GENERAL INNOVATION COMPETITIONS

Jason Reinecke*

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ABSTRACT

The extensive patents-versus-prizes literature has thus far focused on specific competitions—competitions that reward inventions based on how well they solve a narrow, predetermined problem. However, prize competitions do not have to specify the problem to be solved in such great detail. Indeed, the degree by which prize competitions specify the problem to be solved falls along a spectrum, with completely general competitions that permit submission of any innovation under the sun falling on one end of the spectrum, and highly specific competitions that lay out the problem to be solved in painstaking detail falling on the other end. This Article makes three primary contributions to the innovation literature. First, this Article analyzes and discusses prize competitions of various degrees of generality, and in particular tackles theoretical considerations related to where prize competitions fall along this spectrum of generality. Second, this Article highlights key factors to consider when designing these unexplored general innovation competitions. Third, this Article provides survey data collected from participants of more general innovation competitions regarding their subjective evaluations of whether and how general innovation competitions affected their innovative activity.

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I. INTRODUCTION

Innovation Inducement Prize competitions are designed to spur innovation, though they vary significantly in the degree by which they specify the problem to be solved. At one end of this spectrum are general innovation competitions that permit submission of any innovation or startup under the sun. At the other end are highly specific competitions that describe the problem to be solved in painstaking detail. A prize competition's place along the spectrum of generality has numerous implications regarding how it spurs innovation. In spite of this flexibility, the extensive patents-versus-prizes literature has thus far focused on specific competitions.[1]

1. *See, e.g.*, THOMAS KALIL, BROOKINGS, PRIZES FOR TECHNOLOGICAL INNOVATION 2 (2006), https://www.brookings.edu/wp-content/uploads/2016/06/200612kalil.pdf [https://perma.cc/W25B-ZMLZ] ("One currently underutilized tool for stimulating technological innovation is inducement

Prize competitions in practice fall all along the spectrum of generality. For instance, the George Mason Dean's Business Competition is very general, "welcome[ing] ventures and organizations in all industries [and] sectors."[2] For the University of Wisconsin-Madison Transcend Madison competition, "[a]ll you need is an idea to compete."[3] Minnesota residents with *any* startup idea[4] are eligible to participate in the MN Cup,[5] the largest statewide startup competition in the country.[6]

Conversely, the Ansari X PRIZE was rather specific, incentivizing the creation of "a reliable, reusable, privately-financed, manned spaceship capable of carrying three people to 100 kilometers above the Earth's surface twice within two weeks."[7] The 2016-17 Stanford Center on Longevity Design Challenge fell somewhere in between, offering $17,000 in prizes to teams creating inventions adhering to a general "Innovating Aging in Place" theme.[8] Similarly, the Michigan Innovation in Action competition offers prizes for inventions pertaining to one of two tracks, public health and education.[9]

Because prize competitions are so flexible with respect to the degree by which the competition specifies the problem to be solved, and because prize competitions in practice fall all along this spectrum, it is unfortunate that the literature has focused only on specific prize

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prizes, which encourage efforts by contestants to accomplish a particular goal."); Daniel J. Hemel & Lisa Larrimore Ouellette, *Beyond the Patents–Prizes Debate*, 92 TEX. L. REV. 303 (2013) (generally describing prizes as in consideration for solving a specific problem); Amy Kapczynski, *Commentary: Innovation Policy for a New Era*, 37 J.L. MED. & ETHICS 264, 265 (2009) (defining a prize system as one that rewards "innovators who meet specified outcomes."); Heidi Williams, *Innovation Inducement Prizes: Connecting Research to Policy*, 31 J. POL'Y ANALYSIS & MGMT. 752, 754 (2012) ("I focus on 'targeted' prizes that request solutions to prespecified problems, in contrast to 'blue-sky' prizes (such as Nobel Prizes) granted to inventors for innovations that were not specified in advance.").

2. *Deans' Business Competition*, GEORGE MASON UNIV., http://business.gmu.edu/blog/buzz/2017/04/03/2017-deans-business-competition-workshops-april-5th/ [https://perma.cc/2LV5-LVQX].

3. *Guidelines and Regulations*, UNIV. OF WIS.-MADISON, http://transcend.engineering/guidelines [https://perma.cc/V3WP-47TP].

4. Participants are broken into one of eight divisions for the MN Cup, though one of these divisions is "general." *Enter the Competition*, UNIV. OF MINNESOTA, https://carlsonschool.umn.edu/mn-cup/enter-the-competition [https://perma.cc/CUZ8-VELK].

5. For a brief history of the MN Cup, *see History of the MN Cup Competition*, YOUTUBE, https://www.youtube.com/watch?v=wvtUYyCLt1s [https://perma.cc/C4DP-D8ZR].

6. *MN Cup*, UNIV. OF MINNESOTA, https://carlsonschool.umn.edu/mn-cup [https://perma.cc/X4TW-G7VF].

7. ANSARI XPRIZE, https://ansari.xprize.org/ [https://perma.cc/8CY9-56CK].

8. *2016-2017 Design Challenge*, STAN. CTR. ON LONGEVITY, http://longevity.stanford.edu/designchallenge2016-17 [https://perma.cc/V6WL-J3AT].

9. *Team Eligibility*, UNIV. OF MICH. INNOVATION IN ACTION, http://innovationinaction.umich.edu/teams/eligibility.html [http://perma.cc/T4LW-M7RD].

competitions. This Article fills this void in the literature by discussing three important questions regarding prize competitions and the degree by which they specify the problem to be solved. First, in Part I, this Article analyzes and discusses prize competitions of various degrees of generality and compares them to other innovation incentives commonly discussed in scholarship, namely patents and grants. Due to the literature's focus on specific competitions, this spectrum of generality is yet to be explored. Part I also shows that grants can similarly be analyzed on the spectrum of generality, offering a new way to compare prizes and grants.

Second, what is the optimal design of these unexplored general innovation competitions? General innovation competitions can vary in many ways, and the following three design questions must be answered: (1) How should the competition limit the class of eligible participants (or should there be no limit)? (2) How much prize money should be awarded, and how many teams should receive prizes? (3) How much mentorship, feedback, networking opportunities, training, and the like should the competition provide? In Part II, this Article discusses these key design options and provides general guidance toward optimizing general innovation competitions.

Third, do general innovation competitions stimulate innovative activity in reality? In Part III, this Article provides survey data obtained from participants of various general innovation competitions around the country regarding their subjective evaluations of whether the competitions incentivized them to invent.[10] To be sure, people are much better at reporting what they have already done than they are at explaining *why* they've done what they've done.[11] But, in this case, surveys related to why the participants made their choices are the best and only option, because conducting controlled experiments is infeasible. Moreover, "it is important to know whether the people whom [innovation incentives] are supposed to be helping think the system is working."[12]

In practice, prize competitions are used to augment the patent system, not replace it. That is, prize competitions typically do not restrict their competitors' ability to obtain patent protection but rather supplement the incentive provided by patents. Among other things,

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10. Indeed, empirical data in the innovation incentive literature is scarce. Williams, *supra* note 1, at 754 ("[T]he previous literature has placed little emphasis on the problem of how to evaluate the success or failure of innovation inducement prizes. Although economic theory can offer guidance on how to design innovation inducement prizes, empirical evaluations are critical given the strong policy interest in understanding when innovation inducement prizes would be effective tools for spurring innovation, and what forms of innovation inducement prizes are most likely to be successful in any given context. . . . [T]he harsh reality is that we currently have a very small evidence base from which to draw policy conclusions.").

11. *See* Marianne Bertrand & Sendhil Mullainathan, *Do People Mean What They Say? Implications for Subjective Survey Data*, 91 AM. ECON. REV. 67, 68 (2001); John A. List, *Do Explicit Warnings Eliminate the Hypothetical Bias in Elicitation Procedures? Evidence from Field Auctions for Sportscards*, 91 AM. ECON. REV. 1498, 1504 (2001).

12. Lisa Larrimore Ouellette, *Patent Experimentalism*, 101 VA. L. REV. 65, 80 (2015).

this Article argues that prize competitions can best augment the patent system by providing added incentives for classes of individuals that are otherwise under-incentivized by patents, and by targeting general topics of study that are otherwise under-researched.[13] These final two arguments are valid to the extent the patent-plus-prize combination reward does not exceed the social value of the awarded inventions.

II. GENERAL PRIZE COMPETITIONS COMPARED TO OTHER INNOVATION INCENTIVES

This Part analyzes prize competitions of various degrees of generality, compares them to other types of innovation incentives, and argues that scholars should pay more attention to more general competitions because they are a useful incentive mechanism.

A. The Need to Incentivize Innovation

Left to their own devices, competitive markets may not provide adequate incentives for innovation because ideas are often public goods—goods that are both non-rivalrous and non-excludable. Ideas are non-rivalrous because each consumer can use an idea at no or little added marginal cost. Unlike rivalrous goods such as an hour of someone's labor, an apple, or a computer, non-rivalrous goods like ideas and national defense can be used simultaneously by many at little to no incremental cost.

Absent intervention, ideas are also often non-excludable because once someone produces an idea, preventing others from using that idea is difficult. While in certain cases ideas are inherently excludable to some extent,[14] such as through nonlegal mechanisms like first-mover gains, in reality ideas are often non-excludable. Thus, ideas are often public goods, which may be underprovided in the market absent intervention.[15]

Because ideas are likely to be underproduced in the free market, it is well recognized that additional innovation incentives are desirable. Governments and other public-interest-focused actors have numerous policy options for promoting innovation. Patents make

13. Scholarly literature already details yet another way nonpatent innovation incentives can be beneficial: by providing incentives for innovation not covered by patent law. *See* Lisa Larrimore Ouellette, *Patentable Subject Matter and Nonpatent Innovation Incentives*, 5 UC IRVINE L. REV. 1115 (2015).

14. For instance, ideas that can be kept secret (e.g., the formula for Coca-Cola) are naturally somewhat excludable.

15. Once a public good is created, that good is available for everyone to use. Absent some benefit to producing a public good such as first-mover gains, rational actors may freeride by waiting for another to create the public good so they can benefit from the good without incurring the costs of creation. In other words, if the private return to being the first to invent isn't sufficient to overcome the costs of inventing, then risk neutral rational actors will wait for another to create the invention. If the benefit of a public good to any rational actor is outweighed by the cost of producing the good, no rational actor will provide the public good even if the overall benefit to society would exceed the cost.

ideas excludable to an extent by granting inventors the right to exclude others from making, using, or selling their inventions for a set period of time. Prizes stimulate innovation by providing a monetary reward to those who create inventions, thus giving them a private reward for incurring the costs of creating the public good. In particular, more specific prizes reward inventors for solving a prespecified problem, while more general prizes reward inventors for inventing solutions to problems of their choosing. Research grants stimulate innovation by awarding funds to individuals who propose promising research. Such grants typically include an obligation to conduct the proposed research for some time, often requiring the funds to be used in furtherance of the research.

The rest of this Part proceeds as follows. Because more general innovation competitions have not been studied or separated from specific competitions in the scholarly literature, Part I.B explores and compares examples of prize competitions that specify the problem to be solved to various degrees. Part I.C explores how prize competitions change as an innovation incentive depending on how they specify the problem to be solved.

B. General and Specific Innovation Competitions in Practice

Innovation inducement prizes were often used in the eighteenth and nineteenth centuries[16] but fell out of favor for most of the twentieth century.[17] In the late twentieth century, some private prize competitions revitalized the innovation inducement prize industry, and by 2009, McKinsey estimated the global prize sector to be around $1-2 billion.[18] In 2010, to make greater use of prizes, Congress enacted the America COMPETES Reauthorization Act, authorizing federal agencies to issue prizes to promote innovation.[19] Under this Act, federal agencies have hosted more than 740 competitions and awarded $250 million in prize money since 2010.[20] Today, innovation competitions come in all shapes and sizes. Some competitions are funded by the government, such as those authorized under the COMPETES Act, and others are privately funded (of course, even privately funded competitions are still subsidized by the government to an extent, since individuals can deduct from federal income taxation donations to such competitions).

