INNOVATION IN ADVERSITY

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ABSTRACT

Adverse experiences, like long-term poverty, can inhibit innovation. But as much research and many real-world examples show, adversity can also stimulate innovation. Indeed, the COVID-19 pandemic provides a number of recent examples where adverse conditions have led individuals, firms, and governments to innovate in the hope of benefiting society.

Despite the fact that some forms of adversity undermine innovation while others stimulate it, legal scholars have largely failed to distinguish between the two forms or even account for adversity's relationship to innovation when assessing innovation law and policy, including intellectual property (IP) laws. Yet given adversity's significant role in affecting the pace and direction of innovation, doing so is crucial.

In this Article, we undertake that task. Our analysis shows that adversity is most likely to stimulate innovation when it satisfies what we call the Goldilocks principle: the adversity is neither too intense nor too mild, too fleeting nor too enduring, too all-encompassing nor too confined, too commonly experienced nor too isolated, too severe nor too insignificant, but instead is "just right." Hence, for adversity to have the best chance of stimulating innovation, it should be (1) a relatively discrete experience; (2) of moderate intensity; (3) experienced collectively rather than in isolation; and (4) significant enough that, if left unaddressed, the adversity could result in severe consequences for large groups of people. To be clear, these conditions are not necessary for innovation—adversity, or some other trigger, might spur innovation even if each of these conditions is not met. Neither are they sufficient—innovation will not necessarily occur even if all of these conditions are present. Indeed, individual and organizational characteristics often play a role in determining whether a party will respond to adversity with innovation. But existing research suggests that these are some of the features of adversity most conducive to, and thus most likely to inspire, innovation. Conversely, adverse conditions falling outside of these parameters are more likely to inhibit innovation, or at least fail to stimulate it.

We then assess what this means for IP laws and innovation policy more generally. Predominant theories suggest that IP laws are meant to incentivize parties to benefit society through innovation and

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creativity. Yet over the years, commentators have pointed out that IP rights are often unnecessary to inspire these activities and thus at times impose unnecessary costs on society by restricting access to those innovations. We contribute to this important discussion by highlighting the role that adverse conditions frequently play in affecting the pace and direction of innovation. First, we argue that the role of certain types of adversity in stimulating innovations provides another reason to doubt the efficacy of IP rights as applied to many of those innovations. Other policy levers, such as grants and prizes, may often be preferable in such cases. Second, we explore possible solutions to innovation-inhibiting adversity, including bolstering IP rights in certain situations and a greater societal commitment to basic research funding. Finally, we examine the role that adversity can play in creating innovation path dependencies, and we briefly explore some possible solutions to this dilemma.

INTRODUCTION

"*Never waste the opportunities offered by a good crisis.*"
—Niccolo Machiavelli[1]

"[*N*]*ecessity . . . is the mother of . . . invention*."
—Plato[2]

The COVID-19 pandemic has wreaked worldwide havoc. At last count, millions of people have lost their lives,[3] economies have collapsed,[4] and governments have stalled.[5] And unfortunately, the pandemic's devastating effects continue to take their toll.

One can hardly say that such adverse conditions have silver linings, at least in the traditional sense, particularly for those who have lost their lives or livelihoods. But one can say that such adversity may sometimes spur innovative activities that ultimately benefit society. We have certainly seen examples of this during the COVID-19 crisis. Parties have developed new forms of ventilators and protective gear in an effort to make up for shortfalls.[6] In some instances, companies have completely repurposed their operations to develop innovative new medical treatments, including fast-tracking vaccine research, testing kits, and other medical procedures.[7] State governments have teamed up with private companies to develop innovative solutions to COVID-

1. NICCOLO MACHIAVELLI, IL PRINCIPE (Arthur Burd ed., 1891).

2. 2 PLATO, THE REPUBLIC 49 (Benjamin Jowett trans. 3d ed., 1888) (emphasis added).

3. *See COVID-19 Coronavirus Pandemic*, WORLDOMETER, https://www.worldometers.info/coronavirus/ [https://perma.cc/6K3Y-PAZZ] (last visited July 20, 2022).

4. David J. Lynch, *IMF Says Global Economic Collapse Caused by Coronavirus Will Be Even Worse than Feared*, WASH. POST (June 24, 2020, 1:00 PM), https://www.washingtonpost.com/business/2020/06/24/imf-global-economy-coronavirus/ [https://perma.cc/GP6Z-F2F5].

5. *See* Grady Means, *Far Worse to Come: COVID-19 Collapse of State and Local Governments*, HILL (Apr. 12, 2020, 9:00 AM), https://thehill.com/opinion/finance/491503-far-worse-to-come-covid-19-collapse-of-state-and-local-governments [https://perma.cc/5CNU-2JE3] (discussing the struggles of local governments in the United States to stay afloat).

6. Mike Farish, *Manufacturers Making Up the Ventilator Shortfall*, E&T (Apr. 8, 2020), https://eandt.theiet.org/content/articles/2020/04/manufacturers-making-up-the-ventilator-shortfall/ [https://perma.cc/TJG4-X3F3] (describing collaborative efforts in the U.K. to make up for the ventilator shortfall); *Innovative Ventilator Device Developed by Prisma Health to Quickly Increase Ventilator Capacity for COVID-19 Patients*, PRISMA HEALTH (Mar. 25, 2020), https://prismahealth.org/patients-and-guests/news/press-release/innovative-ventilator-device-developed-by-prisma-health-to-quickly-increase-ventilator-capacity-for [https://perma.cc/R2DD-KM5J].

7. *See, e.g.*, Matthew Dalton et al., *Companies Retool Operations to Assist in Coronavirus Fight*, WALL. ST. J. (Mar. 19, 2020, 1:10 PM), https://www.wsj.com/articles/companies-retool-operations-to-assist-in-coronavirus-fight-11584637831 [https://perma.cc/AC32-7NCX]; Alan Rudolph & Raymond P. Goodrich, *Researchers Seek to Repurpose an Existing Manufacturing Platform to Produce a COVID-19 Vaccine*, CONVERSATION (Apr. 15, 2020, 8:13 AM), https://theconversation.com/researchers-seek-to-repurpose-an-existing-manufacturing-platform-to-produce-a-covid-19-vaccine-134216 [https://perma.cc/K9FW-EMGL].

19-related problems.[8] Even legal scholars have gotten into the act, developing innovative legal tools meant to help spur COVID-19-related research and development.[9] Perhaps most dramatically, pharmaceutical companies have developed several effective vaccines in record-breaking time.[10]

Outside of the healthcare field, COVID-19 has also triggered innovation. Educators across the globe have developed creative new ways of educating students remotely and have begun to rethink education more broadly.[11] Food services have rethought their operations, and some have developed innovative new products and methods of delivery as a result.[12] Other companies have or are in the process of identifying a host of innovation opportunities in a post-COVID-19 world.[13] In short, COVID-19 has exposed a number of inefficiencies and created new exigencies, and many individuals, companies, and governments have responded by developing new innovations to address a host of needs.[14]

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8. *Utah Partnering with Silicon Slopes for #TestUtahChallenge to Double State's COVID-19 Testing Capability*, ABC4 (Apr. 2, 2020, 2:22 PM), https://www.abc4.com/coronavirus/utah-partnering-with-silicon-slopes-for-testutahchallenge-to-double-states-covid-19-testing-capability/ [https://perma.cc/MWM4-LJFZ].

9. *See* Diane Peters, *Open COVID Pledge: Removing Obstacles to Sharing IP in the Fight Against COVID-19*, CREATIVE COMMONS (Apr. 7, 2020), https://creativecommons.org/2020/04/07/open-covid-pledge-removing-obstacles-to-sharing-ip-in-the-fight-against-covid-19/ [https://perma.cc/9P87-ATS4] (detailing efforts to create a legally binding pledge to which IP owners can commit and thereby allow others to utilize their IP rights for purposes of developing solutions to COVID-19).

10. Alexi Cohan, *mRNA Coronavirus Vaccines Were Developed in Record Time. Don't Be Fearful of the Speed*, BOS. HERALD (Jan. 20, 2021, 9:59 AM), https://www.bostonherald.com/2021/01/18/mrna-coronavirus-vaccines-were-developed-in-record-time-dont-be-fearful-of-the-speed/ [https://perma.cc/2XAG-823A].

11. *See, e.g.*, Joshua Kim, *3 Bad Educational Ideas That COVID-19 Will Hopefully Kill*, INSIDE HIGHER ED (Apr. 6, 2020), https://www.insidehighered.com/blogs/learning-innovation/3-bad-educational-ideas-covid-19-will-hopefully-kill [https://perma.cc/TV6D-FQ2L]; *Remote Learning, EdTech, & COVID-19*, WORLD BANK (July 15, 2020), https://www.worldbank.org/en/topic/edutech/brief/edtech-covid-19 [https://perma.cc/F366-U5BT].

12. Louis Biscotti, *Food and Beverage Companies Evolve, Innovate and Contribute Amid COVID-19 Crisis*, FORBES (Apr. 17, 2020, 3:46 PM), https://www.forbes.com/sites/louisbiscotti/2020/04/17/food-and-beverage-companies-evolve-innovate-and-contribute-amid-covid-19-crisis/#788b51721cb2 [https://perma.cc/2LER-QRD5].

13. Peter Fretty, *Tale of COVID-19: Crisis Inspiring Innovations*, INDUS. WEEK (Mar. 25, 2020), https://www.industryweek.com/technology-and-iiot/media-gallery/21126839/tale-of-covid19-crisis-inspiring-innovations [https://perma.cc/4WUP-AE4C] (discussing how COVID-19 is forcing manufacturers to be more innovative in pursuing newfound opportunities); Dinsa Sachan, *How Innovators Are Adapting Existing Technologies to Fight COVID-19*, SMITHSONIAN MAG. (Apr. 14, 2020), https://www.smithsonianmag.com/innovation/how-innovators-are-adapting-existing-technologies-fight-covid-19-180974662/ [https://perma.cc/U6YS-VS3A] (discussing some innovators' efforts to repurpose preexisting technologies to address various COVID-19-related needs).

14. *NIH Mobilizes National Innovation Initiative for COVID-19 Diagnostics*, NAT'L INSTS. HEALTH (Apr. 29, 2020), https://www.nih.gov/news-events/news-releases/

Of course, this insight—that crisis often breeds creativity—is nothing new. Some of the most important innovations the world over, including the Internet, GPS, and other digital technologies, came into existence in response to perceived threats to the United States' global position.[15] Faltering companies often respond to adverse conditions by innovating their way out of them.[16] Indeed, dating back to at least Kenneth Arrow, many scholars have argued that adversity in the form of market competition can help promote innovation.[17] And most individuals can probably share some story about how adverse conditions led them to think outside the box and come up with a creative solution to some problem.[18]

But what is equally obvious is that not all adversity has such salutary effects. As one of us has written, long-term poverty can inhibit creative capacities in individuals in ways that rob society of the innovation those individuals may have otherwise contributed.[19] History is also replete with examples of companies and governments faltering in the face of adverse conditions, despite their efforts to innovate their way out of their problems.[20] Indeed, some economists have argued that

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nih-mobilizes-national-innovation-initiative-covid-19-diagnostics [https://perma.cc/6YYJ-JQWT] (discussing a national effort in the United States to mobilize the innovative capacities of government, companies, and individuals to address testing shortfalls).

15. Evan Comen & Grant Suneson, *The Internet and Jeeps Are Among the 15 Commercial Products Invented by the Military*, USA TODAY (Dec. 17, 2019, 7:00 AM), https://www.usatoday.com/story/money/2019/12/17/internet-among-15-commercial-products-invented-by-the-military/40789191/ [https://perma.cc/R9MA-AKVT] (discussing how many consumer products in use today were first developed as part of military research efforts).

16. *See* Bhaskar Chakravorti, *Finding Competitive Advantage in Adversity*, HARV. BUS. REV. (Nov. 2010), https://hbr.org/2010/11/finding-competitive-advantage-in-adversity [https://perma.cc/8JPX-4QM3] (discussing how some entrepreneurs use adversity as a springboard to innovation).

17. *See* Kenneth J. Arrow, *Economic Welfare and the Allocation of Resources for Invention*, *in* THE RATE AND DIRECTION OF INVENTIVE ACTIVITY: ECONOMIC AND SOCIAL FACTORS 609, 619 (Nat'l Bureau of Econ. Rsch. ed., 1962) (discussing why incentives for invention may be greater in a competitive market than one characterized by monopoly).

18. *See generally* Scott Barry Kaufman, *Turning Adversity into Creative Growth*, SCI. AM. (May 6, 2013), https://blogs.scientificamerican.com/beautiful-minds/turning-adversity-into-creative-growth/ [https://perma.cc/WLR9-ED72] (discussing psychological research about how adversity can breed creativity).

19. *See generally* Stephanie Plamondon Bair, *Impoverished IP*, 81 OHIO ST. L.J. 523 (2020).

20. *See, e.g.*, *When Corporate Innovation Goes Bad—The 164 Biggest Product Failures of All Time*, CBINSIGHTS (Oct. 4, 2021), https://www.cbinsights.com/research/corporate-innovation-product-fails/ [https://perma.cc/Y9VZ-CR5L] (discussing some of the most prominent examples of innovation failures in the marketplace); Susan E. Rice, *U.S. Foreign Assistance and Failed States*, BROOKINGS (Nov. 25, 2002), https://www.brookings.edu/research/u-s-foreign-assistance-and-failed-states/ [https://perma.cc/QT7H-JXDJ] (discussing examples of failed states).

adversity in the form of market competition is more likely to stifle than promote innovation.[21] Hence, not all adversity results in innovation. In fact, some forms of adversity may actually make innovation impossible.

Despite these realities, legal scholars have largely failed to distinguish between innovation-promoting and innovation-inhibiting adversity, or to even account for adversity's nuanced role in affecting the pace and direction of innovation when discussing innovation law and policy, including intellectual property (IP) laws. To be sure, legal scholars have argued about the effects of market competition on innovation and how IP laws should take those effects into account.[22] In fact, in important respects, competition's possible effects on innovation are the very foundation of predominant IP law theories.[23] Yet importantly, market competition is just one form of adversity, as we define it below. Furthermore, these accounts fail to grapple with the different characteristics of adversity that help determine adversity's relationship to innovation in any given situation, instead focusing on one form of adversity—competition—in a generic, mostly monochromatic manner.[24]

In this Article, we thus seek to (1) identify the characteristics of adversity most likely to stimulate individuals, companies, and governments to innovate; and (2) assess how adversity's relationship to innovation should affect innovation law and policy. To identify the characteristics of adversity most likely to stimulate innovation, we tap into various literatures to provide a synthesis of what that research tells us about this question. This synthesis leads us to identify what we call the Goldilocks principle: for adversity to have the best chance of stimulating innovation, it should be neither too fleeting nor too enduring, too all-encompassing nor too narrow, too intense nor too mild, too commonly experienced nor too isolated, too severe nor too insignificant, but "just right." This Goldilocks principle can be summed up in the following four main conclusions.

