takes effort to understand what gives rise to such calls for research. To assess research trajectories, Kyle builds novel bibliometric-based measures to assess a given scientist's direction prior to a grant application (based on scientific publications). By comparing that research trajectory to that scientist's grant proposals in response to NIH-directed calls for research, Kyle is able to characterize deviations in scientists' efforts in scientific space, together with an estimate of the financial resources to induce that redirection (what he terms the "elasticity of redirection").

Conducting this type of analysis is bold for a PhD thesis, and as you will see from his job market paper, he already has an impressively developed paper.

The dataset and relationship with the NIH should also continue to be fruitful, as there are a number of research questions in the broad area of the management of innovation and the economics of science which should be addressable with the data. For example, a regression-discontinuity style study which compares those applicants just above versus just below the NIH award line (based on numerical evaluations of grant proposals) should be feasible. Another possibility is to assess the extent to which scientific redirections are individually (from a career standpoint) and/or socially optimal. In short, opening the terrain to more in-depth study of scientific redirection (and the associated benefits and costs), is an exciting research agenda that could keep Kyle and others busy for several years to come. Kyle also describes a number of interesting studies under way in his research statement.

I think you will also find that Kyle is very likely to be effective in the classroom, as he is well-spoken, listens carefully, and can deftly synthesize comments and discussions.

In summary, Kyle is well-trained and has a great deal of potential to contribute to the fields of strategy, entrepreneurship, and the management of innovation. His job market paper illustrates his ability to execute a rigorous study on a neglected research area. If your search is in any of these domains, I encourage you to take a closer look at his materials. Thank you for your consideration, and please let me know if you would like to clarify or discuss the above.

Best wishes,



David Hsu