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16. SUZANNE SCOTCHMER, INNOVATION AND INCENTIVES 1-17, 32-34 (2004); Jonathan H. Adler, *Eyes on a Climate Prize: Rewarding Energy Innovation to Achieve Climate Stabilization*, 35 HARV. ENVTL. L. REV. 1, 19-22 (2011); *see also* Liam Brunt et al., *Inducement Prizes and Innovation*, 60 J. INDUS. ECON. 657, 658 (2012).

17. Hemel & Ouellette, *supra* note 1, at 317.

18. MCKINSEY & CO., "AND THE WINNER IS. . .": CAPTURING THE PROMISE OF PHILANTHROPIC PRIZES 16 (2009).

19. America COMPETES Reauthorization Act of 2010, 15 U.S.C. § 3719 (2017) (authorizing agencies to "carry out a program to award prizes competitively to stimulate innovation that has the potential to advance the mission of [each] respective agency.").

20. *About*, CHALLENGE.GOV, https://www.challenge.gov/about [https://perma.cc/2YJN-SXP4].

Importantly, prize competitions differ in the degree by which they specify the problem to be solved, which has numerous implications from a theoretical standpoint. Competitions that specify the problem to be solved in advance are quite common. Netflix awarded a $1M prize to design an improved recommendation software that predicts movies and television programs customers would like.[21] The FTC awarded a total of $50,000 to the top two teams in a competition to develop software to block illegal robocalls.[22] NASA awarded a total of $350,000 to teams in a competition to improve astronaut spacesuit glove design.[23]

Many notable highly specific prize competitions are offered by the privately funded X PRIZE Foundation.[24] The foundation provides numerous specific prize competitions to try to solve some of the world's most pressing problems,[25] by "defining the challenge and incentivizing teams around the world to find the most effective solutions."[26] The X PRIZE approach "is emerging as a canonical design" for specific competitions and "prizes in the X PRIZE 'tradition' seem to be increasingly common."[27] The X PRIZE competitions even helped inspire the COMPETES Act.[28] For these reasons and more, X PRIZE competitions provide great examples of specific competitions—and show varying degrees by which more specific competitions can outline the problem to be solved.

For instance, the Ansari X PRIZE incentivized the creation of "a reliable, reusable, privately-financed, manned spaceship capable of carrying three people to 100 kilometers above the Earth's surface twice within two weeks."[29] The $10 million prize was awarded to the team that ultimately built SpaceShipOne, the world's first privately developed spacecraft that broke a 41-year-old altitude record.[30] The

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21. Steve Lohr, *Netflix Awards $1 Million Prize and Starts a New Contest*, N.Y. TIMES (Sept. 21, 2009, 10:15 AM), https://bits.blogs.nytimes.com/2009/09/21/netflix-awards-1-million-prize-and-starts-a-new-contest [https://perma.cc/4CZ8-HEG3].

22. *FTC Announces Robocall Challenge Winners*, FED. TRADE COMM'N (Apr. 2, 2013), https://www.ftc.gov/news-events/press-releases/2013/04/ftc-announces-robocall-challenge-winners [https://perma.cc/JHU9-QAEU].

23. *Astronaut Glove Challenge*, NAT'L AERONAUTICS AND SPACE ADMIN., https://www.nasa.gov/offices/oct/early_stage_innovation/centennial_challenges/astronaut_glove/index.html [https://perma.cc/A7CT-AV2U].

24. *Past Prizes*, XPRIZE, http://www.xprize.org/past-prizes [https://perma.cc/J89S-7R6B].

25. *What is an XPRIZE?*, XPRIZE, http://www.xprize.org/about/what-is-an-xprize [https://perma.cc/MJ7E-Y5WY].

26. *Id.*

27. Fiona Murray et al., *Grand Innovation Prizes: A Theoretical, Normative, and Empirical Evaluation*, 41 RES. POL'Y 1779, 1782 (2012).

28. Michael J. Burstein & Fiona E. Murray, *Innovation Prizes in Practice and Theory*, 29 HARV. J.L. & TECH. 401, 418 (2016).

29. ANSARI XPRIZE, *supra* note 7.

30. Alan Boyle, *SpaceShipOne wins $10 Million X Prize*, NBCNEWS.COM (Oct. 5,

competition arguably launched an entire industry.[31] The Qualcomm Tricorder X PRIZE incentivized creation of a "Tricorder device that . . . accurately diagnose[s] 13 health conditions (12 diseases and the absence of conditions) and capture[s] five real-time health vital signs, independent of a health care worker or facility, and in a way that provides a compelling consumer experience."[32] The Wendy Schmidt Oil Cleanup XCHALLENGE awarded $1.4 M to improve crude oil cleanup from the ocean's surface.[33] The winning team (out of over 350 submissions) achieved over three times the industry's previous best oil recovery rate under controlled conditions.[34]

The Progressive Insurance Auto X PRIZE provides an example of a competition that outlined the problem to be solved with extreme specificity. The competition was designed to incentivize creation of a vehicle with a "fuel economy of 100 miles per gallon gasoline equivalent (MPGe)."[35] Other vehicle requirements, spanning thirty-six pages, included that eligible vehicles "seat four or more occupants in a traditional arrangement of two side-by-side front and rear seats,"[36] display sufficient ground clearance,[37] contain at least "ten cubic feet of useful cargo space . . . in one contiguous location,"[38] "be capable of fully enclosing driver and all passengers,"[39] "have a continuous on-road driving range of 200 miles,"[40] and "achieve an on-road life cycle or wells-to-wheels (WTW) greenhouse gas (GHG) emissions level of 200 equivalent grams of CO_2 per mile or less."[41] The winning vehicles had to achieve the fastest race time in their class while still reaching 100 MPGe and meeting all other criteria.[42] In addition to the thirty-six

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2004, 2:58:11 AM), http://www.nbcnews.com/id/6167761/ns/technology_and_science-space/t/spaceshipone-wins-million-x-prize/#.WPwpcYWcGUk [https://perma.cc/QF6K-5VJD].

31. *See* ANSARI XPRIZE, *supra* note 7; *see also* Mike Wall, *How SpaceShipOne and X Prize Launched Commercial Spaceflight 10 Years Ago*, SPACE.COM (Oct. 3, 2014, 6:00 PM), http://www.space.com/27339-spaceshipone-xprize-launched-commercial-spaceflight.html [https://perma.cc/Z9VM-SYMT].

32. XPRIZE FOUND., http://tricorder.xprize.org [https://perma.cc/V2VC-7S8Q].

33. XPRIZE FOUND., http://oilcleanup.xprize.org [https://perma.cc/HW6Y-P6W4].

34. XPRIZE FOUND., http://oilcleanup.xprize.org/press-release/winning-teams-announced-14-million-wendy-schmidt-oil-cleanup-xchallenge [https://perma.cc/FB7N-HWLU].

35. XPRIZE Found., Progressive Insurance Automotive X PRIZE Supplemental Regulations for Knockout and Finals Stages 58 (2010), http://www.xprize.org/sites/default/files/piaxp_guidelines_addendum_supplemental_regulations_v2.2_20100607.pdf [https://perma.cc/NLT5-ZRT8].

36. *Id.* at 25.

37. *Id.*

38. *Id.*

39. *Id.* at 28.

40. *Id.* at 58.

41. *Id.* at 59.

42. *See generally id.*

pages of vehicle requirements, the competition's regulations and guidelines spanned thirty-two more pages outlining other aspects of the competition. Needless to say, the competition was quite specific.

At the opposite end of the spectrum are completely general competitions that accept submission of any invention or startup idea. For example, the George Mason Dean's Business Plan Competition "welcome[s] ventures and organizations in all industries [and] sectors."[43] Winning submissions in 2015 included a mobile phone accessory combining a compression sleeve with a magnetic case, an agricultural machine that autonomously bales hay, and technology that allows children with autism to creatively interact with computers.[44] The Colorado College Big Idea competition, open generally to startups including a requisite number of Colorado College students,[45] is also quite general. Winning submissions in 2017 included a drone that turns your phone into a personal cameraman[46] (an improvement on the Selfie Stick)[47]; chocolate truffles infused with a Chinese herbal formula to ease monthly hormone cycle discomfort; and a business analytics platform to assist with inventory management, bookkeeping, and operations reporting and forecasting.[48] Similarly, submissions to the 2016 ACC Inventure Prize Competition, which permitted one university-selected team from each ACC school to submit their invention or business,[49] included a display and monitoring system to provide Firefighters with data to keep them safe and productive;[50] a wearable device that quantifies rehabilitation progress, assesses injury risk, and provides real-time feedback to reduce athletic injury;[51] and a novel male contraceptive.[52]

Some prize competitions fall closer to the middle of the spectrum. For instance, the 2016-17 Stanford Center on Longevity Design

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43. *Supra* note 2.

44. GEORGE MASON UNIV. (Apr. 14, 2015), http://business.gmu.edu/blog/mba/2015/04/14/deans-competition-awards-10000-mason-innovators/ [https://perma.cc/54RU-BR7K].

45. Colo. C., The Big Idea 1 (2017), https://www.coloradocollege.edu/other/innovation-institute/pdf/BigIdea2017.pdf [https://perma.cc/NZE4-2SMZ].

46. COLO. C., https://www.coloradocollege.edu/other/innovation-institute/big_idea.html [https://perma.cc/XKA6-E4FM].

47. Tucker Cummings Miller, *Top 10 Best Selfie Sticks*, HEAVY (July 7, 2015, 3:27 PM), http://heavy.com/tech/2015/01/buy-best-selfie-stick-pole-monopod-remote-bluetooth-price-review [http://perma.cc/WQ5G-M4B6].

48. COLO. C., https://www.coloradocollege.edu/other/innovation-institute/big_idea.html [https://perma.cc/XKA6-E4FM].

49. ACC INVENTURE PRIZE, http://accinventureprize.com/about/new-type-competition [https://perma.cc/HE49-UXV2].

50. ACC INVENTURE PRIZE, http://accinventureprize.com/acc-teams/archive/2016 [https://perma.cc/9KSW-BDRN].

51. *Biometrix Team Details*, ACC INVENTURE PRIZE, http://accinventureprize.com/acc-teams/173 [https://perma.cc/KMY9-W5Y4].

52. ACC INVENTURE PRIZE, http://accinventureprize.com/acc-teams/archive/2016 [https://perma.cc/9KSW-BDRN].

Challenge offered $17,000 in prizes to teams creating inventions adhering to an "Innovating Aging in Place" theme.[53] The three winning projects still spanned a wide scope, including a wearable device for real-time pathological wrist tremor counteraction,[54] a virtual reality platform for assisting the elderly,[55] and a device that assists handicapped users in moving without sacrificing posture.[56] Similarly, the Michigan Innovation in Action competition offers prizes for inventions pertaining to one of two tracks, public health and education, and is even specifically designed for masters and doctoral students in those fields.[57] Just like with the Stanford Longevity Design Challenge, submissions to Innovation in Action were very broad.[58]

Many universities run general innovation competitions, typically for the benefit of their students. Founded in 1996, the University of Chicago New Venture Challenge (NVC) is possibly the largest.[59] The competition is broken into four distinct challenges, including a general NVC, a Social NVC, a Global NVC, and a College NVC.[60] Each competition has various eligibility requirements, primarily ensuring that at least one current UChicago student has sufficient stake in the startup.[61] Each competition runs in stages, and the competitors ultimately submit a feasibility summary and business plan, and then pitch their startup to judges.[62] Over 180 previous competing startups are still operating, and previous competing teams have raised over $585 million

53. STAN. CTR. ON LONGEVITY, http://longevity.stanford.edu/designchallenge2016-17 [https://perma.cc/M9U6-K4J3].

54. *Tame*, STAN. CTR. ON LONGEVITY, http://longevity.stanford.edu/designchallenge2016-17/2017/02/08/tame [https://perma.cc/KYS3-42LD].

55. *Rendever*, STAN. CTR. ON LONGEVITY, http://longevity.stanford.edu/designchallenge2016-17/2017/02/07/rendever [https://perma.cc/RZ97-SSUX].