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21. JOSEPH A. SCHUMPETER, CAPITALISM, SOCIALISM, AND DEMOCRACY 100-03 (Harper & Brothers 3d ed. 1962) (articulating the view that monopoly, rather than perfect competition, is more conducive to innovation).

22. For a few prominent examples, see Dan L. Burk & Mark A. Lemley, *Policy Levers in Patent Law*, 89 VA. L. REV. 1575, 1576-77 (2003) (discussing the effects of competition in innovation and how IP laws and the theories behind them seek to address that competition); Mark A. Lemley, *The Economics of Improvement in Intellectual Property Law*, 75 TEX. L. REV. 989, 993 (1997); Mark A. Lemley & David McGowan, *Legal Implications of Network Economic Effects*, 86 CAL. L. REV. 479, 526 (1998) ("Indeed, the principle behind intellectual property law is that competition should be sacrificed to some extent in order to give sufficient incentive for innovation."); David McGowan, *Regulating Competition in the Information Age: Computer Software as an Essential Facility Under the Sherman Act*, 18 HASTINGS COMM. & ENT. L.J. 771, 773-76 (1996) (discussing antitrust and copyright theory as focusing on promoting healthy marketplace competition).

23. *See* Burk & Lemley, *supra* note 22.

24. *Id.*

First, adversity that is a relatively discrete experience, both temporally and spatially, is more likely to result in innovation than adversity that affects parties for longer durations and in more facets of their lives or operations.[25] Long-term, spatially broad adversity is typically less likely to inspire innovation because the ongoing, all-encompassing nature of that adversity inhibits a party's ability to successfully undertake innovative activities.[26] On the other hand, if adverse conditions are too fleeting or narrow, those conditions are also unlikely to inspire successful innovation. Hence, for adversity to lead to innovation, it typically must neither be too much nor too little, but "just right."

Second and relatedly, adversity is more likely to lead to innovation when its intensity is moderate—neither too intense nor too mild.[27] Extreme adversity is often overwhelming—both externally and psychologically—increasing the odds that those experiencing it will give up.[28] In contrast, adversity that is so mild that it fails to present a significant challenge is also unlikely to result in an innovative response.[29]

Third, adversity is more likely to inspire innovation when that adversity is experienced collectively rather than individually.[30] This is not to say that adversity does not frequently catalyze isolated parties into some innovative activity—it does.[31] But research shows that when groups rather than individuals face adverse conditions together, that collective experience can provide conditions optimal for innovation.[32] However, similar to the other categories described above, adversity that severely impacts too many may end up impeding, rather than stimulating, innovation.

Finally, adversity is more likely to spur innovation when failing to overcome that adversity poses severe consequences to large groups of people.[33] This point is related to but distinct from the previous condition. Collective adversity may inspire innovation even when, on the whole, that adversity is not a life-or-death situation, or only poses problems to a relatively discrete group of people. But when adversity

25. *See infra* Section I.B.

26. *Id.*

27. *See infra* Section I.C.

28. *Id.*

29. *Id.*

30. *See infra* Section I.D.

31. Scott Barry Kaufman, *Post-Traumatic Growth: Finding Meaning and Creativity in Adversity*, SCI. AM. (Apr. 20, 2020), https://blogs.scientificamerican.com/beautiful-minds/post-traumatic-growth-finding-meaning-and-creativity-in-adversity/ [https://perma.cc/SVL9-G6RX] (discussing various studies showing that adversity often leads to creativity in individuals).

32. *See infra* Section I.D.

33. *See infra* Section I.D-E.

threatens potentially severe consequences for large groups of people, innovative activity becomes more likely. In line with the Goldilocks principle, however, adversity whose severity is too extreme may often stunt innovative responses.

It bears emphasizing at the outset that these are not the only characteristics of adversity, or factors more generally, that lead to innovation. Nor is it true that each of these conditions need be met for innovation to occur. In Part II, we discuss individual and organizational characteristics that may also affect whether any given party responds to adverse conditions with innovation. Furthermore, while these adverse conditions may inspire innovation, they may not always lead to *socially optimal* paths of innovation. For instance, while the COVID-19 crisis may lead to some innovations that benefit society, some of the innovative efforts that the pandemic inspires may be duplicative, wasteful, or otherwise distract innovative parties with scarce resources from other important areas of development.[34] We discuss these implications in Part III. Nonetheless, based on existing research, the types of adversity that we have identified above appear to be the ones most conducive to, and likely to inspire, innovative activities, all else being equal.

These insights about the role of adversity in affecting the pace and direction of innovation have important implications for IP laws and innovation law and policy more generally. Predominant theories underpinning several bodies of IP law hold that we offer these rights to incentivize parties to undertake socially beneficial activities.[35] Without patent and copyright rights, for instance, parties may often be reluctant to pursue socially beneficial innovation out of fear that others will simply replicate their creations without incurring the same costs.[36] IP rights, the theory goes, provide innovators with a mechanism by which to recoup the costs of developing their creations.[37]

But the role of adversity in spurring innovation in many situations undercuts these theories. Indeed, under the circumstances we have discussed, adversity often motivates parties to pursue innovation; attaching IP rights to those innovations can thus threaten access to them

34. For a discussion of various theories of innovation, including path dependency, see Vernon W. Ruttan, *Induced Innovation, Evolutionary Theory and Path Dependence: Sources of Technical Change*, 107 ECON. J. 1520 (1997). For a discussion about how to reduce wasteful duplication in R&D efforts, see Stephen M. Maurer & Suzanne Scotchmer, *The Independent Invention Defence in Intellectual Property*, 69 ECONOMICA 535 (2002).

35. William Fisher, *Theories of Intellectual Property*, *in* NEW ESSAYS IN THE LEGAL AND POLITICAL THEORY OF PROPERTY 168 (Stephen R. Munzer ed., 2001) (discussing the predominant theories of intellectual property rights).

36. *See* Viva R. Moffat, *Mutant Copyrights and Backdoor Patents: The Problem of Overlapping Intellectual Property Protection*, 19 BERKELEY TECH. L.J. 1473, 1483-88 (2004) (discussing the predominant theories behind copyright and patents as utilitarian).

37. Samantha Shoell, *Why Can't the Poor Access Lifesaving Medicines? An Exploration of Solving the Patent Issue*, 4 MINN. INTELL. PROP. REV. 151, 155-56 (2002) (summarizing this rationale).

while in some cases being unnecessary for their development. Of course, innovators may still need some method of recouping their costs of innovation, and in Part III we discuss alternative mechanisms for enabling them to do so, and why these alternatives may be preferable to IP rights in many instances of innovation-promoting adversity.

Finally, we note that because adverse conditions outside the parameters described above are less likely to inspire innovative solutions, in some cases it may be necessary to both relax and bolster certain types of IP rights, as well as other types of incentives, to motivate development of those missing solutions. For instance, because some adverse conditions only affect small groups of dispersed persons, innovative solutions in such circumstances are less likely to emerge. Other incentives may therefore be necessary. On the other hand, because innovation-promoting adversity may at times concentrate much of society's innovative capacity on particular innovative paths, we may need to adjust innovation policy more generally to guard against technological path dependencies that leave other societal needs neglected.

In Part I, we first discuss the types of adversity most likely to stimulate innovation and distinguish these types from those that may harm innovative capacity. Part II then examines individual and organizational characteristics that may also affect whether a party responds to adversity with innovation. Part III concludes by examining predominant theories of IP laws. We argue that these accounts fail to recognize the role of adversity in affecting the pace and direction of innovation. We then assess how scholars and policymakers might better account for that role, both in IP doctrines and innovation policy more generally.

I. ADVERSITY'S RELATIONSHIP TO INNOVATION

In this Part, we draw from literatures in psychology, sociology, organizational behavior, and neuroscience to explore the relationship between adversity and innovation. In doing so, we identify the circumstances and features of adversity most conducive to, and therefore most likely to give rise to, innovation. We contrast these categories of innovation-promoting adversity with the types of adversity most likely to quell innovative efforts. Overall, this analysis leads us to identify a Goldilocks principle undergirding adversity's relationship to innovation: middling adversity in terms of spatial and temporal discreteness, intensity, pervasiveness, and severity has the best chance of stimulating innovation.

However, we wish to reemphasize at the outset that the purpose of this analysis is to identify patterns and probabilities only. In other words, an individual or organization that experiences innovation-inhibiting adversity may still go on to innovate, despite the odds.

Conversely, innovation-promoting adversity is no guarantee that innovation will, in fact, occur. In addition to the features of adversity itself, individual and organizational characteristics play an important role in dictating how an individual or entity will respond to that adversity. In Part II, we discuss some of these characteristics and how they may interact with particular flavors of adversity to produce or inhibit innovation in any given instance.

A. What Is Adversity, What Is Innovation, and What Is the Relationship Between the Two?

The literatures we draw from in this Part define adversity in a number of ways. In order to accommodate these definitions and explore the varying features of adversity that may promote or inhibit innovation, we define adversity broadly as any circumstance that poses a challenge to individuals, firms, or governments in pursuing their objectives. Adversity thus ranges from life-threatening circumstances to fairly minor hindrances, so long as those circumstances stand in the way of some party pursuing their desired outcomes. At the individual level, adversity could include illness, accident, assault, or financial or interpersonal challenges.[38] At the organizational level, adversity might be experienced in the form of regulatory obstacles;[39] money, time, and human resource challenges;[40] or unfavorable market or technological conditions.[41] A particular instance of adversity could also be experienced at both the individual and organizational level simultaneously, such as in situations like the current COVID-19 pandemic, or with natural or economic disasters.[42] On an individual level, adversity is often associated with the subjective experience of pain, unpleasantness, or distress.[43]

Innovation is also a term fraught with complexities. Researchers have conducted entire studies about the term without being able to identify a consensus or an authoritative source on what the term

38. *See, e.g.,* Kaufman, *supra* note 31.

39. Shaker A. Zahra & Donald O. Neubaum, *Environmental Adversity and the Entrepreneurial Activities of New Ventures*, 3 J. DEV. ENTREPRENEURSHIP 123, 124 (1998).

40. Stav Rosenzweig & Amir Grinstein, *How Resource Challenges Can Improve Firm Innovation Performance: Identifying Coping Strategies*, 25 CREATIVITY & INNOVATION MGMT. 110, 112 (2016).

41. Zahra & Neubaum, *supra* note 39, at 124.

42. *See, e.g.*, Kaufman, *supra* note 31 (listing "disaster" as an adverse life event that has the potential to give rise to creative growth).

43. *See, e.g.*, Brock Bastian et al., *Shared Adversity Increases Team Creativity Through Fostering Supportive Interaction*, 9 FRONTIERS PSYCHOL. 2309, 2311 (2018) (citing to a literature discussing the relationship between adverse experience and pain and other subjective negative responses). *But see* Bertram J. Cohler, *Adversity, Resilience, and the Study of Lives*, *in* THE INVULNERABLE CHILD 363, 364 (Elwyn James Anthony & Bertram J. Cohler eds., 1987) (cautioning that "too often it is assumed that circumstances such as poverty or family disorganization must inevitably lead to increased suffering and turmoil" and calling for more research on the topic).

means.[44] For our purposes, we adopt a broad definition of innovation to mean the development and use of new or creative ideas, products, or processes.[45] We adopt this broad definition because we are primarily interested in discerning the relationship between adverse conditions and how they may motivate (or demotivate) parties to action. This broad definition thus allows us to consider a variety of responses to adversity, including the development, deployment, and diffusion of new ideas.[46]

Innovation is a concept distinct from, but related to, creativity. While creativity is generally thought of as a characteristic people exhibit to greater or lesser degrees based on their circumstances and individual capacities, innovation is understood as the process by which creative ideas are converted into new products and services in the marketplace.[47] But because innovation relies on creativity as the raw material for its workings, many scholars believe that innovation generally requires some level of creativity.

A growing body of work has come to recognize that adversity can be a catalyst for creativity.[48] Adversity often presents a new challenge that calls for novel and creative responses.[49] These creative responses may be marshalled as a means of solving and overcoming the challenge,[50] or simply as a way to cope with the subjectively unpleasant

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44. *See, e.g.*, Anahita Baregheh et al., *Towards a Multidisciplinary Definition of Innovation*, 47 MGMT. DECISION 1323, 1324 (2009) ("Whilst there is some overlap between the various definitions of innovation, overall the number and diversity of definitions leads to a situation in which there is no clear and authoritative definition of innovation.").

45. Richard B. Stewart, *Regulation, Innovation, and Administrative Law: A Conceptual Framework*, 69 CAL. L. REV. 1256, 1261 (1981) (defining "innovation" to include the "development and adoption of new products and processes").

46. Timothy F. Malloy, *Regulating by Incentives: Myths, Models, and Micromarkets*, 80 TEX. L. REV. 531, 540 n.22 (2002) (indicating that many commentators distinguish innovation from "invention" and other types of innovative activities).

47. Akbar Fadaee & Haitham Obaid Abd Alzahrh, *Explaining the Relationship Between Creativity, Innovation and Entrepreneurship*, 3 INT'L J. ECON., MGMT. & SOC. SCI. 1, 1 (2014).

48. *See, e.g.*, Mark A. Runco, *Tension, Adaptability, and Creativity*, *in* AFFECT, CREATIVE EXPERIENCE, AND PSYCHOLOGICAL ADJUSTMENT 165, 166-67 (Sandra W. Russ ed., 1999) (reviewing the literature exploring the relationship between "tension" (or adversity) and creativity); Chakravorti, *supra* note 16 (citing the "[c]onsiderable evidence show[ing] that periods of extreme adversity foster innovation and the building of companies," including the fact that "18 of the 30 firms currently on the Dow Jones Industrial Index were founded during economic downturns"); Rosenzweig & Grinstein, *supra* note 40, at 110 ("A growing, multidisciplinary body of research has recently emerged to support the notion that challenges, in the form of adversities and constraints, may be highly beneficial to individuals, teams and firms . . . [by] positively influenc[ing] innovation and innovation-related performance . . . .").

49. *See, e.g.*, Zahra & Neubaum, *supra* note 39, at 123 (citing to a literature explaining how "adverse environmental conditions can compel new ventures to innovate, take risks, and become entrepreneurial").

50. *See id.*; *see also* Glenda Claire Jones, An Exploration of Experiences and Expression of Artistic Creativity During Adversity and Resilient Recovery iii (May 2013) (Ph.D. dissertation, Saybrook University) (ProQuest) (finding via a series of case studies analyzing the

feelings adversity often triggers.[51] Adversity experienced at the individual level also commonly gives rise to what is known in the psychology literature as "posttraumatic growth," wherein a person experiences positive psychological change following a period of trial.[52] The manifestations of this change can include increased appreciation of life, better interpersonal relationships, more well-defined priorities, an increased subjective experience of strength,[53] and as researchers have discovered, self-reported increases in the magnitude and breadth of one's creative capacities.[54]

Furthermore, innovation scholars have long recognized that market competition, a form of adversity under our definition, can play an important role in spurring firms to innovate.[55] For instance, some scholars have argued that because market competition plays such a vital role in triggering innovation, IP rights are less needed, at least in some industries, than some imagine.[56] Indeed, by seeking to encourage innovation-promoting market competition over innovation-inhibiting market concentration, our country's antitrust laws are based in part on the premise that market competition is important for spurring innovation.[57]

However, we also know that not all adversity gives rise to creativity and innovation. Some forms of adversity, such as prolonged impoverishment experienced in childhood, may lead to psychological and neurodevelopmental changes that make creativity harder to come by.[58]

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relationship between adversity and creativity that "using one's creativity was . . . vital for overcoming adversity").

51. *See, e.g.*, Jones, *supra* note 50, at 10, 14 (citing to a literature detailing how "creativity . . . acts as a coping mechanism" in adverse circumstances and "facilitates the ability to better cope with life's challenges"); Runco, *supra* note 48, at 167 (describing how "creative efforts are often motivated by the need to cope with . . . various forms of tension").

52. *See, e.g.*, Richard Tedeschi & Lawrence G. Calhoun, *Posttraumatic Growth: Conceptual Foundations and Empirical Evidence*, 15 PSYCH. INQUIRY 1, 1 (2004).

53. *Id.*

54. Marie J.C. Forgeard, *Perceiving Benefits After Adversity: The Relationship Between Self-Reported Posttraumatic Growth and Creativity*, 7 PSYCH. AESTHETICS, CREATIVITY, & ARTS 245, 245 (2013); *see also* Kaufman, *supra* note 18 (discussing Forgeard's findings).

55. *See* Arrow, *supra* note 17 (discussing why incentives for invention may be greater in a competitive market than one characterized by monopoly). For a review of some of the economic evidence supporting the argument that competition is a better promoter of innovation than monopoly, see Mark A. Lemley, *Property, Intellectual Property, and Free Riding*, 83 TEX. L. REV. 1031 (2005). For the classic view that monopoly, rather than competition, is more conducive to innovation, see SCHUMPETER, *supra* note 21, at 100-03. *See also* Christopher S. Yoo, *Copyright and Product Differentiation*, 79 N.Y.U. L. REV. 212, 226-31 (2004) (arguing that strong property rights in information do not undercut competition but may instead increase it).

56. Mark A. Lemley, *Industry-Specific Antitrust Policy for Innovation*, 2011 COLUM. BUS. L. REV. 637 (2011).

57. Lemley, *supra* note 55, at 1048 ("[A]ntitrust law is devoted to preserving consumer surplus by favoring competition over monopoly . . . .").

58. Bair, *supra* note 19.

Nor, as some research shows, are all forms of market competition conducive to innovation.[59] In fact, some prominent theorists have argued that monopoly, not competition, is the key to innovation.[60] What, then, are the features of adversity that promote innovation?

As we explore in the following sections, adversity that is too fleeting or minor is unlikely to inspire innovation. But adversity that is too overwhelming, either temporally, spatially, or both, is also poorly suited to provoke innovative responses from individuals, firms, and governments. Furthermore, adversity impacting only a few parties may often fail to inspire innovation. But if adverse conditions are too commonly shared or too dire, that may also prove to be a hindrance to innovation in many situations. Overall, for adversity to have the best chance of inspiring innovation, the amount of adversity that individuals, firms, and governments experience must be somewhere in between these various extremes, or "just right."

The basic reasoning underlying this Goldilocks characteristic of innovation-promoting adversity is straightforward: adversity must be significant enough that it inspires change, creative thinking, and growth.[61] Yet if it is too significant, it will likely overwhelm the individual or entity's resources and capacity to deal with it in productive and meaningful ways.[62] We explore this theme, and how it may play out in specific instances of adversity, in more detail below.

B. Adversity Discreteness

As a threshold matter, for adversity to have a better chance of inspiring innovation, it must typically be a relatively discrete experience, in both time and "space" (i.e., a particular life or organizational domain). Adversity lacking these characteristics simply does not lend itself well to innovative activities.

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59. *See, e.g.*, Jianmin Tang, *Competition and Innovation Behaviour*, 35 RSCH. POL'Y 68 (2006) (discussing the "complex relationship between innovation and competition" and indicating that the relationship can be "positive or negative"); *see also* Carl Shapiro, *Competition and Innovation: Did Arrow Hit the Bull's Eye?*, *in* THE RATE AND DIRECTION OF INVENTIVE ACTIVITY REVISITED 361 (Josh Lerner & Scott Stern eds., 2012) (discussing some of the literature and debates surrounding the question of whether competition or monopoly is better for innovation).

60. SCHUMPETER, *supra* note 21.

61. *See, e.g.*, Forgeard, *supra* note 54, at 245 (finding that the psychological phenomenon of "posttraumatic growth" that often follows an adverse life event also gives rise to increased self-reports of creative growth); Kaufman, *supra* note 18 (discussing Forgeard's findings).

62. *See, e.g.*, Jones, *supra* note 50, at 291-93 (discussing how study participants considered the availability of resources including time, space, and emotional and financial support to be essential contributors to their creativity in the midst of adversity).

1. Spatial Discreteness

First, consider adversity that is spatially discrete, in the sense that it arises in one or a few life or organizational domains. Spatially discrete adversity could be experienced on the individual level as a health, financial, or professional challenge; on the organizational level, an instance of spatially discrete adversity might include a particular technological or market obstacle. The limited nature of such challenges lends itself to innovation better than adversity lacking such limits for the simple reason that parties experiencing a spatially discrete challenge maintain the resources necessary to engage in creative endeavors. Creativity requires time,[63] motivation,[64] and cognitive energy.[65] It flourishes when individuals engaging in creative pursuits are supported on a number of levels,[66] including in their interpersonal relationships[67] and in their ability to balance creative work with personal time.[68] If every facet of a person's life is overrun with adversity, that person is less likely to experience this support and have the resources

63. *See, e.g.*, David M. Harrington, *Conditions and Settings/Environment*, *in* 1 ENCYCLOPEDIA OF CREATIVITY 323, 333 (Mark A. Runco & Steven R. Pritzker eds., 1999) ("For many creative people, time is the most precious of all resources, without which creative work is simply impossible.").

64. *See, e.g.*, Cindy P. Zapata-Phelan et al., *Procedural Justice, Interactional Justice, and Task Performance: The Mediating Role of Intrinsic Motivation*, 108 ORG. BEHAV. & DECISION PROCESSES 93 (2009) (discussing how motivation contributes to creative thought and action); Teresa M. Amabile, *The Motivation to be Creative*, *in* FRONTIERS OF CREATIVITY RESEARCH: BEYOND THE BASICS 223 (Scott G. Isaksen ed., 1987).

65. *See, e.g.,* Anandi Mani et al., *Poverty Impedes Cognitive Function*, 341 SCI. 976, 977 (2013) (finding that the cognitive load imposed by poverty reduces the ability of subjects to engage in cognitive tasks commonly associated with creativity, including the Raven's Progressive Matrices test, designed to measure " 'fluid intelligence,' the capacity to think logically and solve problems in novel situations, independent of acquired knowledge").

66. *See, e.g.*, Jones, *supra* note 50, at 291-93 (discussing how study participants considered the availability of resources including time, space, and emotional and financial support to be essential contributors to their creativity in the midst of adversity).

67. *See, e.g.*, Bastian et al., *supra* note 43, at 6 (finding that supportive team interactions promote creativity); Teresa M. Amabile et al., *Assessing the Work Environment for Creativity*, 39 ACAD. MGMT. J. 1154, 1160-61 (1996) (discussing how work group encouragement leads to more creative outcomes); Maryléne Gagné & Edward L. Deci, *Self-Determination Theory and Work Motivation*, 26 J. ORG. BEHAV. 331, 345 (2005) (citing numerous studies finding that feelings of relatedness to others are associated with greater work performance, satisfaction, and persistence); Paul P. Baard et al., *Intrinsic Need Satisfaction: A Motivational Basis of Performance and Well-Being in Two Work Settings*, 34 J. APPLIED SOC. PSYCH. 2045, 2062 (2004) (finding that feelings of relatedness at work were strongly predictive of work performance).

68. Kimberly D. Elsbach & Andrew B. Hargadon, *Enhancing Creativity Through "Mindless" Work: A Framework of Workday Design*, 17 ORG. SCI. 470, 471-72 (2006) (citing to studies finding that work environments with "chronically high-workload pressures" lead to reduced creative output); Robert Rosenthal Kwall, *Remember the Sabbath Day and Enhance Your Creativity!*, 10 ST. THOMAS L.J. 820, 821 (2013) (reviewing social science literature suggesting that a "break period," such as a day of rest, can be beneficial for creativity).

necessary to engage in innovative activity. The all-encompassing nature of their adverse conditions inhibits a person's ability to effectively carve out the time and motivation to pursue innovation.[69]

In contrast, those facing more discrete adverse conditions have a greater ability to respond to the adversity with creativity. When an individual faces a challenge in only one or a few areas of her life, the spatial discreteness of that challenge may mean that other parts of that individual's life remain unaffected. If those other parts of her life include resources conducive to creativity, then a potentially ideal situation for creative thinking arises: the adversity pushes the individual to think of creative solutions and coping mechanisms,[70] and the relative stability of the other parts of her life helps ensure that this creative impulse can flourish. The discreteness of the individual's challenge helps her retain the capacity to think creatively and tackle the challenges she faces by innovating.

Suppose, for instance, that an individual faces a challenging assignment at work, but otherwise her life conditions are stable. Her relationship with her significant other is a happy one, she has many supportive friends, and her finances are, overall, in good shape. Because creativity flourishes when individuals experience interpersonal

69. Recent research on the effect of "cognitive loads" on decisionmaking provides a good illustration of this principle. Poverty is an example of adversity that invades multiple domains of a person's life beyond the financial—from healthcare, to parenting, to professional pursuits. *See* Mani et al., *supra* note 65, at 976 ("The poor use less preventive health care, fail to adhere to drug regimens, are tardier and less likely to keep appointments, are less productive workers, less attentive parents, and worse managers of their finances."). Cognitive scientists have found that the pervasive adversity triggered by poverty imposes a heavy cognitive load on those experiencing it; the result is a disproportionate dedication of scarce attentional resources to dealing with immediate needs, *see* Eldar Shafir, *Decisions in Poverty Contexts*, 18 CURRENT OP. PSYCH. 131, 132 (2017), leaving fewer mental resources for engaging in other cognitive tasks like spatial processing and creative problem solving. *See* Mani et al., *supra* note 65, at 977 (describing the tests researchers used to measure cognitive functioning). Put another way, a person experiencing poverty is often engaged in an all-encompassing struggle to meet basic needs, leaving little ability in their life to think creatively. The adversity they face as a result of poverty consumes almost every facet of their life, stripping them of the cognitive and physical resources that facilitate creative thinking. Psychological research on "choice overload" may also be relevant here. Some evidence suggests that when individuals are faced with an overwhelming number of choices, they have more difficulty choosing. Benjamin M. Marx & Lesley J. Turner, *Student Loan Choice Overload* (Nat'l Bureau of Econ. Rsch., Working Paper No. 25905, 2019). Although it's not clear to what extent the phenomenon of choice overload might generalize to creative decisionmaking during adversity. *See* Jesse Marczyk, *Is Choice Overload a Real Thing?*, PSYCH. TODAY (Feb. 5, 2016), https://www.psychologytoday.com/us/blog/pop-psych/201602/is-choice-overload-real-thing [https://perma.cc/NYD9-K9KE] (examining the research on choice overload and cautioning that the effects "might be limited to particular contexts, assuming they reliably exist in the first place"). One could hypothesize that similar psychological forces may be at play when an individual is simultaneously experiencing challenges in multiple domains.

70. *See* Zahra & Neubaum, *supra* note 39, at 123 ("[A]dverse environmental conditions can compel new ventures to innovate, take risks, and become entrepreneurial . . . ."); Jones, *supra* note 50, at iii (finding via a series of case studies analyzing the relationship between adversity and creativity that "using one's creativity was . . . vital for overcoming adversity").

support and have the time,[71] motivation,[72] and financial and cognitive[73] resources to create, the relative stability provides this person with a better chance of innovating around the adversity at work. Of course, it is no guarantee. Even a discrete obstacle at work, home, or elsewhere may overwhelm a person in such a way that innovation is out of the question—which is why, as we discuss below, adversity intensity also matters.[74] The point here is not that all parties facing discrete adverse conditions ultimately respond with innovation. Instead, it is simply that spatially discrete adversity is more likely to be conducive to and inspire innovation than adversity lacking such limits.

Indeed, taking the same example, if the individual facing adversity at work is also experiencing a broken marriage as well as financial hardship, with few, if any, supportive friendships, her chances of responding to the work adversity with creativity decrease. The all-encompassing nature of her trials simply sucks up the cognitive and emotional space in her life where she might otherwise innovate.

These insights are relevant to organizations as well. Firms, like individuals, need internal and external support to innovate effectively.[75] A company beset with problems in every facet of its operations is less likely to have, or be in a position to take advantage of, this support; the company's problems may be so pervasive that all of its resources are necessarily devoted to simply staying afloat and maintaining day-to-day operations, rather than engaging in innovation.[76] A company experiencing a spatially discrete challenge, on the other hand, faces better odds of innovating through the challenge, simply because it maintains the capacity to do so.[77] Again, this is not a hard-and-fast rule; companies beset with numerous problems can and do rise above their adverse conditions (as do individuals), while organizations (and individuals) facing more moderate problems at times succumb to them. But on the whole, a party facing spatially discrete adversity is more capable of innovating in response to that adversity than a party facing obstacles at every level of operation.[78]

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71. *See, e.g.*, Kaufman, *supra* note 18.