56. *Uppo*, STAN. CTR. ON LONGEVITY, http://longevity.stanford.edu/designchallenge2016-17/2017/02/08/uppo [https://perma.cc/TT4A-WF76].

57. *Team Eligibility*, INNOVATION IN ACTION, http://innovationinaction.umich.edu/teams/eligibility.html [https://perma.cc/89T9-6KFQ].

58. *See Past Teams*, INNOVATION IN ACTION, http://innovationinaction.umich.edu/teams/past-teams.html [https://perma.cc/P9H2-TEPB].

59. *See NVC*, CHI. BOOTH POLSKY CTR. FOR ENTREPRENEURSHIP AND INNOVATION, https://research.chicagobooth.edu/nvc/traditional-nvc [https://perma.cc/4GJR-ZRDG].

60. *Prepare and Apply*, CHI. BOOTH POLSKY CTR. FOR ENTREPRENEURSHIP AND INNOVATION, https://research.chicagobooth.edu/nvc/prepare-and-apply [https://perma.cc/HYN6-9MN3].

61. *Id.*

62. *See* Chi. Booth Polsky Ctr. for Entrepreneurship and Innovation, Official Rules & Guidelines 4-6 (2016), https://research.chicagobooth.edu/~/media/711aefe015e246c59bf92df01933bfbc.pdf [https://perma.cc/5YY9-P8QD]; Chi. Booth Polsky Ctr. for Entrepreneurship and Innovation, Official Rules & Guidelines 4-6 (2017), https://research.chicagobooth.edu/~/media/dbc0e9f1872a4462a43f6a759139f44a.pdf [https://perma.cc/R6HU-N6DC]; Chi. Booth Polsky Ctr. for Entrepreneurship and Innovation, Official Rules & Guidelines 4-6 (2016), https://research.chicagobooth.edu/~/media/428a4fd54e874c268693e2f8d0fda2b2.pdf [https://perma.cc/964Q-2D23].

and earned over $5.8 billion in mergers and exits.[63] The "richest" university-run innovation competition is the Rice Business Plan Competition.[64] The competition is open to any student startup team from any university, and the teams compete within intentionally "broad" sectors, including one catch-all sector for all "[o]ther [i]nnovation."[65] Hundreds of teams submit applications[66] including an executive summary and video pitch of their startups,[67] and forty-two teams are chosen to compete at Rice for prizes.[68] The chosen teams submit a written business plan and conduct various oral presentations to more than 200 judges comprised of venture capitalists, investors, and successful entrepreneurs.[69] Each of the forty two finalists wins at least one monetary prize, and in 2017 alone, over $1.2 million was awarded.[70] In seventeen years, 161 past competitors successfully launched businesses, and competing teams have raised over $1.2 billion in funding.[71]

The Georgia Tech Inventure Prize Competition, open to Georgia Tech undergrads, offered $30,000 in prizes and a free U.S. patent filing to the top two teams in 2017.[72] The competition is very general, permitting entry of all "original student inventions."[73] The final round is recorded in front of over 1,000 fans, with over 50,000 watching on television.[74] The winner is eligible to compete in the ACC Inventure Prize competition, another televised event, against competitors from other ACC schools.[75]

Many universities run similar innovation competitions on a smaller scale, but still with significant success. These competitions typ-

63. *NVC*, CHI. BOOTH POLSKY CTR. FOR ENTREPRENEURSHIP AND INNOVATION, https://research.chicagobooth.edu/nvc [https://perma.cc/6MQT-FD9N].

64. RICE BUS. PLAN COMPETITION, https://rbpc.rice.edu [https://perma.cc/G3LF-XATA].

65. *Compete*, RICE BUSINESS PLAN COMPETITION, https://rbpc.rice.edu/compete [https://perma.cc/QUD9-RLG3].

66. RICE BUSINESS PLAN COMPETITION, https://rbpc.rice.edu [https://perma.cc/G3LF-XATA].

67. Rice Bus. Plan Competition, Official Rules, Requirements, and Judging Criteria 3 (2017), https://rbpc.rice.edu/sites/g/files/bxs806/f/2018-RBPC-Official-Rules-Judging-Criteria.pdf [https://perma.cc/44SZ-6WE6].

68. *Id.* at 2.

69. *Id.*

70. Rice Bus. Plan Competition, Cash Prizes and Awards 1 (2017), https://rbpc.rice.edu/sites/g/files/bxs806/f/2017-RBPC-Prize-List.pdf [https://perma.cc/A2V4-5HMT].

71. *About the RBPC*, RICE BUS. PLAN COMPETITION, https://rbpc.rice.edu/about-rbpc [https://perma.cc/WRC3-T3Z9].

72. *Rules & Eligbility*, GA. TECH, http://www.inventureprize.gatech.edu/about/rules-eligibility [https://perma.cc/H5TX-ZEPR].

73. *Id.*

74. *InVenture Prize 2018*, GA. TECH, https://inventureprize.gatech.edu/about-inventure [https://perma.cc/Y8SK-GXR5].

75. ACC InVenture Prize, ATL. COAST CONF., https://www.accinventureprize.com [https://perma.cc/8XLC-2DYW].

ically provide competitors around $10,000 in prizes and an opportunity to pitch their ideas to judges and an audience. For example, the University of Wisconsin-Madison offered the Innovation Days competition for twenty years (and now offers the Transcend Madison competition). Many financially successful inventions were submitted to the competition over the years, such as a device that helps farmers apply anhydrous-ammonia to fields,[76] and TurboTap,[77] a better and faster beer tap that "pours a perfect pint of beer in about two seconds."[78] In the words of Matt Younkle, the founder of TurboTap, "while waiting for a beer in one of those long and slow lines, I started to think of ways to make the line move faster. . . . Having that $10,000 prize hanging out there certainly provided additional incentive for me to go out and try to solve this problem."[79]

There are many statewide innovation competitions as well. The largest statewide startup competition in the country is Minnesota's MN Cup.[80] The competition allows Minnesota entrepreneurs with less than $1 million in annual revenue to compete across eight broad divisions.[81] The participants compete through four rounds, and all semifinalists are matched with mentors to assist in the entrepreneurial process.[82] Since its inauguration in 2005, the prize competition has supported 12,000 Minnesota-based entrepreneurs, awarded over $2M in seed money, and provided extensive mentorship and networking opportunities to Minnesota entrepreneurs.[83] MN Cup finalists have raised over $230M.[84] More than 1,500 innovators entered in

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76. *Sorenson Wins $10,000 in The Schoofs Prize for Creativity*, UNIV. OF WIS. COLL. OF ENG'G (Jan. 1, 2000), https://www.engr.wisc.edu/sorenson-wins-10000-in-the-schoofs-prize-for-creativity [https://perma.cc/4K4C-TYKG].

77. TurboTap, *TurboTap Entrepreneur Matthew Younkle*, YOUTUBE (Sept. 6, 2011), https://www.youtube.com/watch?v=0284Uk7G2xA [https://perma.cc/3JPB-WF38].

78. Kristen Knutsen, *Collecting MadVideos – Wiscontrepreneur Recognizes TurboTap*, ISTHMUS (Mar. 1, 2007), https://isthmus.com/screens/tv-video/collecting-madvideos-wiscontrepreneur-recognizes-turbotap [https://perma.cc/SYU2-8B2K].

79. *Id.*

80. *MN Cup*, UNIV. OF MINN. CARLSON SCH. OF MGMT., https://carlsonschool.umn.edu/mn-cup [https://perma.cc/AM29-PJEE]. For a brief history of the MN Cup, *see* Carlson Sch. of Mgmt., *History of the MN Cup Competition – MN Cup 2013*, YOUTUBE (Sept. 12, 2013), https://www.youtube.com/watch?v=wvtUYyCLt1s [https://perma.cc/X9XK-YKGN].

81. *Enter the Competition*, UNIV. OF MINN. CARLSON SCH. OF MGMT., https://carlsonschool.umn.edu/mn-cup/enter-the-competition [https://perma.cc/6F75-2SXF].

82. *Process*, UNIV. OF MINN. CARLSON SCH. OF MGMT., https://carlsonschool.umn.edu/mn-cup/enter-the-competition/process [https://perma.cc/JCT5-RNBG].

83. *MN Cup*, UNIV. OF MINN. CARLSON SCH. OF MGMT., *supra* note 80.

84. To provide some context, a list of the past finalists and semifinalists can be found at *Past Winners*, UNIV. OF MINN. CARLSON SCH. OF MGMT., https://carlsonschool.umn.edu/mn-cup/past-winners [https://perma.cc/A3GB-

2016 alone,[85] and over $400,000 in seed money was awarded to the finalists that year.[86]

The Wisconsin Technology Council offers a similar business plan contest for startups owned by Wisconsin residents.[87] Participants compete across four categories (advanced manufacturing, business services, information technology and life sciences) and across three phases, including idea abstract, executive summary, and business plan.[88] Since it began in 2004, the competition has received approximately 3,350 entries and awarded around $2.2 million in cash and in-kind prizes.[89] Contest finalists have raised over $200 million in funding over that period.[90]

In short, prize competitions can, and in practice do, specify the problem to be solved at any point along a spectrum of generality. Truly general competitions that permit entry of any invention or startup fall on one end of the spectrum, and highly specific competitions that specify the problem in detail fall on the other end of the spectrum. Part I.C discusses how prize competitions of various degrees of generality differ as an innovation incentive.

C. Comparing Innovation Incentives

Professors Daniel Hemel and Lisa Ouellette provide a useful framework for assessing the merits and tradeoffs of different innovation incentives,[91] and this Subpart uses this framework to explore the implications of the degree to which prize competitions specify the problem to be solved.

1. Who Decides the Size of the Reward and the Projects to Pursue?

Two related ways in which innovation incentives can differ include (a) who picks which projects to pursue and (b) who decides the size of the reward. Both of these decisions are usually made by the market or private actors, the government or other reward-setting entity, or some combination of the foregoing.[92]

DXYG].

85. *About*, UNIV. OF MINN. CARLSON SCH. OF MGMT., https://carlsonschool.umn.edu/mn-cup/about [https://perma.cc/JBF3-KUWE].

86. *MN Cup*, UNIV. OF MINN. CARLSON SCH. OF MGMT., *supra* note 80.

87. *Guidelines & Eligibility*, WISC. GOVERNOR'S BUS. PLAN CONTEST, http://govsbizplancontest.com/about/guidelines-eligibility [https://perma.cc/EU5A-KZUU].

88. *Id.*

89. About the Contest, WISC. GOVERNOR'S BUS. PLAN CONTEST, http://govsbizplancontest.com/about [https://perma.cc/XDT6-2EH7].

90. *Id.*

91. Hemel & Ouellette, supra note 1, at 326-67 (introducing and discussing the framework).

92. Id. at 327-28. Even when the reward-setting entity is not the government, the government typically subsidizes funding provided by reward-setting entities by offering a tax deduction.

Occasionally, the prize sponsor may be able to identify and value promising projects to pursue, such as when the government has expertise in a particular area of technology (e.g., those regulated by governmental agencies). However, innovators often have superior knowledge of the costs and potential benefits of technologies within their area of expertise and are therefore in a better position than the government to foresee and value potential inventions.[93] For example, the government probably isn't in the best position to foresee valuable inventions such as the Scrub Daddy,[94] OXO angled measuring cup,[95] or TurboTap.[96]

With market rewards, the market rather than the government sets the size of the reward, and innovators with potentially valuable private information regarding the costs and potential payoffs of a project advantageously determine whether the project is worth pursuing.[97]

However, market-set rewards are problematic when the social value of an invention is not reflected by its cost. This problem occurs when projects include large positive externalities, and when inventions benefit users more than they can afford to pay.[98] Sponsors can take these considerations into account with sponsor-set rewards, though there is still a concern that the sponsor will not be in a good position to adequately estimate a project's social value.

Because market-based rewards and sponsor-set rewards are better under different circumstances, optimal innovation policy should include both types of rewards. Sponsor-set rewards may be best when the market value of a product doesn't reflect its social value. Market-based rewards may be best when it's beneficial to allow innovators, rather than the government, to choose which projects to pursue.