72. *See* Bair, *supra* note 19.

73. *See* Mani et al., *supra* note 65, at 977 (finding that the cognitive load imposed by poverty reduces the ability of subjects to engage in cognitive tasks commonly associated with creativity).

74. *See infra* Section I.C.

75. *See, e.g.*, Rosenzweig & Grinstein, *supra* note 40, at 115-17 (discussing how internal and external "coping assets" contribute to a firm's ability to innovate through adversity, and stating that firms "need financial, time and human resources to conduct [innovative] activities").

76. *See id*. at 114.

77. *See id*. at 115-16.

78. *See id*. at 114 ("[E]xtreme challenges with multiple constraints tend to stifle the individual's ability to increase innovativeness.").

Of course, adversity that is *too* spatially discrete, in the sense that it affects a very minor domain of an individual's life or a company's operations, may fail to inspire innovation at all, simply because it does not provide a motivating need. On the individual level, for example, a minor relationship challenge may do little to inspire creativity because the person undergoing it may not consider the problem significant enough to merit a thoughtful and innovative solution;[79] nor does he experience the subjective discomfort that may trigger creative pursuit as a coping mechanism.[80] Similarly, on the organizational level, a firm facing a minor glitch in its operations may see no real reason to innovate in response to the glitch, as it does not appear to hamper the firm's ability to operate effectively. To be most conducive to creativity, then, adversity should be spatially discrete, but not so discrete that it fails to register as a challenge worthy of creative response.

2. Temporal Discreteness

Second, adversity that is discrete in time is also more likely to be conducive to innovation than long-term adversity. Indeed, adversity that drags on over long periods of time, with no end in sight, may frequently dampen or extinguish the motivation of those experiencing it to innovate around the problem.

In a series of cases studies, for example, Glenda Jones examined how periods of prolonged adversity impacted the motivation of subjects engaged in creative pursuits.[81] Subjects uniformly reported that they were less productive in their creative work during prolonged adversity.[82] One subject reported that he "lost [his] momentum" and "his forward motion" and felt that his "creative drive" had plummeted.[83] Another stated that the prolonged adversity "took . . . hope and inspiration away."[84] Subjects experiencing prolonged adversity worried that "their creativity might be lost forever."[85]

There are various reasons why prolonged adversity may sap creative motivation. On the most basic and intuitive level, prolonged adversity might do so simply because the challenge's seeming

79. *See, e.g.*, Zahra & Neubaum, *supra* note 39, at 123 ("[A]dverse environmental conditions can compel new ventures to innovate, take risks, and become entrepreneurial . . . .").

80. *See, e.g.*, Jones, *supra* note 50, at 10, 14 (discussing literature that notes how creativity "acts as a coping mechanism" and "facilitates the ability to better cope with life's challenges"); Runco, *supra* note 48, at 167 ("[C]reative efforts are often motivated by the need to cope with . . . various forms of tension . . . .").

81. Jones, *supra* note 50, at 301.

82. *Id.* at 303.

83. *Id.*

84. *Id.* at 301.

85. *Id.* at 303.

endlessness may prove to be overwhelming.[86] If a party cannot "see light at the end of the tunnel" because of an obstacle's long-term nature, he may simply give up the chase.

Another possibility is that prolonged adversity is more likely to impact the resources and support systems necessary for creative endeavor. In Jones's study, for example, subjects reported that periods of prolonged adversity coincided with a concurrent reduction in some of these very resources.[87] In particular, subjects undergoing long periods of adversity also reported concurrently experiencing lower interpersonal support,[88] higher financial instability,[89] and a lack of time and space[90] in which to be creative. They also reported that these impacts directly affected their ability to be creative.[91]

The same insights are relevant for organizations. The longer adversity drags on within an organization, the greater the chances that the organization will deplete the resources and support structures necessary for innovating out of their challenge.[92] Money might run out and frustrated employees may leave, making it increasingly difficult for an organization to deal with the adversity in an innovative way.[93] In fact, we have recently seen some of this at play with Uber, the ride-hailing giant that cannot seem to stay out of its own way, contributing to employee exoduses and a dampening of the company's innovation

86. *See, e.g.*, Anneli Marttila et al., *Keep Going in Adversity—Using a Resilience Perspective to Understand the Narratives of Long-Term Social Assistance Recipients in Sweden*, 12 INT'L J. EQUITY HEALTH 1, 1 (2013) (studying long-term recipients of social welfare and finding that "[e]xperiences of cumulative adversity" made it more difficult for the recipients to find a way out of hardship).

87. Jones, *supra* note 50, at 302.

88. *Id.* at 302.

89. *Id.* at 301.

90. *Id.* at 302.

91. *See, e.g.*, *id.* at 301 (quoting a subject as saying that there was "no money or time for my creative thinking" during her period of prolonged adversity); *id.* at 302 (quoting a subject as saying that because of his prolonged adversity, he "didn't have time for being creative").

92. *See, e.g.*, Stevan E. Hobfoll et al., *Conservation of Resources in the Organizational Context: The Reality of Resources and Their Consequences*, 5 ANNU. REV. ORGAN. PSYCH. ORGAN. BEHAV. 103 (2018) (discussing conservation of resources theory, which posits that individuals and organizations are affected more by resource loss than resource gain, and that those that lose resources are more vulnerable to resource loss and less capable of resource gain, often resulting in resource loss cycles and increasing organizational stress over time).

93. *See* Rosenzweig & Grinstein, *supra* note 40, at 117 (citation omitted) ("When a team faces a severe resource challenge of funding, time or workers, coping with such a situation is exceptionally difficult.").

ambitions.[94] Hence, as with individuals, long-standing adversity, with no clear end in sight, may also sap an organization's collective motivation and ability to pursue innovative solutions to its problems.[95]

On the individual level, the concept of toxic stress may also help explain why prolonged adversity is not ideal for promoting creative endeavors. A prolonged stress response leads to a number of potentially detrimental biological[96] and cognitive[97] impacts. Most relevant here is the fact that chronic stress leads to impaired decisionmaking[98] that may interfere with creativity.[99] In particular, the biological stress response may lead to an overreliance on decisionmaking strategies that privilege sticking with tried-and-true methods over exploring new

94. *See, e.g.*, Julia Carrie Wong, *Disgruntled Drivers and 'Cultural Challenges': Uber Admits to Its Biggest Risk Factors*, GUARDIAN (Apr. 12, 2019, 5:10 PM), https://www.theguardian.com/technology/2019/apr/11/uber-ipo-risk-factors [https://perma.cc/J9VD-BECD] (discussing some of Uber's persistent problems); Lizette Chapman, *Uber's Job Cuts, Office Closures Reflect Narrower Ambitions*, BLOOMBERG (May 18, 2020, 9:34 PM), https://www.bloomberg.com/news/articles/2020-05-18/uber-s-job-cuts-office-closures-reflect-narrower-ambitions [https://perma.cc/U7KY-U4BE] (discussing Uber's narrowing ambitions in light of a number of challenges it has experienced).

95. Trenton A. Williams et al., *Organizational Response to Adversity: Fusing Crisis Management and Resilience Research Streams*, 11 ACAD. MGMT. ANNALS 733, 747 (2016) (discussing how organizations are better able to respond to crises when they have some sense as to their duration because they are better able to maintain positive functioning under such conditions).

96. *See, e.g.*, Georgina Russell & Stafford Lightman, *The Human Stress Response*, 15 NATURE REV. ENDOCRINOLOGY 525, 525 (2019) ("[C]hronic exposure to stress . . . can lead to a broad range of problems including the metabolic syndrome, obesity, cancer, mental health disorders, cardiovascular disease and increased susceptibility to infections.").

97. *See, e.g.*, Bruce S. McEwen, *Central Effects of Stress Hormones in Health and Disease: Understanding the Protective and Damaging Effects of Stress and Stress Mediators*, 583 EUR. J. PHARMACOL. 174 (2008); Christopher Bergland, *How Do Various Cortisol Levels Impact Cognitive Functioning?*, PSYCH. TODAY (Jun. 17, 2015), https://www.psychologytoday.com/us/blog/the-athletes-way/201506/how-do-various-cortisol-levels-impact-cognitive-functioning [https://perma.cc/PS4N-AFCR] (reporting on a study finding that very high and very low levels of cortisol result from unstable family environments and lead to impaired cognitive functioning).

98. *See, e.g.*, J.M. Soares et al., *Stress-Induced Changes in Human Decision-Making Are Reversible*, 2 TRANSLATIONAL PSYCHIATRY 131, 131 ("[W]hen [biological stress response systems] are disrupted . . . by a continuous activation, maladaptive responses take place and predispose to cognitive impairment and even to pathological conditions."); Martha J. Farah et al., *Childhood Poverty: Specific Associations with Neurocognitive Development*, 1110 BRAIN RSCH. 166, 168-70 (2006) (finding that poverty leads to impaired neurocognitive development and hypothesizing that a prolonged stress response to impoverished conditions plays a mediating role); Clancy Blair et al., *Salivary Cortisol Mediates Effects of Poverty and Parenting on Executive Functions in Early Childhood*, 82 CHILD DEV. 1970 (2011) (finding that chronic stress resulting from poverty leads to impaired executive functioning in children); Hannah Potts, *A Brain-Changer: How Stress Redesigns Our Decision-Making*, DECISION LAB, https://thedecisionlab.com/insights/health/stress-redesigns-decision-making/ [https://perma.cc/MGB6-E47Z] (last visited July 20, 2022).

99. *See* Bair, *supra* note 19, at 539-44 (discussing how chronic stress experienced as a result of poverty leads to the privileging of exploitative (or familiar) over explorative decisionmaking strategies and habit-based over goal-based decisionmaking strategies and explaining how this relates to creative thinking).

solutions.[100] Long-term adversity thus also stacks the odds against successful innovation because it directly affects the brain, resulting in cognitive changes that inhibit creative ways of thinking.

Organizations, of course, do not have a biology of their own, despite frequent discussions of organizational "DNA."[101] But extreme, chronic stress within an organization can lead to similar dynamics by making it more likely that the organization will respond to its adverse conditions with rigidity rather than agility.[102] And failure to respond to problems with flexibility often compounds the very issues afflicting an organization, resulting in a vicious cycle of adversity from which many organizations have difficulty ever recovering.[103]

Of course, some parties may persist in spite of the seeming insurmountable odds; history includes many anecdotes of innovators eventually succeeding despite the long-term, seemingly insurmountable difficulties they face.[104] These are inspiring stories, but they are likely the exception, not the rule. Indeed, history almost certainly includes even more untold stories[105] of those who simply gave up in the face of long-term adverse conditions. In short, long-term adversity tends to inhibit innovation by making it more difficult for parties to muster the necessary motivation and capacity to innovate out of their problems.

Temporally discrete adverse conditions, on the other hand, are more likely to be conducive to and inspire innovative activities. The reasons for this mirror the reasons why long-term adversity has the opposite effects. First, while long-lasting adversity tends to sap motivation, adversity perceived as a temporary roadblock is more likely to

100. *See, e.g.*, Madeline B. Harms, *Stress and Exploitative Decision-Making*, 37 J. NEUROSCI. 10035, 10035 (2017) (finding that stress biases subjects towards exploitative decisionmaking strategies, where the subject exploits familiar options, over explorative decisionmaking strategies, where the subject explores new options about which he has less information); Soares et al., *supra* note 98 (finding that prolonged stress biases subjects towards habits over goal-based decisionmaking strategies); Bair, *supra* note 19, at 539-44 (discussing some of the research); Potts, *supra* note 98.

101. *See, e.g.*, Mark Bonchek, *How to Discover Your Company's DNA*, HARV. BUS. REV. (Dec. 12, 2016), https://hbr.org/2016/12/how-to-discover-your-companys-dna [https://perma.cc/6XKL-7LHH] (discussing a company's DNA as its overall culture and strategy).

102. *See, e.g.*, Williams et al., *supra* note 95, at 747 (discussing research exploring this dynamic).

103. *Id.*

104. *See, e.g.*, Joshua Spodek, *12 Incredibly Successful People Who Overcame Adversity*, INC. (May 20, 2016), https://www.inc.com/joshua-spodek/12-incredible-people-who-succeeded-despite-adversity.html [https://perma.cc/3TPN-PNEG] (listing individuals who experienced long-term adversity and yet succeeded in creative endeavors).

105. *See, e.g.*, Bair, *supra* note 19, at 544-45 (explaining how the frequent telling of "underdog" and "rags to riches" stories of creative success in the face of poverty and other adverse conditions might trigger the public's availability heuristic, leading them to believe that these stories are much more common than they actually are).

motivate affected parties to pursue creative solutions.[106] The COVID-19 pandemic, for instance, has inspired unprecedented levels of biomedical research aimed at finding a pharmacological solution to the problem.[107] It seems unlikely that so many parties would be pursuing that research if those parties did not believe that COVID-19 was a transitory problem with a viable solution.[108]

Second, the prospect of shortening or fixing a challenge may also give the party undergoing the challenge a sense of control over the situation, a mental state well-known to enhance creative motivation.[109] Of course, to the extent that those initially discrete conditions morph into enduring ones, then a party's sense of control and motivation to tackle the problem may ultimately wane. But the adversity's initial potential discreteness may often lead to successful innovation before that adversity becomes entrenched.

Third, temporally discrete adversity also provides a potential innovator with greater opportunity to think creatively because it is more likely that he will possess and retain the resources necessary for creativity to flourish. While prolonged adversity can take a heavy toll on creativity-supporting assets like finances,[110] personal time,[111] and interpersonal relationships,[112] a temporally discrete challenge (assuming

106. In reality, parties may perceive most adverse conditions as temporally discrete, at least initially, because of optimism bias. *See* Tali Sharot, *The Optimism Bias*, 21 CURRENT BIOLOGY R941 (2011).

107. *See, e.g.*, *Clinical Trials for COVID-19 Treatments or Vaccines Reaching Unprecedented Levels*, PRNEWSWIRE (Apr. 21, 2020), https://www.prnewswire.com/news-releases/clinical-trials-for-covid-19-treatments-or-vaccines-reaching-unprecedented-levels-301043905.html [https://perma.cc/B244-VSHB] ("[A]s of April 6 [2020], more than 200 clinical trials of COVID-19 treatments or vaccines [we]re either ongoing or recruiting patients . . . [with] [n]ew ones . . . being added every day.").

108. *See, e.g.*, Carl Zimmer et al., *New Entry in the Race for a Coronavirus Vaccine: Hope*, N.Y. TIMES (July 1, 2020), https://www.nytimes.com/2020/05/20/health/coronavirus-vaccines.html [https://perma.cc/WGM3-BMQH] (discussing increasing optimism that a successful vaccine for COVID-19 will be developed in record time).