With patents, while the government sets the rules, market actors with potentially valuable private information choose which projects to pursue and the market ultimately determines the size of the reward.[99] For grants and prizes, the sponsor (e.g., the government)

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93. See, e.g., Nancy Gallini & Suzanne Scotchmer, Intellectual Property: When Is It the Best Incentive System?, 2 INNOVATION POL'Y & ECON. 51, 54-55 (2002); Brian D. Wright, The Economics of Invention Incentives: Patents, Prizes, and Research Contracts, 73 Am. Econ. Rev. 691, 703 (1983).

94. SCRUB DADDY, https://scrubdaddy.com [https://perma.cc/4JZZ-R97D]; *see also* U.S. Patent No. D690,892 (filed Mar. 16, 2016).

95. *3 Piece Angled Measuring Cup Set*, OXO, https://www.oxo.com/3-piece-angled-measuring-cup-set-344 [https://perma.cc/MX8U-68BK]; *see also* U.S. Patent No. 6,263,732 (filed May 18, 1999).

96. TURBOTAP, https://turbotapusa.com [https://perma.cc/HK8W-5YY8]; *see also* U.S. Patent No. 5,842,617 (filed Sept. 10, 1997).

97. Hemel & Ouellette, *supra* note 1, at 327-28.

98. Burstein & Murray, *supra* note 28, at 447; Hemel & Ouellette, *supra* note 1, at 328-29; Amy Kapczynski & Talha Syed, *The Continuum of Excludability and the Limits of Patents*, 122 YALE L.J. 1900, 1942 (2013).

99. Because the government sets ground rules for patents, it still significantly shapes the size of the reward, albeit less directly. For instance, the government directly sets the length of the patent term, the scope of patent protection that can be obtained, *see* Tun-Jen Chiang, *The Levels of Abstraction Problem in Patent Law*, 105 NW. U. L. REV. 1097 (2011) (demonstrating the levels of abstraction problem in

typically determines which projects to pursue and the size of the reward, though market forces can be taken into account by relating the size of the reward to market performance.[100]

Importantly, the more specific the prize competition, the more control the sponsor has over the projects that are pursued. Indeed, very specific competitions, by their nature, seek solutions to problems the sponsors themselves have identified in advance. Conversely, more general competitions reward inventors for identifying both the problem and a solution and thus place more control over the projects that are pursued into the hands of private actors.

It is absolutely critical that members of society come up with inventive ideas,[101] like the Scrub Daddy, OXO angled measuring cup, and TurboTap. More general competitions can and do play an important role in fostering such innovation. Like patents and unlike more specific competitions, more general prize competitions can take advantage of private actors' superior knowledge. Unlike with patents, more general competitions can do so without providing a reward through monopoly pricing.[102]

By providing some degree of specificity by which eligible inventions must comply, prize competitions can incentivize innovation in important fields of research that may otherwise be under-developed. Such prizes can be used in conjunction with the patent systemto the extent the prize combination does not exceed the social value of the innovations.

In summary, as prize competitions become more general, the power to choose which projects to pursue gets reallocated from the prize sponsors to market actors. Thus, more general prize competitions can take advantage of private actors' superior knowledge regarding which problems to pursue without providing a reward through monopoly pricing.

2. When Will the Reward be Provided?

Rewards can be provided as early as when an inventor devises an idea, delayed until the inventor sells a product on the market, or awarded anywhere in between. Reward timing affects incentives to

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claim drafting arguing that "relevant economic information can be collected and considered in determining the appropriate level of abstraction for patent rewards"), and which types of inventions can receive patent protection, each of which significantly affects the size of the reward obtained by inventors.

100. *See, e.g.*, Michael Abramowicz, *Perfecting Patent Prizes*, 56 VAND. L. REV. 115, 176-77 (2003).

101. For a discussion on the importance of society's role in developing innovative ideas, see Williams, *supra* note 1, at 763-64.

102. In addition, like specific competitions and grants, and unlike patents, general competitions can reward inventions based on their social utility because weight can be placed on the social value of a project when awarding prizes. Of course, whether this weighting would be done in fact depends on the quality of judging and whether the prize competition explicitly uses social value as a metric in choosing the winners.

both bring products to market and to innovate due to potential inventors' capital constraints, risk aversion, and optimism bias.[103]

Market rewards also often provide additional incentives to invent and commercialize market-viable products because the reward is obtained through product sales.[104]

In addition, potential innovators with capital constraints (e.g., those who have innovative ideas but cannot fund their projects without outside funding)[105] will be comparatively less incentivized by ex post incentives.[106] Potential inventors with capital constraints must discount their chance of success by the probability they won't secure funding, and by the equity stake they would have to surrender if they obtain funding (which may be large since they are in particular need of cash). Inventors with capital constraints may also have to secure funds at an earlier stage in the process, when they won't receive funding as easily or favorably. If innovators with capital constraints aren't business savvy, and don't have the means to obtain proper assistance in securing outside funding, they will be less likely to invent because they will be at risk of securing funding on unfavorable terms, if at all. Capital providers may even be hesitant to invest in projects when the innovators do not provide capital themselves. Moreover, small and new innovative firms with capital constraints face exorbitant costs of capital compared to larger firms,[107] which dilutes the effects of ex post incentives for such firms and benefits wealthy firms at the exclusion of more capital constrained ones.

Ex ante rewards can mitigate these problems by providing needed funds to innovators with capital constraints. Ex ante rewards may provide inventors with some or all of the capital they need; a reward can at least help such innovators delay obtaining outside funding to a later stage of the innovation process, where they may receive funding more easily and on more favorable terms.

In addition to monetary restrictions, optimal reward timing also depends on the opposing forces of risk aversion and optimism bias. It is well known that people are generally risk-averse,[108] and risk aversion makes people value a guaranteed reward more than an uncertain reward in the future of equal expected value. To the extent inno-

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103. Hemel & Ouellette, *supra* note 1, at 333-345.

104. *See, e.g.*, Rachel Glennerster et al., *Creating Markets for Vaccines*, Innovations: Tech., Governance, Globalization, Winter 2006, at 67, 71. However, this added incentive may be unnecessary. *See* Ian Ayres & Lisa Larrimore Ouellette, *A Market Test for Bayh-Dole Patents*, 102 CORNELL L. REV. 271 (2017).

105. By innovators with capital constraints, I am not referring to those innovators who are capital constrained because their projects are bad and for that reason capital providers will not provide them with funds. I am referring to individuals who do not have sufficient funds of their own to pursue their projects.

106. *See, e.g.*, Tomas Forsfält, *The Effects of Risk Aversion and Age on Investments in New Firms* (1999); Hemel & Ouellette, *supra* note 1, at 334-336.

107. *See* Bronwyn Hall, *The Financing of Research and Development*, (Nat'l Bureau of Econ. Research & Inst. of Fiscal Studies, Working Paper No. E02-311, 2002).

108. *See, e.g.*, Daniel Kahneman & Dan Lovallo, *Timid Choices and Bold Forecasts: A Cognitive Perspective on Risk Taking*, 39 MGMT. SCI. 17, 18 (1993).

vators are risk-averse, ex ante rewards provide more innovative activity per dollar than ex post rewards. In other words, all else equal, ex ante rewards better incentivize risk-averse individuals to innovate.

Although people are risk-averse, they can also be overly optimistic, and this optimism bias combats risk aversion. It has been argued that risk aversion tends to dominate optimism bias in knowledge-good producers.[109] Since knowledge-good producers are generally risk-averse, relying on ex post incentives like patents comes at a heavy cost. Suppose, for example, a risk-averse knowledge-good producer can choose whether to invest $100 in a research project with a 10% chance of success. If the project is successful, overall welfare is increased by $1,500. Clearly, the efficient outcome is to conduct the research (.1*$1,500 > $100). Any reward greater than $100 and less than $150 provided before significant investment must be made toward the project (in other words, before risk is borne) would optimally incentivize the knowledge-good producer to pursue the project (without providing a reward greater than the expected return), regardless of the knowledge-good producer's tolerance for risk.

However, ex post incentives like patents may not be as desirable because the ultimate reward is provided after risk is borne. Suppose the knowledge-good producer requires a risk premium of $900 to undertake the project.[110] In that case, patents do not appropriately incentivize innovation because the patent reward would have to be set greater than the entire social surplus created by pursuing the project ($1900 > $1,500).[111] In short, the net effect of using ex post rewards like patents to incentivize research by risk-averse individuals comes at a social cost because risk averse individuals will inevitably fail to pursue positive net present value projects due to their distaste for risk. Rewards that can be provided ex ante with respect to risk mitigate this deadweight loss.

A third factor to consider is that, the later the reward is given, the easier it will be for decision makers to assess project value and thus properly fund the best projects. If it's difficult for the prize sponsor to ascertain which projects have the best chances of success, ex ante rewards provide greater risk of funding bad projects. In addition, if promising projects ultimately don't receive funding, they may not be pursued at all, and innovators may even take a lack of success in securing a prize as a signal to discontinue the line of research.

Additionally, providing rewards as soon as a project's merit can be ascertained is beneficial for two reasons: the best projects are funded early, reducing the risk that good projects will be abandoned, and rewards from bad projects will be withheld early, increasing the probability the bad projects will be discontinued earlier on.

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109. Hemel & Ouellette, *supra* note 1, at 341-42.

110. A patent reward greater than $1,000 would entice a risk-neutral rational actor to undertake the project, so if a risk-averse actor requires $1,900, then the risk-averse actor's risk premium would be $1,900 - $1,000 = $900.

111. A risk-neutral actor would invent if the patent reward exceeded $1000 because the project requires a $100 investment and comes with a 10% chance of success ($100/.1). The risk-averse actor with a risk premium of $900 would require $1000+$900 = $1900.

Patents provide an ex post reward delayed until a product is sold on the market. As stated above, such ex post rewards generally provide an added incentive to take valuable products to market. Some patent holders, however, benefit from their patents only by suing others for using their technology while never using the technology themselves,[112] or by suppressing a promising line of products that would otherwise compete with their own products.[113]

Grants are intended to provide an ex ante incentive because grant funding is typically provided after an innovator proposes a promising line of research but before significant funds have been expended on a project. Of course, this characterization of grants is hotly debated because they can theoretically provide funding at any stage of the innovation process. I believe there's probably some truth to the statement that competitive grant proposals are written based on prior, completed research to fund future research (in other words, grants may sometimes be more like prizes than we think).[114] Nevertheless, grants are awarded so that their recipients can fund their projects without bearing risk.

Scholars misleadingly label prize competitions as an "ex post" incentive. While prize competitions do provide rewards "ex post" relative to invention, they can also provide rewards "ex ante" with respect to bearing risk (such as when the risk is borne through commercialization rather than invention). A great example is software. Valuable software can often be written by inventors without bearing much risk (besides spending time on the project), but commercialization of the software itself can be much more expensive and thus risky.

Importantly, as prize competitions become more specific, the reward must generally be provided at a later stage in the innovation process. This relationship between reward timing and competition specificity stems from the fact that some competition requirements can only be proven through detailed designs or even reduction to practice. To be clear, even specific innovation competitions can sometimes provide rewards before much risk is borne; however, this will not be the case for many specific competitions. For example, the competitors in the Auto X PRIZE could only prove their vehicle designs

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112. *See, e.g.*, James Bessen & Michael J. Meurer, *The Direct Costs from NPE Disputes*, 99 CORNELL L. REV. 387 (2014); Paul R. Gugliuzza, *Patent Trolls and Preemption*, 101 VA. L. REV. 1579 (2015); Mark A. Lemley, *Should Patent Infringement Require Proof of Copying*, 105 MICH. L. REV. 1525 (2007); Mark A. Lemley, *The Surprising Resilience of the Patent System*, 95 TEX. L. REV. 1 (2016); Oskar Liivak & Eduardo M. Peñalver, *The Right Not to Use in Property and Patent Law*, 98 CORNELL L. REV. 1437 (2013); David L. Schwartz & Jay P. Kesan, *Analyzing the Role of Non-Practicing Entities in the Patent System*, 99 CORNELL L. REV. 425 (2014).

113. *See, e.g.*, Charles Allen Black, *The Cure for Deadly Patent Practices: Preventing Technology Suppression and Patent Shelving in the Life Sciences*, 14 ALB. L.J. SCI. & TECH. 397 (2004); Oskar Liivak et al., *supra* note 112; Kurt M. Saunders, *Patent Nonuse and the Role of Public Interest as a Deterrent to Technology Suppression*, 15 HARV. J.L. & TECH. 389 (2002).

114. *See, e.g.*, Jorge Cham, *The Grant Cycle*, PHD (2011), http://phdcomics.com/comics/archive.php?comicid=1431 [https://perma.cc/3TZ3-QXS7].

could reach a "fuel economy of 100 miles per gallon gasoline equivalent (MPGe)"[115] by making and testing an expensive prototype.

More general prize competitions can often provide rewards after invention but before risk is borne. For example, when significant investment must be made during the commercialization stage but reaching the invention stage is inexpensive, any reward provided pre-commercialization is advantageously provided ex ante with respect to risk bearing since the reward is provided before significant resources must be put toward the project.[116] Moreover, the reward may advantageously be provided ex post with respect to any material information regarding the project's value since the funding occurs post-invention.

General competitions can complement the patent system by targeting cognizable groups of individuals who are unlikely to be adequately incentivized to innovate through the patent system alone (such as risk-averse individuals and individuals with monetary restrictions) and by keying the timing of the reward to these individuals. The reward can then be provided ex post with respect to invention (so the best inventions can be rewarded) but ex ante with respect to risk-bearing (to complement the patent system for such cognizable groups). This theory is valid to the extent the patent-prize reward combination doesn't exceed the social value of the project.

For instance, students at universities are a cognizable group that have monetary constraints that may restrict their inventing capability. At the same time, college students typically have time to spend inventing, and they generally aren't confined by a restrictive employment agreement. General innovation competitions could be a valuable tool in helping university students overcome their monetary restrictions and invent.

Many general innovation competitions provide rewards post invention but pre-commercialization, thus providing an ex ante reward with respect to risk-bearing. For example, for the University of Wisconsin-Madison Transcend Madison competition, "[a]ll you need is an idea to compete."[117] Similarly, the George Mason Dean's Business Plan Competition is "open to early, idea stage ventures."[118] To partici-

115. X Prize, Progressive Insurance Automotive X PRIZE Supplemental Regulations for Knockout and Finals Stages: Amendment and Addendum v2.2 to Competition, at 58 (2010), http://www.xprize.org/sites/default/files/piaxp_guidelines_addendum_supplemental_regulations_v2.2_20100607.pdf [https://perma.cc/NLT5-ZRT8].

116. Commercialization is particularly risky for the first mover, since they bear the cost of market development and must invest before the product's success is known. For a discussion on the risk that is borne by a corporation in entering the market before knowing whether consumer demand and other market conditions will permit commercial success, and possible reforms, *see* Michael Abramowicz & John F. Duffy, *Intellectual Property for Market Experimentation*, 83 N.Y.U. L. REV. 337 (2008); Ted Sichelman, *Commercializing Patents*, 62 STAN. L. REV. 341 (2010).

117. *Guidelines and Regulations*, TRANSCEND ENGINEERING, , http://transcend.engineering/guidelines [https://perma.cc/V3WP-47TP].

118. Mary Byerley, *Startup Mason: Deans' Business Competition Workshops*,

pate in Dickinson's IC@D competition, teams must only initially submit "preliminary ideas," and then the competition coordinators help the participants develop their ideas over the course of two months.[119] Likewise, for the New Hampshire Paul J. Holloway Prize Competition, participants present pre-commercialization business proposals to judges who assess the project's research potential.[120]

Of course, not all innovation competitions provide rewards so early. For instance, Northwestern University offers the VentureCat Competition, where "Northwestern's most promising student-founded startups" compete for over $100,000 in prize money.[121] Like some competitions, VentureCat seeks only serious student startups well past the preliminary ideation stage.[122] Likewise, the Colorado College Big Idea Competition seeks "actual startup ventures."[123]

In short, prize competitions can provide rewards ex ante or ex post with respect to bearing risk and with respect to when relevant information about the project's value is known. For prize competitions, as the competition becomes more specific, the prize must generally be rewarded at a later stage in the innovation process. This relation is because as a competition becomes more specific, eventually highly detailed invention proposals or actual prototypes must be developed to ascertain whether the invention meets the specific criteria.

3. Nonmonetary Considerations

Nonmonetary considerations play an important role in incentivizing innovation by allowing society to obtain valuable innovation less expensively. Patents, prizes, and grants can play a role in incentivizing innovation through, among other things, pride, prestige, respect of colleagues, legitimization of the invention, and publicity.

Simply having a patent to your name can be rewarding and prestigious.[124] Professor William Hubbard argues that "patent law can strengthen and shape inventing norms by . . . identifying and validating

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GEORGE MASON UNIVERSITY SCHOOL OF BUSINESS (April 3, 2017), http://business.gmu.edu/blog/buzz/2017/04/03/2017-deans-business-competition-workshops-april-5th/ [https://perma.cc/5RSU-CM8P].

119. DICKINSON COLLEGE, *Innovation Competition Participant Manual*, http://www.dickinson.edu/info/20443/innovation_competition/3128/participant_manual [https://perma.cc/VCZ8-PAAX].

120. Peter T. Paul Coll. of Bus. and Econ., *Paul J. Holloway Prize Competition*, UNIVERSITY OF NEW HAMPSHIRE, https://paulcollege.unh.edu/holloway [https://perma.cc/9G4U-BRYC].

121. VentureCat, *Overview of VentureCat*, NORTHWESTERN UNIVERSITY, http://www.venturecat.northwestern.edu/about [https://perma.cc/95LC-RKAW].

122. *See id.*

123. Colorado College, Eligibility Requirements for The Big Idea Competition 2017, at 1 (2017), https://www.coloradocollege.edu/other/innovation-institute/pdf/BigIdea2017.pdf [https://perma.cc/QFH2-NKQN].

124. *See, e.g.*, William Hubbard, *Inventing Norms*, 44 CONN. L. REV. 369, 369 (2011).

successful inventions," which motivates people to invent.[125] This identification of inventions and inventors both reinforces internalized inventing norms and facilitates external enforcement by publicizing discoveries to inventors' friends and colleagues. Non-technical audiences, like friends and family members, can understand the simple fact that a patent has been granted even if the person lacks the technical background to understand the details of the discovery. "Patents are also important in professional circles, and patentees often treat issued patents" as a credential-like degree.[126]

Similarly, Professor Jeanne Fromer argues that "[p]erhaps the most promising expressive incentive is a right attributing a protected work to its creators."[127] She points out that "attribution can bolster an author's or inventor's reputation. Attribution makes it easy to broadcast a creator's involvement, enabling the public to give kudos to the creator. A strongly positive reputation can provide the creator with financial rewards, such as increased professional opportunities and a higher salary."[128] Empirical work validates that creators are even willing to accept reduced licensing revenues in exchange for receiving attribution for their work.[129]

To obtain a patent, an inventor must convince a patent examiner that the invention is, among other things, novel and nonobvious. However, it's unclear to what extent society actually believes patents are legitimatizing, and individuals have widely varying views about the patent system.[130] Professor Fromer also argues that patent laws only "faintly" provide attribution rights by requiring inventors to be named on the patent because attribution only occurs when people see the relevant patent.[131]

Prize and grant rewards can also provide a nonmonetary incentive, such as prestige or respect of colleagues for winning. To place well in a competition, winning teams must convince third parties (judges) that their invention is superior to the competing teams' inventions. Similarly, to obtain a grant, grant recipients must convince third parties that their proposals were superior. By winning or placing in a competition, such recognition provides attribution similar to patents. Of course, just like patents only provide attribution when people see the relevant patent, prize competitions only provide attribution when people are notified of the winners.

Although it's unclear whether patents, grants, or prizes generally provide superior nonmonetary incentives, the nonmonetary incentive is probably greatest for ex post rewards and for rewards where

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125. *Id.*

126. *Id.* at 400.

127. Jeanne C. Fromer, *Expressive Incentives in Intellectual Property*, 98 VA. L. REV. 1745, 1790 (2012).

128. *Id.*

129. *See id.* at 1791, 1791 n. 275.

130. For a discussion on the public perception of patents and other IP, *see* Gregory N. Mandel, *The Public Perception of Intellectual Property*, 66 FLA. L. REV. 261 (2014).

131. Fromer, *supra* note 127, at 1792.

there is direct competition since both types of rewards would tend to show more legitimization of the invention. It is also important to note that, unlike prize competitions and grants, patents also provide exclusive rights to the corresponding invention, which may provide some nonmonetary utility to the inventors as well.[132]

Furthermore, it's possible that inventors' personhood interests are somewhat stronger when they come up with the problem and the solution to be solved. Inventors will likely feel a stronger personal connection to inventions when they identified both the problem and the solution than when they develop the solution to someone else's problem. They may also believe that solving a pre-specified problem that they did not think of is less impressive, and to the extent other competitors in a specific prize competition are developing projects extremely similar to their own, the inventions may feel less personal as well. To the extent these observations are true, inventors' nonmonetary personhood interests may decline as prize competitions increase the specificity of the problem to be solved.

4. Racing

Racing occurs when multiple innovators race to solve the same problem in pursuit of a reward awarded for being first to the finish line. The utility of racing is an empirical question and will likely depend on the circumstances. Racing is good to the extent it leads to faster innovation and useful alternatives,[133] and to the extent alternatives spur useful future innovation. Racing is detrimental when it leads to duplicative investment[134] or wasteful investment toward inferior alternatives.[135]

Racing can be minimized with incentives that encourage early disclosure, provide shared rewards, or provide smaller rewards.[136] Early disclosure can prevent subsequent duplicative research to the extent other innovators become aware of the disclosure and cease wasteful activities. Shared rewards reduce racing because researchers don't need to "win" the race to obtain a portion of the reward, and each

132. *Id.* at 1821 ("Just as with the fear of heavy expressive costs associated with a broad right of integrity, there ought to be a worry about imposing heavy restraints on creators' ability to alienate their rights in their intellectual property. The rights provided by copyright and patent law primarily and visibly serve to exclude others from certain uses of the creator's work. As such, these rights themselves signal copyright and patent laws' solicitude for creators' expressive interests by granting them broad rights excluding others from using their work in ways that do not accord with the creators' expressive goals.").

133. *See* John F. Duffy, *Rethinking the Prospect Theory of Patents*, 71 U. CHI. L. REV. 439, 446 (2004); Mark A. Lemley, *The Myth of the Sole Inventor*, 110 MICH. L. REV. 709, 754-55 (2012); Robert P. Merges & Richard R. Nelson, *On the Complex Economics of Patent Scope*, 90 COLUM. L. REV. 839, 878 (1990).

134. *See* Abramowicz, *supra* note 100, at 185.

135. *See generally id.*

136. *Id.* at 188-90.

team may expect to win only a fraction of the final reward.[137] Smaller rewards reduce duplicative research because fewer inventors will enter the race in the first place, and those that do may not invest as heavily.[138]

Patents can cause a racing problem because inventions won't generally be disclosed at least until the invention is ready for patenting,[139] and even then, the disclosure may not publish for eighteen months. Thus, if the patent incentive is sufficiently large, inventors may race for a patent on the same invention, even for a period after an inventor won the race.

Prize systems may do a little better. "Conceivably, a prize system could be used to compensate parties for releasing information even if that information would be insufficient for patentability. If researchers have the option of obtaining a reward by releasing preliminary information, research could become more of a cooperative process than a competitive one."[140] In addition to being able to promote and reward disclosure earlier than patents, prize systems can also deter racing by offering shared rewards.[141]

As the competition becomes more specific, there is more opportunity for cooperation because the competitors are all trying to solve the same problem. Such cooperation can theoretically reduce detrimental overlap in investment. As the competition becomes more general, promoting cooperation may be fruitless because the competitors may all be vying to solve different problems (and there would be no overlap to begin with). All the competitors working on similar problems may be spread across many different competitions and thus opportunities for cooperation are limited.