109. When we speak of "control," we are referring to the concept of autonomy, which is the ability to choose one's own goals and actions. Kennon M. Sheldon et al., *What Makes for a Good Day? Competence and Autonomy in the Day and in the Person*, 22 PERSONALITY & SOC. PSYCH. BULL. 1270, 1271 (1996). The creativity literature has long recognized that a sense of autonomy enhances intrinsic motivation, which gives rise to objectively more creative thinking and better performance outcomes. *See., e.g.*, Richard M. Ryan & Edward L. Deci, *Self-Determination Theory and the Facilitation of Intrinsic Motivation, Social Development, and Well-Being*, 55 AM. PSYCH. 68, 70-71 (2000); Teresa Amabile, *The Social Psychology of Creativity: A Componential Conceptualization*, 45 J. PERSONALITY & SOC. PSYCH. 357, 364 (1983) (finding that the positive effects of autonomy on motivation are strengthened when the task is a creative one); Gagné & Deci, *supra* note 67, at 342 (finding that job motivation and performance are positively related to autonomy support by managers); Amabile, *supra* note 64, at 244.

110. Jones, *supra* note 50, at 301.

111. *Id.* at 301.

112. *Id.* at 302.

it is of moderate intensity)[113] does not impose the same burdens. A party facing temporally discrete adversity thus has more capacity to think creatively and innovate around their obstacle.

Finally, the distinction between acute and chronic stress also matters. While chronic stress seems to interfere with decisionmaking in ways that steer those experiencing it away from creativity (including within organizations),[114] a temporally discrete stress response may have the opposite effect. Acute stress can actually enhance decisionmaking competence in some real-world situations.[115] It is also known to increase risk-taking decisionmaking strategies,[116] which are essential for creativity.[117]

As with spatial discreteness, however, adversity that is *too* temporally discrete may fail to inspire innovation at all. If an obstacle—even a substantial one—is too fleeting, it may fail to provide the inspiration to innovate. If the challenge is over before a party feels subjective discomfort or experiences the need to act in order to overcome the challenge, then the challenge likely won't make much of an impression on the impacted party. Their response, if any, will likely lack a creative twist, simply because the adverse conditions did not last long enough to trigger creative motivation.[118]

C. Adversity Intensity

The intensity of a particular challenge also impacts its potential to inspire innovation. Adversity that is too intense tends to inhibit creativity for many of the reasons already discussed.[119] Extreme adversity

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113. *See infra* Section I.C. (discussing how challenge intensity affects the ability of those undergoing it to respond creatively).

114. *See* Barry M. Staw et al., *Threat Rigidity Effects in Organizational Behavior: A Multilevel Analysis*, 26 ADMIN. SCI. Q. 501, 501 (1981) (discussing how organizations often respond to adversity similarly to humans because of possible "parallels in the effect of threat upon individual, group, and organizational behavior" and because "organizational actions are often initiated by individual and group forces, such that social and psychological effects indirectly influence organization-level phenomena").

115. *See, e.g.*, Grant S. Shields et al., *Exposure to Acute Stress Enhances Decision-Making Competence: Evidence for the Role of DHEA*, 67 PSCYHONEUROENDOCRINOLOGY 51, 51 (2016) (finding in a study where an acute stress response was induced that "[p]articipants in the stress induction group showed enhanced decision-making competence, relative to controls").

116. *See, e.g.*, Katrin Starcke & Matthias Brand, *Decision Making Under Stress: A Selective Review*, 36 NEUROSCI. & BIOBEHAVIORAL REV. 1228 (2012) (reviewing the literature). *But see* Ruud van den Bos et al., *Stress and Decision-Making in Humans: Performance is Related to Cortisol Reactivity, Albeit Differently in Men and Women*, 34 PSYCHONEUROENDOCRINOLOGY 1449, 1449 (2009) (finding gender differences in the degree of risk-taking behavior in response to an acute stressor).

117. Andres Sawicki, *Risky IP*, 48 LOYOLA U. CHI. L.J. 81, 101-04 (2016) (discussing the relationship between risk-taking and creativity).

118. *See, e.g.*, Runco, *supra* note 48, at 167 ("[C]reative efforts are often motivated by the need to cope with . . . various forms of tension . . . .").

119. *Supra* Section I.B.

can be psychologically overwhelming, leading those experiencing it to view the challenge as insurmountable.[120] Thus, rather than inspiring creativity, an extreme challenge might simply cause the party undergoing it to give up. For example, a person struggling with a major health challenge may be overwhelmed with the intensity of the challenge, leaving little motivation to create.[121] Relatedly, an organization may figuratively raise the white flag when the intensity of the challenge it faces is simply too great.[122]

Even if a party chooses to innovate in response to an extreme challenge, the challenge's intensity might make it less likely that the party will succeed.[123] This is because the extreme nature of the challenge might interfere with the party's ability to respond to it effectively. On the individual level, an extreme challenge can easily usurp the cognitive, emotional, interpersonal, and other resources necessary for successful innovation.[124] It is much the same at the organizational level, where extreme challenges may simply make it too difficult to marshal the resources necessary to effectively confront them.[125]

In contrast, challenges of mild to medium intensity are more likely to hit the innovation sweet spot, wherein the challenge inspires

120. *See, e.g.*, Michael Gibbert et al., *In Praise of Resource Constraints*, 48 MIT SLOAN MGMT. REV. 15-17 (2007); Rosenzweig & Grinstein, *supra* note 40, at 114 (citation omitted) ("[E]xtreme challenges are viewed as impossible barriers . . . [and] will likely cause firms not to cope with the challenge . . . .").

121. *See* Jones, *supra* note 50, at 191 (discussing the experience of Graceful, a subject in a case study of creativity and adversity who, after experiencing two major strokes, reported that "the 'depth of the injury' caused 'overwhelming fatigue' " and sapped her ability to be creative).

122. Ben Fox Rubin & Roger Cheng, *Fire Phone One Year Later: Why Amazon's Smartphone Flamed Out*, CNET (July 24, 2015, 5:00 AM), https://www.cnet.com/news/fire-phone-one-year-later-why-amazons-smartphone-flamed-out/ [https://perma.cc/T82F-3U5L] (discussing some of the reasons why Amazon's foray into the smartphone space failed, including a saturation of the smartphone field that presented a nearly insurmountable obstacle for Amazon to overcome).

123. Rosenzweig & Grinstein, *supra* note 40, at 114 ("[I]f managers decide to cope with [a] challenge, its intensity may determine the effectiveness of a coping strategy in terms of innovation performance.").

124. *See* Jones, *supra* note 50, at 190-91. Interestingly, in Jones's study, subjects reported experiencing a decline in interpersonal support when undergoing extreme challenges. *Id.* at 302. It appears that the friends and family of those undergoing extreme challenges may withdraw or be unfamiliar with the best ways of supporting them. Interpersonal support plays an important role in fostering creativity. Bastian et al., *supra* note 43, at 6 (finding that supportive team interactions promote creativity); Amabile et al., *supra* note 67, at 1160-61 (discussing how work group encouragement leads to more creative outcomes); Gagné & Deci, *supra* note 67, at 345 (citing numerous studies finding that feelings of relatedness to others are associated with greater work performance, satisfaction, and persistence); Baard et al., *supra* note 67, at 2062 (finding that feelings of relatedness at work were strongly predictive of work performance). It is thus possible that the loss of interpersonal support during extreme adversity is one of the primary reasons creativity might fail to flourish.

125. *See, e.g.*, Rosenzweig & Grinstein, *supra* note 40, at 117 (citation omitted) ("When a team faces a severe resource challenge of funding, time or workers, coping with such a situation is exceptionally difficult.").

engagement, but is not so overwhelming that it saps motivation or the ability to deal with the challenge effectively.[126] Research suggests that a manageable challenge, whether experienced by a firm[127] or an individual,[128] can be stimulating and inspire the active engagement that leads to creativity.[129]

D. Adversity in Common

How widespread a particular instance of adversity is also bears on whether it will be conducive to innovation. When a group of people experiences adversity collectively, that group is more likely to innovate in response to the adversity than if only one or a few parties in that group experience the adversity.

Group dynamics can contribute to creativity in various ways. For example, a large body of research shows that when people feel related to those they work with, they exhibit more productivity[130] and experience greater levels of intrinsic motivation, a type of motivation that leads to more creative outcomes.[131] Supportive team environments have been shown to lead to the generation of more novel and creative

126. *Id.* at 114 ("Prior research indicate[s] that minor- and medium-intensity challenges may be stimulating and may motivate managers to actively engage with the challenge . . . .").

127. *Id.*

128. *See* Jones, *supra* note 50, at iii (finding via a series of case studies analyzing the relationship between adversity and creativity that "using one's creativity was . . . vital for overcoming adversity").

129. Rosenzweig & Grinstein, *supra* note 40, at 114 (discussing an Indian textile firm that innovated through the resource challenge of "rising electricity costs;" according to the authors, an important factor in the firm's success was the fact that "the resource challenge that [the firm] faced was substantial, but not to the extent that it threatened the firm's existence").

130. *See, e.g.*, Bastian et al., *supra* note 43, at 6 (finding that supportive team interactions promote creativity); Amabile et al., *supra* note 67, at 1160-61 (discussing how work group encouragement leads to more creative outcomes); Gagné & Deci, *supra* note 67, at 345 (citing numerous studies finding that feelings of relatedness to others are associated with greater work performance, satisfaction, and persistence); Baard et al., *supra* note 67, at 2062 (finding that feelings of relatedness at work were strongly predictive of work performance).

131. *See, e.g.*, Ryan & Deci, *supra* note 109, at 73 (discussing how people who feel related to those they work with feel intrinsic motivation to engage in behaviors valued by the organization and its members).

ideas.[132] Even when someone is innovating individually, the amount of interpersonal support that person receives from others appears to impact their ability to be creative.[133]

This is relevant to creativity during times of adversity because shared adverse experiences tend to increase feelings of relatedness and interpersonal support.[134] For example, when people experience natural disasters[135] or war[136] together, the result is often an increase in helping behaviors and the formation of new supportive communities. This boost to relatedness and interpersonal support might in turn facilitate creative action. In fact, in support of this hypothesis, a recent study found that when teams were subject to a shared stressor, they were more creative, and that these effects were mediated by the increased supportive interactions within the group that occurred as a result of the shared adversity.[137]

The COVID-19 pandemic offers an additional example, beyond the effects of interpersonal support on creativity, of how shared adversity can lead to cooperative behaviors that promote innovation. Researchers have reported that the COVID-19 pandemic has led to unprecedented levels of sharing and collaboration in the scientific quest to

132. *See, e.g.*, Amy Edmondson, *Psychological Safety and Learning Behavior in Work Teams*, 44 ADMIN. SCI. Q. 350, 350 (1999) (finding a relationship between feelings of psychological safety in a work group and team performance); Markus Baer & Michael Frese, *Innovation Is Not Enough: Climates for Initiative and Psychological Safety, Process Innovations, and Firm Performance*, 24 J. ORG. BEHAVIOR 45, 45 (2003) (finding a relationship between feelings of psychological safety in a work group and process innovation); Amy C. Edmondson & Josephine P. Mogelof, *Explaining Psychological Safety in Innovation Teams: Organizational Culture, Team Dynamics, or Personality?*, *in* CREATIVITY AND INNOVATION IN ORGANIZATIONAL TEAMS 109 (Leigh L. Thompson & Hoon-Seok Choi eds., 2006) ("Past research has identified an interpersonal climate characterized by psychological safety as conducive to interpersonal risk-taking and hence to creativity and innovation in teams . . . ."); A. Pirola-Merlo, *Agile Innovation: The Role of Team Climate in Rapid Research and Development*, 83 J. OCCUPATIONAL & ORG. PSYCH. 1075, 1075 (2010) (finding that work teams with higher measures of safety (or support) progressed significantly faster in their research and development goals and scored higher on ratings of project innovation).

133. *See, e.g.*, Jones, *supra* note 50, at 291-93 (discussing how study participants considered the availability of emotional support to be an essential contributor to their creativity).

134. Scott S. Wiltermuth & Chip Heath, *Synchrony and Cooperation*, 20 PSYCH. SCI. 1, 1 (2009) (finding that a shared experience leads to more cooperative behavior in groups); Brooks B. Gump & James A. Kulik, *Stress, Affiliation, and Emotional Contagion*, 72 J. PERSONALITY & SOCIAL PSYCH. 305, 305 (1997) (finding that subjects exposed to threatening stimuli were more likely to trust and cooperate with those who shared the experience).

135. Lisa Grow Sun, *Disaster Mythology and the Law*, 96 CORNELL L. REV. 1131, 1138 (2011).

136. *See, e.g.*, Harvey Whitehouse et al., *The Evolution of Extreme Cooperation via Shared Dysphoric Experiences*, 7 SCI. REPS. 1, 1 (2017) (discussing how having shared a painful experience such as wartime military service can lead to increased group alignment and greater willingness to sacrifice for the group).

137. Bastian et al., *supra* note 43, at 1 ("[W]e find evidence that sharing an adverse (vs. non-adverse) experience leads to increased supportive interactions between team members and this in turn boosts creativity within a novel team.").

combat the disease.[138] This is significant because sharing of scientific and technical innovation is known to lead to significant innovation spillovers that build the knowledge base and help the art to progress.[139] In the context of the psychological effects of shared adversity, this outcome is not surprising. Shared adversity tends to give rise to helping and cooperative behaviors,[140] and psychological research shows that an individual's motivation for sharing valuable knowledge is primarily driven by a desire to help others rather than the prospect of some pecuniary reward.[141]

In contrast, when adversity is experienced in isolation, the opposite might occur, with corresponding effects on people's ability to innovate. In a series of case studies examining the impacts of adversity on creativity, for example, a striking theme to emerge was the extent to which those undergoing individual-level adversity felt abandoned or misunderstood by their friends, family, and others.[142] When adversity is experienced on the individual level, it might be more difficult to experience feelings of relatedness and interpersonal support, as those around the person going through the adversity fail to understand or empathize with the situation; or, despite the best of intentions, struggle to know how to best support the person in a situation they are not themselves personally experiencing.[143]

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138. Alvin Powell, *How Far Are We from a Vaccine? Depends On Who 'We' Is*, HARV. GAZETTE (May 7, 2020), https://news.harvard.edu/gazette/story/2020/05/assessing-where-vaccine-efforts-stand-and-the-challenges-ahead/ [https://perma.cc/VXZ3-JAZJ] (quoting Harvard public health researcher and former dean of the Harvard T.H. Chan School of Public Health Barry Bloom as saying that he has "not seen anything like the current level of sharing] in my entire career . . . [t]his is moving at lightning speed. Not everything you read is going to turn out to be correct, but at least the information is being shared.").

139. *See, e.g.*, Roberto Mazzoleni & Richard R. Nelson, *Economic Theories About the Benefits and Costs of Patents*, 32 J. ECON. ISSUES 1031, 1038-39 (1998) (discussing how a patent encourages disclosure of innovation, which in turn is expected to promote innovation as others are free to build on the knowledge of the patentee); Jeanne C. Fromer, *Patent Disclosure*, 94 IOWA L. REV. 539, 548 (2009) (discussing how disclosure benefits innovation in various ways); Brett M. Frischmann & Mark A. Lemley, *Spillovers*, 107 COLUM. L. REV. 257, 260-61 (2007) (describing some of the ways in which dissemination of innovative information benefits innovation); Zachary Liscow & Quentin Karpilow, *Innovation Snowballing and Climate Law*, 95 WASH. U. L. REV. 387, 397-98 (discussing the various ways in which dissemination of innovation knowledge results in "innovation spillovers [that] benefit[] other innovators").

140. *See, e.g.*, Sun, *supra* note 135, at 1138 (reviewing some of the literature).

141. Stephanie Plamondon Bair, *The Psychology of Patent Protection*, 48 CONN. L. REV. 297, 317-18 (2015).

142. *See* Jones, *supra* note 50, at 302 (detailing the theme of lack of interpersonal support during individual adversity and quoting one subject's experience that while experiencing adversity, she was "ignored, whispered about, beaten down and thrown to the cold").

143. *See, e.g.*, David DeSteno, *The Funny Thing About Adversity*, N.Y. TIMES (Oct. 16, 2015), https://www.nytimes.com/2015/10/18/opinion/sunday/the-funny-thing-about-adversity.html [https://perma.cc/6FPX-P7F2] (discussing the author's research on how undergoing adversity impacts a person's ability to show compassion to others). Furthermore, a number of psychological mechanisms might help explain why those undergoing adversity are met with less than helpful and supportive responses from their communities. For

Collective adversity is thus likely innovation-enhancing. Yet, following the Goldilocks principle of adversity and innovation, it might also be important that group adversity is not *too* widely shared. The reasons for this go back to the basic push and pull of adversity and innovation—the adversity must provide a motivation to create, yet if it drains the creator(s) of the resources and support necessary for creativity, it might impede, rather than promote, innovation.

For instance, if an entire community is impoverished, that condition may inhibit the innovative capacities of the community, simply because it is more difficult for members of the community to obtain the financial, temporal, and relational resources needed to support creativity. It will be more difficult to get the money that greases the wheels of innovation if your network is equally strapped for cash. It will be more difficult to experience interpersonal support if everyone around you is also struggling. And it will be more difficult to find the time and space to create if you have no one to help you carve it out, by offering help with childcare and other duties, for example.

Similarly, on the organizational level, firms undergoing adversity succeed best at innovating when they have both internal and external structures in place to support their innovative efforts.[144] For example, managers at a firm undergoing adversity often look to their networks in other firms, government, or financial institutions for the support necessary to innovate through their challenges.[145] But if these sources of external support are unavailable or ineffective because of widely shared adversity—if a widespread and debilitating financial crisis makes it impossible to get help from financial institutions or other firms, for example—then it will be more difficult to successfully innovate in response to the challenge. Shared adversity is

example, victims of crimes or assaults may experience the phenomenon of victim blaming, where others, in an unconscious attempt to uphold their beliefs that the world is just and that they have control over their own personal situations, assign some responsibility—and correspondingly less empathy—to the victim for his misfortune. *See, e.g.*, Kayleigh Roberts, *The Psychology of Victim Blaming*, ATLANTIC (Oct. 5, 2016), https://www.theatlantic.com/science/archive/2016/10/the-psychology-of-victim-blaming/502661/ [https://perma.cc/SP5B-G4VA] (discussing the phenomenon of victim blaming, and how "people blame victims so that they can continue to feel safe themselves"). Those who have suffered adversity that leaves a physical trace of some kind—for example, paralysis—may also be subject to protective prejudice, a cognitive defense mechanism that leads people to avoid those who physically deviate from "normal" as an evolutionarily-driven (yet often irrational) means of protecting themselves from unwanted disease and infection. *See, e.g.*, Rick Chillot, *Do I Make You Uncomfortable?*, PSYCH. TODAY 72, 72-73 (Nov. 5, 2013), https://www.psychologytoday.com/us/articles/201311/do-i-make-you-uncomfortable [https://perma.cc/WZ2C-TMK2] (discussing the phenomenon of protective prejudice). Because interpersonal support is so critical for creativity, *see, e.g.*, Jones, *supra* note 50, at 340 (discussing the importance of interpersonal support in subjects' ability to be creative), these impediments to support during individual adversity might also act as impediments to innovation.

144. Rosenzweig & Grinstein, *supra* note 40, at 116 (discussing internal and external "coping assets," or resources, and how they contribute to firm innovation during adversity).

145. *Id.*

therefore innovation-enhancing, but only if it is not so widely shared that a potential innovator is unable to seek and obtain the support and resources necessary for innovation.

E. Adversity with Severe Consequences

Finally, adversity is more likely to result in innovation if the adversity, left unchecked, will result in severe consequences for large groups of people. This characteristic of adversity is related to the previous one but extends it: common suffering becomes even more likely to motivate innovation when failing to do so poses dire consequences for large groups of people. The COVID-19 pandemic is a clear recent example in support of this proposition. But history is replete with others.

For instance, some of the most important innovations of our time came from investments the U.S. government sponsored in an attempt to address challenges to its position in the world order. Satellite technologies,[146] GPS,[147] even the Internet[148] developed in part as responses to worries about the U.S.S.R. and the spread of communism. Even before that, the United States, United Kingdom, and Canada financed the Manhattan Project in a race to obtain the first nuclear weapons in response to the perceived threats of Nazism and Japan's authoritarian regime.[149]

In each of these examples, governments responded to adversity with innovation because that adversity, if left unchecked, was a potential threat to their interests, and consequently, the health and well-being of their citizens. Of course, one may dispute whether those innovations actually turned out to be socially beneficial.[150] But the fact

146. Bradford W. Parkinson & Stephen T. Powers, *The Origins of GPS, and the Pioneers Who Launched the System*, GPS WORLD (May 1, 2010), https://www.gpsworld.com/origins-gps-part-1/ [https://perma.cc/97YN-T6NH] (describing how the United States responded to Russia's launch of the Sputnik satellite with its own satellite research program).

147. *Id.* (describing how the research that eventually evolved into the development of GPS technology was spurred by Russia's launch of the Sputnik satellite and the United States' attempts to "catch up").

148. *See, e.g.*, Ben Tarnoff, *How the Internet Was Invented*, GUARDIAN (Jul. 15, 2016, 7:00 PM), https://www.theguardian.com/technology/2016/jul/15/how-the-internet-was-invented-1976-arpa-kahn-cerf [https://perma.cc/E9RZ-C8UY] (describing "the dream of a networked military using computing power to defeat the Soviet Union and its allies . . . the dream that produced the internet").

149. *See, e.g.*, FRANCIS GEORGE GOSLING, THE MANHATTAN PROJECT: MAKING THE ATOMIC BOMB 6-10 (1999) (describing how early government and scientific support for the Manhattan Project evolved after World War II began and key players "became convinced of the need for the government to marshall the forces of science for a war that would inevitably involve the United States").

150. *See, e.g.*, Stephanie Meeks, *Preserving the History of the Manhattan Project*, L.A. TIMES (June 7, 2013, 12:00 AM), https://www.latimes.com/opinion/la-xpm-2013-jun-07-la-oe-meeks-manhattan-project-20130607-story.html [https://perma.cc/QMT6-VSYM] (discussing how "the Manhattan Project . . . raised profound ethical questions, which remain just as challenging and urgent today as in 1945"); *see generally* Ofer Tur-Sinai, *Technological*

remains that adversity posing significant consequences to large groups of people motivated the relevant governments to pursue innovation they felt would protect those groups from dire consequences.

The COVID-19 pandemic similarly shows how adversity posing significant consequences to large groups of people often motivates innovation. This innovation has occurred on many levels—from individuals, to companies, to the government—and has spanned a range of fields, including vaccine development, medical equipment, food services, education, and others.[151]

But the adversity need not be a worldwide pandemic for it to be capable of inspiring innovation, so long as the adversity still poses dire consequences for significant numbers of people. For instance, in the 1980s, software innovators faced a number of challenges in pursuing innovation.[152] One of these challenges was simply that many software vendors would not permit third-party users of the software products to improve those products so that the increasingly connected software ecosystem would work together more seamlessly.[153]

Software innovators responded to this growing crisis by fomenting the free and open source software (FOSS) movement.[154] This movement sought, among other things, to improve software innovation by making software innovations publicly available under terms that allowed subsequent innovators to build upon what they received, subject to satisfying a number of conditions.[155] One of these conditions, the so-called "copyleft" concept, requires those who use and build upon the FOSS to make those improvements available to the public under the same terms.[156] Other types of license conditions require those using the software to simply include a copyright notice and the original license

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Progress and Well-Being, 48 LOY. U. CHI. L.J. 145 (2016) (arguing that not all innovation is socially beneficial and that the patent system is not a good mechanism for sorting socially valuable innovations from socially harmful innovation); Estelle Derclaye, *Eudemonic Intellectual Property: Patents and Related Rights as Engines of Happiness, Peace, and Sustainability*, 14 VAND. J. ENT. TECH. L. 495, 502-03 (2012) (arguing that innovation and "progress" are not synonymous).

151. Politico Staff, *17 Pandemic Innovations That Are Here to Stay*, POLITICO (Dec. 10, 2021, 4:30 AM), https://www.politico.com/news/2021/12/10/17-ways-covid-hit-fast-forward-on-the-future-523845 [https://perma.cc/687V-EQGA].

152. Dave Neary, *6 Pivotal Moments in Open Source History*, OPENSOURCE.COM (Feb. 1, 2018), https://opensource.com/article/18/2/pivotal-moments-history-open-source [https://perma.cc/WLW2-G7AD].

153. *Id.*

154. *Id.* (describing the rise of the free and open source software movement).

155. *See* Eric S. Raymond, *The Cathedral and the Bazaar*, FIRST MONDAY (Feb. 10, 1998), https://firstmonday.org/article/view/578/499 [https://perma.cc/75DW-DN5A] (discussing some of this philosophy).

156. *See What Is Copyleft?*, GNU, https://www.gnu.org/licenses/copyleft.en.html [https://perma.cc/5D2M-SZSV] (last visited July 20, 2022) (discussing copyleft).

terms in their software's documentation.[157] Over time, this movement and the software products it has spawned have come to power much of the software architecture behind the modern Internet and most other important digital technologies.[158]

While the FOSS movement gave rise to some of the world's most important innovations in response to the adverse conditions plaguing the industry in the late 1980s and early 1990s,[159] the movement's innovation posed new adversity for large numbers of software vendors whose primary source of revenue had been software licensing.[160] Because the FOSS movement made it more difficult for these software vendors to charge for use of their software, they in turn had to pursue innovative new ways of making a profit.[161] Some succeeded, and some failed. But the point remains, both with respect to the FOSS movement and these subsequent software vendors, that adversity posing significant consequences to large numbers of people and organizations motivated many of them to pursue innovation in hopes of overcoming those consequences.

Of course, it is difficult to know when the problems that adverse conditions pose are dire enough to motivate parties to action. Often, we can only discern this ex post, not ex ante. Furthermore, as with the other categories discussed, the fact that adverse conditions pose dire consequences is no guarantee that innovation will result. Indeed, adversity that poses dire consequences frequently fails to motivate parties to action (or, at least, to do so successfully). The environmental consequences of human pollutants may be such an example.[162] But as

157. Clark D. Asay, *A Case for the Public Domain*, 74 OHIO ST. L.J. 753, 759-60 (2013) (discussing "permissive" open source licenses in contrast to more restrictive, copyleft licenses).

158. *E.g.*, Tim Yeaton, *In a World Without Open Source*, WIRED (July 2013), https://www.wired.com/insights/2013/07/in-a-world-without-open-source/ [https://perma.cc/7E8Y-CHMF] (discussing the pervasiveness of open source software in a variety of important technologies); Katie Brigham, *How Open-Source Software Took Over the World*, CNBC (Dec. 14, 2019, 9:11 AM), https://www.cnbc.com/2019/12/14/how-open-source-software-became-the-new-industry-standard.html [https://perma.cc/E9QJ-DDPT].

159. Yeaton, *supra* note 158.

160. *See* Max Schireson & Dharmesh Thakker, *The Money in Open-Source Software*, TECHCRUNCH (Feb. 9, 2016, 4:00 PM), https://techcrunch.com/2016/02/09/the-money-in-open-source-software/ [https://perma.cc/CT2V-GYCJ] (describing some of the difficulties and strategies employed in attempting to derive revenues from developing software in a world characterized by open source software development).

161. *See, e.g.*, Thomas Claburn, *Open-Source Companies Gather to Gripe: Cloud Giants Sell Our Code as a Service—And We Get the Square Root of Nothing*, REGISTER (Sept. 20, 2019, 12:19 AM), https://www.theregister.com/2019/09/20/open_source_companies_cloud/ [https://perma.cc/B3MA-5N9N] (discussing how many companies have adopted a strategy of offering complementary services on top of the open source software in order to gain profits).

162. Chris Mooney & Brady Dennis, *The World Has Just Over a Decade to Get Climate Change Under Control, U.N. Scientists Say*, WASH. POST (Oct. 7, 2018, 9:00 PM), https://www.washingtonpost.com/energy-environment/2018/10/08/world-has-only-years-get-climate-change-under-control-un-scientists-say/ [https://perma.cc/S729-2D72].

with the other categories discussed above, it seems clear that adverse conditions presenting relatively trivial consequences will more typically fail to motivate parties to action.

F. Conclusions

The quality of adversity most likely to be conducive to and inspire innovation must be neither too much nor too little, too long nor too short. Nor should it be too intense nor too mild, too widespread nor too confined, too trivial, in terms of its collective impact, nor too dire. Instead, to have the greatest likelihood of stimulating innovation, the adversity should be "just right." Again, parties can and will certainly pursue successful innovation without this Goldilocks principle being satisfied. Furthermore, there are a number of other factors affecting whether parties will respond to adversity with creativity, and entire literatures examine those distinctive features. We discuss some of those features in greater detail below. But generally speaking, it is more likely that parties will successfully pursue innovation when the adversity they face falls within a sweet spot in terms of that adversity's breadth, duration, intensity, commonality, and consequences.