On the other hand, more specific competitions are naturally vulnerable to racing because all competitors are vying to solve the same problem. Even when specific competitions are coupled with early disclosure and cooperation, mini races in between disclosures still occur.[142] Research efforts between competitors will tend to become more duplicative as the competition becomes more specific. Moreover, the prize sponsor in specific competitions won't have perfect information regarding the optimal reward size, which may lead to racing or inactivity. If the reward is set too low, no one will enter the race, and society won't obtain a solution to the specified problem as quickly. If the

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137. See *id.* at 189-90.

138. *See id.*

139. Obviously, this won't always be the case, and sometimes patents are filed before the invention was ready for patenting. Moreover, Professor Gideon Parchomovsky argues that at least in some cases, firms may be incentivized to "prevent other firms from winning the [patent] race by publishing their research findings." Gideon Parchomovsky, *Publish or Perish*, 98 MICH. L. REV. 926, 927 (2000). However, other scholars have pushed back on this thesis. *See* Douglas Lichtman, Scott Baker & Kate Kraus, *Strategic Disclosure in the Patent System*, 53 VAND. L. REV. 2175 (2000).

140. Abramowicz, *supra* note 100, at 188.

141. *Id.*

142. *Id.* at 189-90.

reward is set too high (or arguably even if it's set properly), many innovators will enter the race, and racing will occur to some extent.

Thus, it's unclear how racing varies with the degree by which the prize competition specifies the problem to be solved. More specific competitions may provide better opportunities for cooperative innovation, but they are also particularly vulnerable to racing because all competitors are expending resources to solve the same problem.[143]

5. The Adverse Selection Problem

Commercially unviable inventions are not typically rewarded by the patent system, because the patent reward is keyed to market success.[144] But prize competitions that do not key the size of the reward to future market success might reward some bad inventions, either because judges misvalue an invention or because there are no good inventiosn in the competition to reward.[145] For this reason, if an optional patent-prize system is utilized, where inventors choose between a patent and a prize, there's a chance that all inventors with good inventions will opt into the patent system because it provides a market-based reward, and only inventors with bad, commercially unviable inventions will opt into the prize system.[146]

But, in reality, there are many reasons to think this would not be a problem. For one, many potential inventors are either risk averse or have monetary restrictions, and these inventors may be attracted to a prize system irrespective of the merits of their inventions. This is particularly true due to the high degree of uncertainty regarding the success of any particular invention.[147] In addition, inventors with inventions that provide significant social value beyond that which can be rewarded in the market will also prefer the prize system.

Specific competitions may likewise be vulnerable to providing rewards to bad inventions when bad inventions nonetheless meet the submission requirements.[148] Indeed, it can be impossible to sufficiently specify the problem to be solved ex ante and may need to be updated

143. I won't address the related problem of inventing around since it has already been extensively addressed, and specific and general competitions may not work much differently. One difference is that with specific competitions, the government could intentionally fund alternatives to patents already owned by companies. This could be good since it lowers consumer prices and deadweight loss, bad because it lowers incentives to invent, and bad to the extent the government abuses the power to selectively target corporations (such as for political motives). For a thorough discussion of inventing around, *see id.* at 190-93.

144. *See id.* at 193-99.

145. *See id.*

146. *See id.*

147. *See, e.g.*, James E. Bessen, *The Value of U.S. Patents by Owner and Patent Characteristics*, (Bos. Univ. Sch. of Law, Working Paper No. 06-46, 2006); Dennis D. Crouch, *The Patent Lottery: Exploiting Behavioral Economics for the Common Good*, 16 GEO. MASON L. REV. 141 (2008); Kimberly A. Moore, *Worthless Patents*, 20 BERKELEY TECH. L.J. 1521 (2005).

148. *See* Burstein & Murray, *supra* note 28, at 407.

as the competition progresses.[149] But competition coordinators should only make changes after careful consideration, as it has been found that competitors get frustrated when the problem to be solved becomes a "moving target."[150]

The broad flexibility given to judges in general competitions reduces the need to adequately specify the problem to be solved, which eliminates the risk of (1) needing to specify and respecify the problem to be solved and (2) providing rewards to bad inventions that meet the submission requirements. However, although the competitors may not have a moving target, it's possible they could get equally frustrated when judges can award prizes without turning to any guidance at all.

Furthermore, judges may have a more difficult time providing rewards in general innovation competitions because judges will invariably be required to assess the value of inventions outside their area of expertise. While venture capitalists and others regularly assess projects from many different fields, specific competitions may fare better because they can utilize judges with expertise in the specific area of science the competition focuses on.

If a patent-plus-prize system is utilized, as is commonly the case, there's an additional problem in that unnecessary prizes may be given out. Inventors may obtain both a patent and a prize for inventions that would've been disclosed even if only one or no incentive were awarded. The problem can be reduced or eliminated if the competition specifies problems that aren't on researchers' radars and by selectively choosing an eligible class of participants that are otherwise under-incentivized by patents (e.g., a class that is risk-averse or has monetary restrictions). The problem can be further reduced or eliminated by both types of competitions to the extent prizes are rewarded for socially valuable inventions that may not be as commercially attractive or for other classes of inventions that are for some reason otherwise underproduced (e.g., insufficient public awareness).

6. Other Innovation Incentives

While this Subpart has discussed innovation incentive implications arising from to prize competition specificity, the discussion holds equally for other innovation incentives. For example, grants, which are very related to prize competitions, can also vary the degree by which the problem to be solved is specified. Once this realization is made, it becomes clear that grants and prize competitions are functionally similar when they similarly specify the problem to be solved. Although different, even patents can be placed on the spectrum because while the patent system rewards a broad swath of subject matter, not everything is patentable subject matter. This Part provides a new way to compare grants and all types of prize competitions, by assessing the specificity by which the innovation incentive lays out the problem to be solved. Analyzing the incentives in this manner provides significant insight.

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149. *See id.* at 427.

150. *Id.* at 429.

III. OPTIMAL DESIGN OF GENERAL COMPETITIONS

Because highly specific competitions are widely discussed in the literature, this Part will focus on more general prize competitions. In particular, this Part will focus on three ways by which general competitions provide value to society:

- BY INCENTIVIZING MORE AND QUICKER INNOVATION THAT OTHERWISE WOULDN'T HAVE OCCURRED.
- BY PROVIDING SEED MONEY TO YOUNG STARTUPS.
- BY PROVIDING VALUABLE NONMONETARY OPPORTUNITIES TO THE COMPETITORS.

General innovation competitions can provide value beyond incentivizing innovation. For instance, innovation competitions can incentivize quicker innovation. Innovators may tend to work more intently on their inventions on the verge of a competition's deadline in order to compete, and as a result, society will benefit from the invention more quickly. However, as described earlier, incentivizing quicker innovation can also incite racing, and the efficacy of racing is unclear.[151] For this reason, it may be best for general competitions to target classes of competitors who would otherwise be inclined to sit on their ideas rather than proactively pursue them. College students may be a perfect example because they typically have monetary restrictions and may plan to wait until after college to begin working on their inventions.

In addition, general innovation competitions can provide seed money to young startups. If the startup is on the verge of operating but in need of capital, financial awards may allow the startup to operate with less external funding. Debt financing is often not a viable option for such a startup, and external funding will dilute the inventor's interest. When the inventor can keep a larger stake in the startup, the inventor's incentives to further pursue the startup are increased. Even moderate amounts of seed capital can allow a startup to operate for more time before seeking funding; at this later stage, the startup may obtain funding more easily and on more favorable terms. Moreover, because young startups face exorbitantly large costs of capital,[152] obtaining any seed money can be critically helpful.

Furthermore, the competitions can provide valuable nonmonetary opportunities to the competitors, such as feedback, mentorship, networking, publicity, training, and seminars. Competitions often provide an ideal vehicle to provide such opportunities because they naturally bring many innovators together, and they can even weed out the less serious competitors before providing the limited and valuable resources.

General innovation competitions strive to obtain these goals in vastly different ways. One critical difference between competitions is that they award prizes at various stages of the innovation process.

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151. *Supra* 4

152. *Supra* note 107.

Competitions can award prizes as early as conception, when the inventor has a definite idea of the invention. At this stage, the competition acts similarly to a grant competition, though grant competitions sometimes provide rewards even earlier. Competitions can also provide rewards as late as when the invention is on or almost on the market, or at any point in between. In practice, competitions typically award at (1) the *business plan stage*, when an idea is conceived of and a business plan has been created including product marketability and viability; at this stage, proof-of-concept or some reduction to practice may be complete as well; or (2) the *startup stage*, when the team is a young startup selling or on the verge of selling products. Many competitions that provide rewards at the business plan stage also provide rewards for teams at the startup stage, such that competitors are at vastly different stages in the innovation process. Other competitions strictly limit participation to the startup stage.

This Part discusses three important considerations to address in designing general innovation competitions. These considerations will shed light on when to best provide rewards. The goal of this Part is not to offer definitive conclusions, but rather to highlight key considerations so that competition designers consider as many pertinent factors as possible. The three considerations discussed are the size of the reward, the eligible class of participants, and the amount and type of valuable nonmonetary opportunities provided.

A. The Size and Distribution of the Reward

1. Optimal Size of the Reward

All else equal, the later the reward is provided, the larger the ultimate reward must be to stimulate such action. Innovators will obviously be more willing to pursue an invention to an earlier stage of the innovation process to receive a given award than a later stage of the process for that same reward. In other words, the reward must be larger when teams are required to put in more work to receive it.

But as money is awarded earlier, there is greater risk of innovators entering the competition just to win the award with no serious intention of further marketing the invention, and greater risk of rewarding innovators who aren't fully committed to pursuing their projects. Incentivizing such individuals can be good to the extent the inventors disclose the information to the public and are willing to license or forego patent protection. In such cases, the initial inventor may be in the best position to conceive of the invention but not in the best position to market it.[153] However, incentivizing individuals to conceive of inventions they won't pursue past conception can be bad to the extent the inventors can extract money for thinking of an idea that may not be pursued by others[154] (e.g., poor competition disclosure function).

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153. *See* Mark A. Lemley, *The Myth of the Sole Inventor*, 110 MICH. L. REV. 709, 711 (2012) ("[M]ost first inventors turn out to be lousy commercializers who end up delaying implementation of the invention by exercising their rights.").

154. *Id.*

Furthermore, the earlier an award is provided, the harder it will be for judges to determine which inventions are superior, and thus the harder it will be to appropriately allocate funds. The smaller the reward, the less risk of innovators pursuing and submitting bad inventions to the competition to extract money. If the reward is provided at a later stage, such as when a product is on or nearly on the market, there's obviously less risk that the inventors aren't devoted to the project, less risk the inventors don't think the invention is a good one, and a better chance the judges can appropriately reward the best inventions.[155] For these reasons, rewards provided earlier should be smaller, so that large sums of money are not grossly misallocated.

2. Optimal Distribution of the Reward

How many teams should receive an award? The allocation of prize money obviously affects the size of the reward, since allocating prizes to more teams dilutes each reward. Such effects were just treated in the previous Subpart. This Subpart considers two additional considerations related to the distribution of the reward: (1) that allocation of prizes may affect team incentives to continue vigorous pursuit of their projects after the competition, and (2) that increasing the number of teams receiving an award may increase the number of teams submitting bad inventions.

When a team doesn't receive an award, the loss can be demoralizing and cause a team to discontinue pursuit of a project. Such demoralization is good to the extent it halts further pursuit of bad projects. Conversely, when a team receives an award, the win can incentivize and help fund further pursuit of the project, which is beneficial when good projects are awarded. Importantly, the earlier rewards and losses can be reliably given, the sooner these effects take place.

Another effect is that, as the number of prizes awarded increases, there may be greater incentive for teams to pursue bad projects and enter them into the competition. If, say, only one prize is awarded and the competition is statewide, teams with bad projects may assume they'll lose. Now suppose the other extreme: that every entering team receives a prize. It's pretty clear in this case that many teams will enter bad projects just to get the guaranteed prize. This problem could be prevalent even when less than 100% of teams receive an award.