II. INDIVIDUAL AND FIRM CHARACTERISTICS THAT PREDICT INNOVATIVE RESPONSES TO ADVERSITY

Thus far, we have examined various characteristics of adversity likely to promote innovation. But experiencing an innovation-promoting strain of adversity is no guarantee that the person or entity undergoing it will respond by innovating. An important variable in the equation that helps determine whether a party will respond to adversity with innovation is the individual makeup and characteristics of that party. In other words, it's not just the quality of adversity that determines whether innovation will result, but also the quality of the party experiencing it. While some will respond to innovation-promoting adversity with innovation, others will not.

So what determines whether a party will take up the challenge to innovate that adversity offers? There is a large literature examining the characteristics that help predict whether an individual or organization will try—successfully—to overcome adversity with innovation. While that literature is too big to canvas comprehensively here, we spend some time in this Part outlining some of the main findings from this body of work.

A. Individual Characteristics

Aside from the quality of the adversity a person faces, a number of other factors may affect whether that person responds to adversity with innovation. One vital factor is what a large literature calls "resilience." Resilience has been defined as the ability to rebound from and

adapt to adversity.[163] Higher resilience has been associated with creative responses to adversity.[164] The extent to which a person exhibits this quality of resilience will thus help determine whether they are able to respond to adversity with creative action.

What, then, makes a person resilient?[165] Resilience has been associated with a number of personality traits, including humor, empathy, optimism, sense of purpose, flexibility, and easygoing temperament.[166] However, it also appears that resiliency can be developed, and that previous experience with adversity is helpful in this process—as long as the adversity is not overly severe and the total cumulative adversity remains manageable.[167] Life circumstances, including the presence of supportive adult relationships during childhood and adolescence, likely also contribute to one's resiliency.[168] Indeed, perhaps unsurprisingly, some researchers suggest that children who receive coaching in responding to early-age adversity with creative solutions are better equipped to deal with adversity in later stages of life in similarly creative ways.[169]

Because behavior arises in the brain, the individual characteristics that lead particular individuals to respond to adversity with innovation are rooted in brain structure and function. Indeed, psychology and

163. *See, e.g.*, Anita J. Hunter, *A Cross-Cultural Comparison of Resilience in Adolescents*, 16 J. PEDIATRIC NURSING 172, 172 (2001); Mark D. Seery et al., *Whatever Does Not Kill Us: Cumulative Lifetime Adversity, Vulnerability, and Resilience*, 99 J. PERSONALITY & SOC. PSYCH. 1025, 1025 (2010).

164. *See, e.g.*, Dirk De Clercq & Renato Pereira, *Resilient Employees Are Creative Employees, When the Workplace Forces Them to Be*, 28 CREATIVITY & INNOVATION MGMT. 329, 329 (2019) (finding that resilient employees under time constraints are more likely to engage in disruptively creative workplace behaviors); Alia Weston & J. Miguel Imas, *Creativity: Transformation of Adversity*, *in* THE PALGRAVE HANDBOOK OF CREATIVITY AT WORK 287 (Lee Martin & Nick Wilson eds., 2018) (discussing how resilience fosters creative action and exploring how marginalized communities transform adversity into creativity). Interestingly, while some scholars focus on how resilience helps spur creative response to adversity, others have hypothesized that resilience is actually built through creative response to adversity. *See, e.g.*, Hunter, *supra* note 163, at 178 (citing adolescent subjects' perception that resilience was "being courageous through creativity and humor"); Einat S. Metzl & Malissa A. Morrell, *The Role of Creativity in Models of Resilience: Theoretical Explanation and Practical Applications*, 3 J. CREATIVITY MENTAL HEALTH 303, 310-11 (2008) (discussing the relationship between creativity and resilience).

165. Cohler, *supra* note 43, at 363-64 ("[Q]uestions [of resilience] involve the complex interplay of temperament, social context, and life changes.").

166. Metzl & Morrell, *supra* note 164, at 305; *see also* Marie J.C. Forgeard, *Happy People Thrive on Adversity: Pre-Existing Mood Moderates the Effect of Emotion Inductions on Creative Thinking*, 51 PERSONALITY & INDIVIDUAL DIFFERENCES 904, 904 (2011) (finding that people with more positive moods and low in depression were more likely to respond to an adverse circumstance with creative response than those with lower mood or higher depression).

167. Seery et al., *supra* note 163 (discussing the relationship between resiliency and experience with adversity).

168. Hunter, *supra* note 163, at 172.

169. Marilyn Price-Mitchell, *Adversity and the Creative Mind*, PSYCH. TODAY (Jan. 18, 2016), https://www.psychologytoday.com/us/blog/the-moment-youth/201601/adversity-and-the-creative-mind [https://perma.cc/X5A2-3D9Y].

neuroscience researchers "have started to identify thinking processes and brain regions involved with creativity" and have pointed to some evidence suggesting that creative thinking abilities arise in part based on neural connections between three particular brain networks.[170] At this point, it remains unclear to what degree these neuronal characteristics arise from genetics, experience, or both, and whether they are "malleable or relatively fixed."[171] However, the evidence that experience with overcoming adversity leads to learning along this axis suggests that individuals can, to some extent, develop the neural pathways that lead to creative responses to adversity. [172]

B. Organizational Characteristics

When confronted with adversity, some organizations respond with innovation and achieve success, while others succumb to the obstacles placed in their path. Why? While we have argued here that the type of adversity an organization faces matters, a large organizational and entrepreneurship literature has tackled the question of what it is about an organization itself that leads it to innovate, under circumstances of adversity or otherwise. Below we provide two of the main findings of this literature.

1. Management Characteristics

First, the traits and personalities of an organization's management play a significant role in determining whether an organization responds to adversity with innovation.[173] For example, Rosenzweig and Grinstein have mined the sociology, psychology, and management literatures to identify what they term "coping assets" of company managers.[174] Such coping assets are related to the concept of resilience discussed above; in fact, they might be best viewed as a form of resilience within the specific context of managing an organization. Organizations that have management with high levels of coping assets are more likely to tackle adversity and succeed through innovation, in part because those coping assets enable the managers to lead their organizations through troubled waters.[175]

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170. Roger Beaty, *Why Are Some People More Creative Than Others?*, CONVERSATION (Jan. 16, 2018), https://www.scientificamerican.com/article/why-are-some-people-more-creative-than-others/ [https://perma.cc/XV3W-JM6K].

171. *Id.*

172. The concept of neuroplasticity also suggests that many skills, including potentially the skills of creativity and creative coping, can be learned. Price-Mitchell, *supra* note 169.

173. *See, e.g.*, Cameron M. Ford & Dennis A. Gioia, *Factors Influencing Creativity in the Domain of Managerial Decision Making*, 26 J. MGMT. 705, 705 (2000) (discussing the characteristics of a firm's management's decisionmaking process as an understudied area of innovation).

174. Rosenzweig & Grinstein, *supra* note 40, at 115.

175. *Id.*

How, then, does a manager develop the coping assets that will help her successfully and innovatively guide her organization through adversity? Perhaps unsurprisingly, one of the most important contributors to individual-level coping assets is past experience with adversity.[176] Like many skills, successfully responding to adversity with creativity is, in part, a learned ability that individuals can improve upon with practice.[177] Individuals "who face adversities develop skills and propensities for the efficient exploitation of opportunities and of available resources" that help them effectively tackle future challenges, including as managers in the workplace environment.[178] For example, one strain of research has examined how minorities (and immigrants in particular) may be able to respond to resource challenges in the workplace more efficiently and creatively than others because of their prior experience dealing with social and financial hardship.[179]

As with present adversity that facilitates innovation, however, past experience with adversity must meet certain criteria if it is to lead to the kind of growth and skill development characteristic of innovators. Specifically, lifetime experience with adversity also has a U-shaped, "Goldilocks" relationship with a range of life outcomes, including well-being,[180] mental health,[181] and the cognitive capacity[182] for creative thinking.[183] Too little adversity and a person never learns how to confront and overcome a challenge; equally important, they never gain the confidence that dealing with adversity is something they can in fact do

176. *See id.*

177. *See, e.g.*, Seery et al., *supra* note 163 (finding that "people with a history of *some* lifetime adversity reported better mental health and well-being outcomes than not only people with a *high* history of adversity but also than people with *no* history of adversity," and were less impacted by adverse events than those from the other study groups).

178. Rosenzweig & Grinstein, *supra* note 40, at 115.

179. *See, e.g.*, *id.* at 115 (summarizing some of the research); Alejandro Portes, *Economic Sociology and the Sociology of Immigration: A Conceptual Overview*, *in* THE ECONOMIC SOCIOLOGY OF IMMIGRATION 1, 25-29 (Alejandro Portes ed., 1995) (describing entrepreneurship in immigrant communities); Mark Granovetter, *The Economic Sociology of Firms and Entrepreneurs*, *in* THE ECONOMIC SOCIOLOGY OF IMMIGRATION 128 (Alejandro Portes ed., 1995) (describing the sociological aspects of entrepreneurship in immigrant communities); Weston & Imas, *supra* note 164 (discussing, among other things, how adversity functions "as a form of capital that can be used by marginalized people for their own empowerment and transformation within precarious social conditions").

180. Seery et al., *supra* note 163, at 1025.

181. *Id.*

182. Jack P. Shonkoff & Andrew S. Garner, *The Lifelong Effects of Early Childhood Adversity and Toxic Stress*, AMER. ACAD. PEDIATRICS e232, e235 (2012) (explaining how "excessively high levels [of stress hormones] or prolonged exposures can be quite harmful or frankly toxic . . . lead[ing] to a chronic 'wear and tear' effect on multiple organ systems, including the brain").

183. *See* Bair, *supra* note 141, at 333-44 (explaining how the cognitive effects of prolonged poverty experienced in childhood may impact affected individuals' ability to be creative).

successfully.[184] Too much adversity, however, and the person may be so beleaguered by challenge and trauma that they equally lack the opportunity to gain valuable experience confronting and successfully overcoming obstacles.[185]

Finally, in addition to past experience with adversity, a number of personality traits of managers, including self-efficacy, growth mindset, extraversion, and openness to experience, have also been hypothesized to contribute to management coping assets that will determine whether a manager responds to organizational adversity with innovation.[186] These traits are likely reflected in brain structure and function, providing an additional physiological explanation as to why a particular manager will respond to organizational adversity with successful innovation.[187]

2. Organizational Norms, Culture, and Practices

The influence of managers is also felt to the extent that it contributes to and shapes broader organizational characteristics—attributes like norms, culture, and practices—that help determine how a firm responds to challenges.[188]

The entrepreneurial orientation literature, for instance, has sought to elucidate what makes a firm "entrepreneurial"—a term defined to include innovativeness.[189] The entrepreneurial orientation of a firm is empirically correlated not only with higher levels of innovation generation (as opposed to innovation adoption),[190] but also with firm

184. *See, e.g.*, Runco, *supra* note 48, at 171 (summarizing some of the research connecting early adversity with personal benefits in achievement, creativity, and perseverance in the face of challenge).

185. *See, e.g.*, Seery et al., *supra* note 163, at 1025. The reason for this is likely at least partly rooted in the physiological stress response. When the adversity is mild or moderate in intensity and the person experiencing it has appropriate support, the physiologic response facilitates learning, while the adversity "provide[s] important opportunities to observe, learn, and practice healthy, adaptive responses to adverse experiences." Shonkoff & Garner, *supra* note 182, at e235. However, when the stress is severe, prolonged, and the person experiencing it lacks the resources necessary to mitigate it, the physiological response—a chronic or toxic stress response—can wreak havoc on the brain and body, impacting a person's long-term capacity for learning, memory, and other creativity-related cognitive skills. *Id.* at e235. If a person has "the right" kind of previous experience with adversity, this experience can pay dividends throughout the person's life in fostering healthy and creative responses to personal and professional challenges. And if that person plays a managerial role, the organization can also benefit as the manager chooses to respond competently and confidently to adversity with innovation. *Id.* at e236.

186. Rosenzweig & Grinstein, *supra* note 40.

187. Price-Mitchell, *supra* note 169.

188. Rosenzweig & Grinstein, *supra* note 40.

189. Brain S. Anderson et al., *Reconceptualizing Entrepreneurial Orientation,* 36 STRATEGIC MGMT. J. 1579, 1579 (2014).

190. Ana Perez-Luno et al., *The Dual Nature of Innovative Activity: How Entrepreneurial Orientation Influences Innovation Generation and Adoption*, 26 J. BUS. VENTURING 555, 555 (2011) (finding that firms that are proactive and have an orientation towards risk-taking tend to generate innovation more than simply adopting innovations from competing firms).

performance during times of adversity.[191] Because entrepreneurial orientation encompasses a range of firm characteristics, including the "decision-making styles, practices, processes[,] and behavio[]rs"[192] that lead to innovation, managers play a significant role in determining the extent to which a firm exhibits this desirable quality. For example, firm risk-taking and proactivity are important components of entrepreneurial orientation,[193] and managerial attitude toward risk unsurprisingly contributes to firm risk-taking.[194]

In addition to entrepreneurial orientation, other organizational characteristics have been shown to contribute to an organization's ability to innovate—whether in response to adversity or otherwise. For innovation in general, one meta-analysis found that higher levels of specialization, technical knowledge resources, external and internal communication, and other firm characteristics were positively associated with innovation; in contrast, higher levels of firm centralization were negatively associated with innovation, and firm formalization, managerial tenure, and vertical differentiation were unassociated with innovation.[195]

For innovation during times of adversity specifically, a number of organizational characteristics have been hypothesized to play a role. For example, there is some evidence that firms with more structured research and development protocols are better able to innovate during times of challenge.[196] Firms with high levels of "learning capabilities," or institutional capacity to assimilate and apply new information, are also likely to respond positively to adversity.[197] Characteristics like size and organizational structure may also play a role; less hierarchical firm structures, for instance, confer increased flexibility, which in turn allows a firm to respond adaptively to challenges.[198] In sum,

191. *See, e.g.*, Sascha Kraus et al., *Entrepreneurial Orientation and the Business Performance of SME's: A Quantitative Study from the Netherlands*, 6 REV. MANAGERIAL SCI. 161, 161 (2012) (finding that entrepreneurial orientation of small and medium sized firms positively predicts firm performance during economic crisis).

192. *Id.* at 163.