A third consideration for reward distribution is the risk profile of competitors. To the extent the participants are risk-averse, they would prefer a more dispersed allocation of resources. Thus, to get the most innovative activity per dollar of reward, the reward should be spread across more competitors. Similarly, the sponsor may not want to put "all their eggs in one basket" and provide large rewards to just one or a few teams, risking a significant misallocation of funds.

155. Of course, as discussed earlier, the rewards could also be made a function of future market success.

A final consideration for reward distribution is the definitiveness of the prize structure. For most competitions, the prize structure is provided ex ante (e.g., fixed first, second, and third place prizes fully disclosed ex ante), but for some competitions, such as the Berkeley Delta Prize, only the total size of the award is provided, and judges are given maximum flexibility regarding how to allocate the money.[156] Flexible reward allocation can provide many benefits, such as rewarding fewer or greater teams depending on the number of quality submissions. This benefit alone may justify using flexible reward allocation; however, there could be downsides as well. For instance, teams that don't win a reward under a flexible reward system may be more prone to feeling unworthy of a reward, which is good when the team is pursuing a bad project but bad when the team is pursuing a good project.

3. Reward Size in Practice

Do competitions tend to follow these guidelines in practice? Generally speaking, the answer is yes. For instance, the UVA offers three different E-Cup competitions: Concept, Discovery, and Launch.[157] The Concept Competition is the first stage competition and provides rewards for ideas that have been conceived, but before a business plan has been created.[158] The Launch Competition is the third and final stage competition and provides seed capital for the best new student startups, seeking sustainable projects with dedicated teams.[159] The second stage Discovery Competition is provided for teams between the Concept and Launch stages.[160] From Concept to Launch, the competitions progressively offer rewards to fewer participants: twenty-five for Concept,[161] five for Discovery,[162] and three for Launch.[163] Also from Concept to Launch, the competitions generally provide larger total rewards: $25,000 in total for each of Concept[164] and Discovery,[165] and $50,000 for Launch.[166]

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156. Telephone Interview with Eugene Noh, Delta Prize Program Manager, University of California Berkeley (Feb. 14, 2017).

157. UNIV. OF VA. ENTREPRENEURSHIP CUP, http://entrepreneurshipcup.com [https://perma.cc/4SXE-HW28].

158. *Stage I: Concept*, UNIV. OF VA. ENTREPRENEURSHIP CUP, http://entrepreneurshipcup.com/concept [https://perma.cc/S97H-8BHZ].

159. *Stage III: Launch*, UNIV OF VA. ENTREPRENEURSHIP CUP, http://entrepreneurshipcup.com/launch [https://perma.cc/LN8L-EDKA].

160. *Stage II: Discovery*, UNIV OF VA. ENTREPRENEURSHIP CUP, http://entrepreneurshipcup.com/discovery [https://perma.cc/9TSL-S6CN].

161. *Stage I: Concept*, UNIV. OF VA. ENTREPRENEURSHIP CUP, *supra* note 158.

162. *Stage II: Discovery*, UNIV OF VA. ENTREPRENEURSHIP CUP, *supra* note 160.

163. *Launch! Stage: Awards*, UNIV. OF VA. ENTREPRENEURSHIP CUP, http://entrepreneurshipcup.com/launch/launch-stage-awards/ [https://perma.cc/8JY9-Z3ZC].

164. *Stage I: Concept*, UNIV. OF VA. ENTREPRENEURSHIP CUP, *supra* note 158.

165. *Stage II: Discovery*, UNIV OF VA. ENTREPRENEURSHIP CUP, *supra* note 160.

166. *Stage III: Launch*, UNIV OF VA. ENTREPRENEURSHIP CUP, supra note 159.

The MIT 100K challenge is somewhat similar, offering $2,000-$5,000 for its PITCH competition,[167] $3,000-$10,000 for its Accelerate competition,[168] and $135,000 for its Launch competition.[169] Although only two prizes are awarded for PITCH[170] and Accelerate,[171] while four prizes are awarded for Launch,[172] this deviation is probably due to MIT's significant increase in resources devoted to Launch (more teams can be rewarded without dilution problems).

B. The Eligible Class of Participants

The two aspects of the eligible class discussed in this Subpart include the size of the eligible class and the characteristics of the eligible class.

1. Size of the Class

The expected size of the class can be modified by directly changing the eligible class or by adding some specificity to the innovation requirements. For example, most university-run competitions limit participation to teams that include students from the university.[173] Similarly, statewide competitions limit participation to startups founded by entrepreneurs from the state with less than some threshold amount of revenue.[174]

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167. *PITCH*, MIT $100K, http://www.mit100k.org/pitch [https://perma.cc/3EMB-X66B].

168. *Accelerate*, MIT $100K, http://www.mit100k.org/accelerate [https://perma.cc/F3LS-92XX].

169. *Launch*, MIT $100K, http://www.mit100k.org/launch [https://perma.cc/2RR8-3N7P].

170. *PITCH*, MIT $100K, *supra* note 167.

171. *Accelerate*, MIT $100K, *supra* note 168.

172. *Launch*, MIT $100K, *supra* note 169.

173. *See, e.g.*, *The Big Idea*, COLO. COLL., https://www.coloradocollege.edu/other/innovation-institute/pdf/BigIdea2017.pdf [https://perma.cc/TF4Y-AS27] ("At least 50% of the team shall be comprised of currently enrolled Colorado College students, and these students must have an active and founding role in the venture."); *Competition Details*, DICKINSON COLL., http://www.dickinson.edu/info/20443/innovation_competition/3040/competition_timeline [https://perma.cc/BR5X-DC23] (requiring teams of "3-5 students" that represent "at least two of the three academic divisions of the college by major"); *Guidelines and Regulations*, TRANSCEND ENGINEERING, http://transcend.engineering/guidelines [https://perma.cc/XML5-LQWL] (requiring participants to be "a University of Wisconsin - Madison student").

174. *See, e.g.*, *Enter the Competition*, UNIV. OF MINN., https://carlsonschool.umn.edu/mn-cup/enter-the-competition [https://perma.cc/D6DF-PUEU] (limiting participation to "[e]ntrepreneurs based in MN with less than $1 million in annual revenue"); WISC. GOVERNOR'S BUSINESS PLAN CONTEST, http://govsbizplancontest.com/about/guidelines-eligibility [https://perma.cc/M34M-RH2R] (limiting participation to teams comprising Wisconsin residents, based in Wisconsin or planning to locate a business in Wisconsin,

Of course, the actual size of the class may be predetermined based on, for instance, the source of the funding. If the competition funding is provided by state tax revenue, most likely the competition will be created to serve residents of the state. Similarly, if private donors donate to their alma mater in support of its innovation competition, they probably don't want their donated money to go to a team from a different school.

If necessary, the competition can further limit the expected size of the competition pool by providing the reward at a later stage in the innovation process, since fewer eligible participants will reach such a later stage. Another way to limit the expected size is to add some degree of specificity to the competition. By limiting the class of inventions, the competition will obviously reduce the expected number of entries and can also target a problem that may otherwise be under-researched, as described previously.

The Stanford Center on Longevity, for instance, runs a Design Challenge which allows any student from any university around the world to participate,[175] but keeps participation limited by requiring inventions to be based on a yearly theme.[176] The competition focuses on human life longevity, which generally means a well-lived life. The competition designers believe students and other young entrepreneurs aren't currently thinking about how to make this increased lifespan valuable. The competition provides a reward for the best longevity-related innovations to incite innovation in this important, yet otherwise under-researched field.

Another example is the Michigan Innovation in Action competition, which provides a "Public Health Challenge" and an "Education Challenge" to incite innovation in these fields.[177] Furthermore, many competitions provide a special track for social innovation,[178] which, as discussed, is likely to be otherwise underprovided by a patent-driven incentive system.[179]

There can be good reasons to cast a wide net with respect to the eligible class of participants. Most importantly, it may be valuable to expand the eligible class of participants so that limited resources (prize money, feedback, networking opportunities, etc.) go to the best

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which have "received less than $25,000 in private equity funding").

175. *Design Challenge*, STANFORD CENTER ON LONGEVITY, http://longevity.stanford.edu/designchallenge2016-17/#tab-id-4 [https://perma.cc/77SM-T4V4].

176. For example, the 2016-2017 challenge was based on "Innovating Aging in Place." *Id.*

177. *Innovation in Action*, UNIV. OF MICH., http://innovationinaction.umich.edu/competition/index.html [https://perma.cc/8AC4-RQP9].

178. *See, e.g.*, *2014 DifferenceMaker Idea Challenge Winners*, UMASS LOWELL, https://www.uml.edu/Innovation-Entrepreneurship/DifferenceMaker/Idea-Challenge/2014-Final-Awards.aspx#Significant [https://perma.cc/X5PA-7PUE] (providing a dedicated "significant social impact" award); UNIV. OF MINN., *supra* note 174 (including an "Impact Ventures" track); *Concept Stage: Tracks*, UNIV. OF VA. ENTREPRENEURSHIP CUP, http://entrepreneurshipcup.com/concept/concept-stage-tracks [https://perma.cc/T4AD-GZ8U] (including a "Social Entrepreneurship" track).

179. *See supra* note 98 and accompanying text.

projects available in a larger pool. Indeed, as the class size increases, so do the expected number of good entries.

There are, however, also good reasons to limit the eligible class of participants. Importantly, the larger the eligible class, the more the participants will discount their chances of receiving the reward, since there will be more competition as the class size increases.

In addition, limiting the class may be particularly useful for business plan type competitions. Competitors at the startup stage may have an advantage competing against competitors at the business plan or conception stage, since such competitors have spent much more time on their projects and are at a more defined and mature stage in the innovation process. If the eligible class of participants is too large, then the competition may be overrun by competitors at the startup stage, crowding out innovators at earlier stages. This crowding out effect would transform a business plan competition into a startup competition because teams at the startup stage may tend to receive the rewards. Competitions can limit this problem by disallowing participation by more mature startups,[180] but if limiting competition is difficult, a second-best solution is to limit the size of the class and thus the number of mature startups that can enter the competition. Reducing the overall reward size as described above can also help.[181]

2. Characteristics of the Class

Risk-averse individuals and those who have monetary constraints may be under-incentivized to invent if only ex post patent-type rewards are used, since such rewards are provided after risk is borne. But as described in Part I, general prize competitions can be designed to incentivize innovation before risk is born. Thus, general prize competitions could advantageously be targeted toward classes of participants that are risk averse or have monetary constraints. This could be advantageous to the extent the patent-prize reward combination doesn't exceed the social value of the project. Moreover, because society is generally risk-averse, our current reliance on ex post mechanisms comes at a cost.

University students are a good example of such a population. They are easily cognizable, typically have monetary restrictions, and may especially benefit from the nonmonetary value provided by such

180. Some form of limiting is common in practice. *See, e.g.*, COLO. COLL., *supra* note 173 (limiting participation to "startup ventures as opposed to already existing operations" and only "startups who have received *limited* previous seed funding" from sources other than professional funding sources); UNIV. OF MINN., *supra* note 174 ("Entrepreneurs based on MN with less than $1 million in annual revenue are eligible to apply."); *Concept Stage: Eligibility*, UNIV. OF VA. ENTREPRENEURSHIP CUP, http://entrepreneurshipcup.com/concept/concept-stage-eligibility [https://perma.cc/ZT7J-AQS8] ("Business projects that have generated greater than $75,000 in revenue, are or were part of another project, or raised funding other than from the team members are not eligible to participate."); WISC. GOVERNOR'S BUSINESS PLAN CONTEST, *supra* note 174 (limiting participation to teams having received less than $25,000 in equity funding).

181. *Supra* Part II.A.

competitions, such as resume value and from the experience generally. Moreover, to the extent university students are otherwise inclined to sit on their inventions until they're done with school, competitions may incentivize them to initiate their projects during school.

C. Valuable Nonmonetary Opportunities

A third consideration is the amount and type of nonmonetary opportunities provided to the competitors. The amount of feedback, mentorship, publicity, training, seminars, and networking events that should be provided will depend on the stage in the innovation process the reward is provided and the amount of pre-screening or cutting that has taken place.

Different types of nonmonetary opportunities are best utilized at different stages of the innovation process. As stated earlier, feedback regarding the merit of a particular invention is best given early. That way, bad projects will get disincentivized early, and good projects will get reinforced. Different types of mentorship, on the other hand, will be most valuable at various stages in the innovation process. Introducing the teams to venture capitalists may come best later on in the process, since venture capitalists may be looking for only more mature startups in which to invest. Competition coordinators should know which types of nonmonetary opportunities they can provide and at which stage in the innovation process these opportunities can best serve the competitors; then, the coordinators should strive to focus their competition around projects at this stage in the innovation process.

Many nonmonetary opportunities, such as networking events with venture capitalists and mentorship, may be best provided after a round of "cuts" has been performed. Although a seminar may have room for all, only so many mentors will be available to help the competitors. A competition that takes this concept to the extreme is the Berkeley Delta Prize competition. The Delta Prize is predicated on the fact that Berkeley can provide outstanding resources, but such resources are best utilized when devoted to the most promising startups coming from current or former Berkeley students.[182] Delta Prize coordinators receive applications from many teams but choose only a few teams to undertake a 2.5 month mentoring program that culminates with awarding monetary prizes.[183] Delta Prize offers to the three teams mentorship, networking opportunities, space to work, constant feedback, and a chance to win an award at the end.[184] Through focusing resources and including only the most promising and dedicated teams, Delta Prize has helped produce many active startups.[185]

182. Telephone Interview with Eugene Noh, Delta Prize Program Manager, University of California Berkeley (Feb. 14, 2017).

183. *Id.*

184. *Id.*

185. *Id.*

Other prize competitions are more traditional and inclusive, but still limit opportunities to some extent. The University of Massachusetts-Lowell Idea Challenge competition, for example, begins by offering four different workshop series.[186] The workshops include "Identifying Problems," "Assessing Opportunities and Value Propositions," "Developing Business Models," and "Delivering Your Rocket Pitch."[187] These workshops are broadly focused on the initial conception stage of innovation and then lightly tread into business modeling and pitching the idea. A Networking event is also offered.[188] Only after a round of cuts does the competition begin to provide pitch coaching.[189] By limiting opportunities to the competitors who are pursuing the most promising projects, scarce resources can be conserved and utilized most efficiently.

IV. ANALYZING GENERAL COMPETITIONS WITH SURVEY DATA

One-hundred-sixteen competition participants across 10 university run general innovation competitions were surveyed regarding the participants' subjective evaluation of how the competition affected their innovative actions.[190] While the surveyed competitions vary greatly, they are also similar in important ways. Most notably, every surveyed competition was designed for university students (or, in some instances, recent graduates) and every surveyed competition is general in nature. Basic details regarding each surveyed competition is provided in Table 1.

186. *Idea Challenge*, UMASS LOWELL, https://www.uml.edu/Innovation-Entrepreneurship/DifferenceMaker/Idea-Challenge/default.aspx [https://perma.cc/VL4P-75GE].

187. *Id.*

188. *Id.*

189. *Idea Challenge*, UMass Lowell, https://www.uml.edu/docs/Difference%20Maker%20postcard%20Schedule%2012.17_tcm18-286304.pdf [https://perma.cc/3HP5-2DC7].

190. The survey results are on file with the author.

TABLE 1: SURVEYED COMPETITION DEMOGRAPHICS

Competition	Public / Private	Number of Students	Total Participants	Responses	Response rate
#1	Private	20,000 – 30,000	unreported	6	
#2	Public	40,000 – 50,000	80	24	30%
#3	Public	40,000 – 50,000	15	7	46.7%
#4	Private	< 10,000	32	10	31.25%
#5	Private	10,000 – 20,000	63	7	11%
#6	Private	20,000 – 30,000	unreported	6	
#7	Public	20,000 – 30,000	unreported	12	
#8	Public	40,000 – 50,000	36 for 9 of the responses, unknown for 2 of the responses	11	
#9	Private	< 10,000	40	17	42.5%
#10	Public	10,000 – 20,000	142	16	11.3%

Before turning to the survey results, three cautionary notes are in order. First, the survey asked participants to subjectively evaluate how the competition affected their actions. Although I believe many participants can accurately answer such questions in this case, there is evidence that survey participants are not always good at answering questions requiring subjective evaluation. Indeed, people are better at reporting what they have done in the past than they are at explaining why they made choices or at predicting future choices.[191] Nevertheless, surveys can be the best option when conducting controlled experiments is infeasible, and "it is important to know whether the people whom [innovation incentives] are supposed to be helping think the system is working."[192]

Second, the results may contain nonresponse bias. For the seven competitions for which I have response rate data,[193] the response rates for five of the surveys ranged between 25% and 46.7%, while the other two surveys achieved a response rate of around 11%.[194] There is

191. *See* sources cited *supra* note 11.

192. Ouellette, *supra* note 12, at 80.

193. Every survey had to be run through a competition coordinator. As such, I was occasionally unable to obtain certain information or ask certain questions.

194. I recorded the following response rates: 30% (24/80); 25% (9/36) for 2017

a risk of response bias if the respondents and non-respondents differ from one another with respect to how they would answer the questions. Here, the respondents and non-respondents differ in material ways, though it's unclear whether and how these differences affect their answers. For instance, although the vast majority of participants do not win an award, of the respondents for which I have award data, 54.3% won an award. To account for this bias, the data is also analyzed in awarded and unawarded subgroups.

To the extent the award-winning participants represent the competitors most likely to continue further pursuit of their projects (which appears to be true; *see infra*), that data may be most important anyway. Although award winners constitute a small fraction of the participant population, they constituted 54.3% of the responding population; thus, the data obtained from award winners may be more representative for their own respective population.

However, there are also other nonresponse concerns that cannot be accounted for, and it's unclear whether and how this nonresponse affects the data. For example, respondents are probably more likely to have had a particularly positive or negative experience with the competition. It is unclear whether such participants would answer the questions differently than the other participants. Accordingly, it is unclear to what extent the results relate to the participant population as a whole.

Third, the surveyed university run competitions do not constitute a random sample, but rather a set of university run competitions found through web searching and that agreed to send out the survey. Because the competitions do not comprise a random sample of all competitions, it is unclear to what extent the results can be generalized to other university run competitions.

What the data does provide is the respondents' subjective evaluations of whether the competitions altered their innovative behavior, which is one important question (of many) in assessing whether innovation incentives provide social value. Because randomized experiments are infeasible, such data may be most appropriate in determining whether such competitions truly affect individual behavior. Moreover, ascertaining whether the individuals for whom such competitions are supposed to support think the system is working is important in its own right.

A. Data as a Whole

The survey data as a whole illustrates a number of trends. First, many survey participants subjectively believed the competition enticed them to pursue their projects. Of the 116 surveyed participants,[195] over half (51.8%) indicated that they would not have or only might have developed their invention if it were not for the competition (31.2% indicated that they would not have, and 20.6% indicated that they only

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and 2 responses from 2016 out of unknown; 42.5% (17/40); 31.25% (10/32); 46.7% (7/15); 11% (7/63); and 11.3% (16/142).

195. Keep in mind that over half of these participants won an award in the competition.

might have), which suggests the competitions at least subjectively provided an incentive effect.

Respondents who did not win a prize were more likely to indicate that they would not have developed their invention if it weren't for the competition (40% for those who didn't win a prize vs. 23% for those who won a prize). The numbers are slightly closer when those who only might have otherwise developed their inventions are included (46% and 56.7%). If prize winning is a good indicator of project value, then the data indicates the competitions were more likely to entice individuals with lower value projects to develop than individuals with projects of greater value (at least for the respondents).

Furthermore, respondents who do not plan on pursuing their inventions after the competition were nearly twice as likely to be enticed to develop their projects for the competition than individuals who plan on pursuing their projects in the future (50% vs. 25.6%). Again, if the respondents with the best projects are the ones willing to pursue them after the competition, then this data again indicates the competitions were more likely to entice individuals with lower value projects to develop their inventions (at least for the respondents).

This finding is consistent with the fact that, on average, better projects may tend to be pursued absent additional incentives, and prize competitions may be vulnerable to adverse selection. To the extent prize competitions in reality tend to incentivize the pursuance of more good *and* bad projects, it is unclear whether such an increase in the number of good projects being pursued outweighs the larger increase in the number of bad projects being pursued.

Second, respondents generally believed the competition incentivized them to innovate more quickly. Of the fifty-four respondents who indicated that they would have developed their invention even absent the competition, 59% indicated that they developed their invention more quickly than they otherwise would have to prepare for the competition; another 26.7% might have developed their inventions more quickly. Faster innovation allows society to benefit from inventions and invention disclosures more quickly, which, absent racing, is socially valuable. To the extent this quicker innovation may have caused racing, the benefit is somewhat less clear.[196]

Third, a sizeable portion of respondents planned on pursuing their inventions after the competition, including many respondents who did not win an award. Of the 116 surveyed participants, 71.3% indicated that they either were pursuing or planned on pursuing their inventions in the future.[197] Of the respondents for which prize data was obtained, prize winning respondents were far more likely to plan on pursuing their projects in the future than those who didn't win a prize (92.5% compared to 51.6%). It's unclear to what extent this difference is attributable to winning respondents having better ideas versus the competition providing added incentives to award winners (and added dis-incentives to those who didn't win an award).

196. *Supra* Part I.C.4.

197. Because most of the respondents participated in the competition just prior to filling out the survey, it's highly likely that many of these respondents who plan to pursue their projects will fail to do so.

Most likely, far fewer participants will in fact pursue their inventions in the future than those who plan to further pursue their inventions. Most surveys were administered soon after the competition ended, when participants are likely to be most optimistic about continuing pursuit of their projects. Moreover, it's possible that respondents who plan on further pursuing their projects in the future were most willing to respond to the survey.

B. Individual Surveyed Competitions

In this Subpart, three surveyed competitions will be discussed in a non-identifying level of detail. These three competitions were chosen because they exemplify how the survey results varied somewhat depending on how the competition was designed.

1. Competition #1

Competition #1 is hosted at a top private university and designed for rewarding true startups, not ventures in their infancy. The results obtained from the six respondents (four of whom won a prize) are in congruence with this goal: every respondent indicated that they would've developed their inventions even absent the competition, and only one respondent indicated the competition enticed quicker innovative activity.[198]

2. Competition #2

Competition #2 is a general innovation competition hosted at a top public university; the competition provides two "tracks" that offer some degree of specificity.[199] The competition hosts numerous workshops intentionally placed over a four-month period so that the competitors have more time to experience and assess the life of an entrepreneur. Of the twenty-four respondents (half of which received an award),[200] 69%[201] indicated that they would not have developed their invention if it weren't for the competition. This number is larger than for most competitions, possibly because the competition included two tracks that enticed students to think of ideas within those tracks. Notably, 70.8%[202] of respondents plan on pursuing their projects in the future.

198. Even this respondent guessed that the competition only sped up the team's innovative activity by a month or two.

199. The tracks will not be disclosed so that the competition retains anonymity.

200. For this competition, I received 24 responses of 80 students for a 30% response rate; however, some responses were not recorded for every question due to inconsistencies in the responses between answers.

201. 16/23.

202. 17/24.

3. Competition #3

Competition #3—offered at a top public university—offers an in-depth mentoring program to a few serious and hand-selected teams per year (chosen from many applicants). Each team is paired up with a mentor, and then the mentors decide at the end of the program which team(s) should receive a monetary reward.

Although some teams realize in the midst of the lengthy program that entrepreneurship is not for them,[203] the competition has enjoyed much success. Over its three year run, at least seven companies have emerged from the competition and are still in operation as of the Spring of 2017.

V. CONCLUSION

The federal government is considering a shift away from supporting innovation through grants and towards more specific prize competitions. This Article showed that functionally this may simply be a change in the degree to which the government specifies the problem to be solved. This Article outlined the theoretical implications of changing the specificity by which innovation incentives specify the problem to be solved, and these implications should be considered before the government reallocates funds.

203. Helping people make this realization is itself helpful.