193. *See id.* at 161; Anderson et al., *supra* note 189, at 1579.

194. *See, e.g.*, Anderson et al., *supra* note 189, at 1583-84 (discussing how managerial attitude toward risk contributes to entrepreneurial orientation).

195. Fariborz Damanpour, *Organizational Innovation: A Meta-Analysis of Effects of Determinants and Moderators*, 34 ACAD. MGMT. J. 555, 567-69 (1991).

196. *See, e.g.*, Rosenzweig & Grinstein, *supra* note 40, at 116 (discussing some of the research). At the same time, firms that engender a culture of "fun" and play seem to have success in innovating, likely because this orientation fosters team relationships. Deborah Dougherty & C. Helen Takacs, *Team Play: Heedful Interrelating as the Boundary for Innovation*, 37 LONG RANGE PLAN. 569, 569 (2004).

197. *See, e.g.*, Rosenzweig & Grinstein, *supra* note 40, at 116 (discussing some of the research).

198. *Id.*

while the quality of adversity affects whether a party responds with innovation, other individual and organizational characteristics, as discussed above, may also often play a role.

III. IMPLICATIONS FOR INTELLECTUAL PROPERTY AND INNOVATION POLICY

The preceding discussion about how certain forms of adversity frequently inspire innovation has implications for IP and innovation law and policy. In this Part, we discuss some of those implications. We also discuss how we might reform certain IP doctrines, and innovation policy more generally, in order to better account for the role that adversity frequently plays in affecting the pace and direction of innovation.

A. Predominant Intellectual Property Law Theories

Commentators have articulated a number of theories to account for the purposes behind IP laws. This Section does not comprehensively review the many variants of those theories. Instead, it aims to provide a snapshot of predominant IP law theories so as to better consider them in light of the role that adversity often plays in stimulating (and inhibiting) innovation.

There are at least four distinct bodies of law that govern the creation and exercise of IP rights: patent law, copyright law, trademark law, and trade secret law. Some may dispute this characterization, particularly with respect to trade secret and trademark laws, which have long perplexed commentators because of their confusing mix of theoretical justifications.[199] But for our purposes, this characterization is apt because these are the bodies of law commentators most typically associate with IP rights.[200]

According to predominant theory, the purpose of patent law is to incentivize parties to develop new, nonobvious, and useful inventions, all for the benefit of society.[201] Patent rights are necessary to provide such incentives, the theory goes, because without patent rights others

199. *See, e.g.*, Robert G. Bone, *A New Look at Trade Secret Law: Doctrine in Search of Justification*, 86 CAL. L. REV. 241, 243 (1998) (arguing that trade secret law is not independently needed because contract law is adequate to protect the relevant interests of trade secret owners); Michael S. Mireles, Jr., *Towards Recognizing and Reconciling the Multiplicity of Values and Interests in Trademark Law*, 44 IND. L. REV. 427, 428 (2011) (discussing predominant theory of trademark law and how it fails to address a number of relevant interests).

200. *See, e.g.*, U.S. PAT. & TRADEMARK OFF., PROTECTING INTELLECTUAL PROPERTY IN THE UNITED STATES: A GUIDE FOR SMALL AND MEDIUM-SIZED ENTERPRISES IN THE UNITED KINGDOM, https://www.uspto.gov/sites/default/files/documents/UK-SME-IP-Toolkit_FINAL.pdf [https://perma.cc/AUE9-EQ5D] (listing patent, copyright, trademark, and trade secret laws as the main bodies of intellectual property law).

201. *See* Oskar Liivak, *Maturing Patent Theory from Industrial Policy to Intellectual Property*, 86 TUL. L. REV. 1163, 1168-69 (2012) (discussing this predominant theory behind patent law).

could duplicate the inventions without incurring the same costs as the original inventor.[202] Given that reality, many potential inventors would be reluctant to develop the invention because, absent patent rights, they would find it difficult to recoup their costs of invention.[203] This theory is often referred to as the "utilitarian" account of patent law.[204]

Of course, over the years commentators have poked many holes in this theory, as well as offering refinements to it.[205] For instance, other factors often affect whether a party is able to recoup their costs, including lead-time, know-how, resources, and other competitive considerations.[206] Indeed, it is not always a simple matter of cut-and-paste for a subsequent party to compete with the original inventor.[207] Furthermore, parties frequently invent things for reasons other than the lure of patent rights, even if those rights become useful to those parties at some point later on.[208]

But setting aside for the moment these and other permutations on the same themes, the basic utilitarian account of patent law remains the dominant one. Commentators interpreting the constitutional provision authorizing Congress to create patent laws typically conduct those interpretations with this utilitarian theory in mind.[209] And courts frequently allude to the utilitarian theory when applying patent law to actual cases, independent of its empirical veracity.[210]

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202. Gideon Parchomovsky & R. Polk Wagner, *Patent Portfolios*, 154 U. PA. L. REV. 1, 12-14 (2005) (discussing patent law's main justification as being aimed at solving inventor's "appropriability problem" given the public good nature of intellectual goods).

203. *Id.* at 13-14.

204. Bair, *supra* note 141, at 303-04.

205. It would be impossible to capture this vast literature in one footnote. For a few examples, see Bair, *supra* note 141 (critiquing predominant patent law theories, including the utilitarian account, in light of neuroscience research); Mark A. Lemley, *The Myth of the Sole Inventor*, 110 MICH. L. REV. 709 (2012) (critiquing utilitarian accounts of the patent system in light of the frequent reality of simultaneous invention by multiple parties).

206. *See, e.g.*, Bronwyn Hall et al., *The Choice Between Formal and Informal Intellectual Property: A Review*, 52 J. ECON. LIT. 1, 6 (2014) (pointing to surveys of firms that indicate that lead-time is a more important means of appropriating the value of an innovation than either patents or trade secrecy).

207. Some evidence, in fact, suggests that those accused of patent infringement rarely actually directly copy from the patent holder. *See* Christopher A. Cotropia & Mark A. Lemley, *Copying in Patent Law*, 87 N.C. L. REV. 1421, 1423 (2009).

208. *See, e.g.*, Clark D. Asay, *Patent Schisms*, 104 IOWA L. REV. 45, 45 (2018) (discussing how parties often pursue patents for one reason, only to use those patents for another later on).

209. Bair, *supra* note 141, at 308 (noting that the utilitarian theory's popularity owes in part to the fact that it is the theoretical justification for patents alluded to in the Constitution itself).

210. *See, e.g.*, Festo Corp. v. Shoketsu Kinzoku Kogyo Kabushiki Co., 535 U.S. 722, 738 (2002) (noting imperfections in patent law's disclosure requirements due to the imprecision of language but indicating that such imperfections are the price society pays to ensure sufficient incentives for innovation).

Copyright law has followed a similar theoretical trajectory as patent law. According to its predominant theory, copyright law is meant to incentivize parties to engage in socially beneficial creative activities that, absent copyright protections, they may be reluctant to pursue.[211] The same basic utilitarian impulse just discussed in the context of patent law holds sway in copyright law as well: without granting authors rights in their works, those authors would often forego their creative activities because others could duplicate and use their creations without incurring the same costs.[212] Consequently, creators would have difficulty recouping the costs of developing their creations.[213] Of course, similar to patent law, commentators have pointed out problems with this account, including the reality that many parties pursue creative activity for their own intrinsic purposes.[214] But this utilitarian account remains the dominant one.[215]

Traditionally, trademark law has relied less on this utilitarian account, though strains of the same reasoning surface in this context as well. The dominant account of trademark law is that by providing commercial actors with rights in their marks, we reduce consumers' information costs in navigating the marketplace.[216] Hence, the dominant theoretical account of trademark law is consumer focused; trademark rights are meant to help reduce consumer confusion in the marketplace, and court decisions frequently rely on variants of this theory in interpreting and applying the law.[217]

Yet other, more recent accounts of trademark law are similar to predominant theories in patent and copyright laws in their utilitarian

211. Pierre N. Leval, *Toward a Fair Use Standard*, 103 HARV. L. REV. 1105, 1107 (1990) ("[Copyright law] is designed . . . to stimulate activity and progress in the arts for the intellectual enrichment of the public. This utilitarian goal is achieved by permitting authors to reap the rewards of their creative efforts."). *But see* Sara K. Stadler, *Forging a Truly Utilitarian Copyright*, 91 IOWA L. REV. 609, 610-11 (2006) (arguing that in practice copyright law has veered from these utilitarian underpinnings).

212. Jeanne C. Fromer, *An Information Theory of Copyright Law*, 64 EMORY L.J. 71, 75-76 (2014).

213. *Id.*

214. *See, e.g.*, Jessica Litman, *The Public Domain*, 39 EMORY L.J. 965, 967 (1990) (discussing the importance of the public domain); Christopher Jon Sprigman, *Copyright and Creative Incentives: What We Know (and Don't)*, 55 HOUS. L. REV. 451 (2017) (discussing a lack of empirical evidence linking copyright incentives to creative activity); JESSICA SILBEY, THE EUREKA MYTH: CREATORS, INNOVATORS, AND EVERYDAY INTELLECTUAL PROPERTY (2014) (discussing a variety of reasons beyond intellectual property rights, including intrinsic reasons, why people engage in creative activity).

215. Leval, *supra* note 211, at 1105.

216. *See, e.g.*, Mark P. McKenna, *A Consumer Decision-Making Theory of Trademark Law*, 98 VA. L. REV. 67, 73-81 (2012) (setting forth this theory while offering an alternative thereto).

217. *Id.*

reasoning.[218] For instance, trademark rights may help incentivize trademark owners to invest more time and effort in developing high-quality goods.[219] In other words, by providing commercial actors with rights in their marks, we provide them with greater motivation to invest in the products associated with those rights.[220] And by doing so, society benefits with more high-quality goods and services.[221]

Trade secret law also has a number of theoretical underpinnings.[222] Federal and state trade secret laws generally prohibit third parties from taking, through improper means, commercially valuable information from others that trade secret claimants have taken reasonable measures to keep secret (and which is otherwise neither generally known nor readily obtainable).[223] On the one hand, some commentators have argued that the primary purpose of trade secret law is to prevent wrongdoing by others.[224] Under this view, the purposes of trade secret law have less to do with incentivizing parties to undertake socially beneficial activities and more to do, simply, with deterring bad actors.[225]

Yet others have championed trade secret law as a means by which to encourage the development and disclosure, ironically, of socially beneficial inventions.[226] For instance, by providing parties with protections relating to their commercially valuable information, we encourage them to develop such information, which can ultimately benefit society.[227] Furthermore, with protection in place, trade secret owners may be more willing to disclose that information to others in

218. *See* William M. Landes & Richard A. Posner, *Trademark Law: An Economic Perspective*, 30 J.L. & ECON. 265, 269 (1987) (arguing that trademarks encourage producers to invest in quality and consistency in order to reap the benefits of reduced consumer search costs); David W. Barnes, *A New Economics of Trademarks*, 5 NW. J. TECH. & INTELL. PROP. 22 (2006) (arguing that trademarks are public goods similar to copyrightable expression and patentable inventions).

219. 2 PETER S. MENELL ET AL., INTELLECTUAL PROPERTY IN THE NEW TECHNOLOGICAL AGE: 2019 876 (2019) (discussing how trademarks sometimes serve as incentives to trademark owners to incur a number of costs associated with their products and services); Michael Abramowicz & John F. Duffy, *Intellectual Property for Market Experimentation*, 83 N.Y.U. L. REV. 337, 382 (2008) (justifying trademark law because "[t]rademark helps protect producers' investments").

220. Abramowicz & Duffy, *supra* note 219.

221. *Id.*

222. *See* Deepa Varadarajan, *Trade Secret Fair Use*, 83 FORDHAM L. REV. 1401, 1414-20 (2014) (discussing the different theories of trade secret law).

223. *Id.* at 1408-09.

224. Mark A. Lemley, *The Surprising Virtues of Treating Trade Secrets as IP Rights*, 61 STAN. L. REV. 311, 319 (2008).

225. *Id.*

226. Varadarajan, *supra* note 222, at 1418; Michael Risch, *Why Do We Have Trade Secrets?*, 11 MARQ. INTELL. PROP. L. REV. 1, 3 (2007).

227. Varadarajan, *supra* note 222, at 1418; Risch, *supra* note 226, at 3.

pursuit of a variety of commercial opportunities, knowing that trade secret law provides them with some legal protections in the event that recipients of their information misappropriate it.[228]

Indeed, even the view of trade secret law as a means by which to deter wrongful behavior can easily be recast into an incentives-based account. By deterring wrongful behavior, for instance, we incentivize parties to develop trade secrets, because those parties have some assurance under the law that misappropriators will be punished.[229]

Hence, each of the four primary bodies of IP law has a significant justification based in utilitarian reasoning. Commentators and courts typically justify patent and copyright laws on utilitarian grounds, with the constitutional basis for each body of law providing some justification for this approach. And trademark and trade secret laws, while not as closely aligned with utilitarian theories as copyright and patent laws, still find significant backing on the basis of utilitarianism. In the next Section, we examine these theories in light of adversity's role in inspiring innovation.

B. Adversity and Intellectual Property Laws

As discussed in Part I, certain types of adversity frequently inspire parties to innovate. And as discussed in the preceding Section, incentivizing parties to engage in socially beneficial innovation is the dominant justification for both copyright and patent laws, and a significant justification for trademark and trade secrecy laws as well. In this Section, we assess how adversity's relationship to innovation may change how we think about the utilitarian justifications for IP rights and our innovation law and policy more generally.

1. Less Intellectual Property?

On the one hand, the fact that some forms of adversity inspire innovation may mean that IP rights, at least when those adverse conditions are present, are less justified. After all, IP rights impose known social costs—including restricting access to the innovations subject to those rights.[230] But as discussed above, we accept those costs as the necessary tradeoff for motivating parties to innovate for the benefit of

228. Lemley, *supra* note 224.

229. *But see* Jon Chally, *The Law of Trade Secrets: Toward a More Efficient Approach*, 57 VAND. L. REV. 1269, 1270 (2004) (arguing that when courts focus on the morality of a party's action, that sometimes prevents courts from focusing on the best purpose of trade secrecy—to provide incentives for innovation).

230. Lemley, *supra* note 55, at 1058-59 (summarizing these costs).

society.[231] So to the extent that society can benefit from adversity-inspired innovation without the necessity of IP rights as incentives for its creation, in the abstract, at least, we should favor withholding rights from those innovations.

For instance, as discussed above, the COVID-19 pandemic has triggered a number of socially beneficial healthcare innovations. These include a number of useful healthcare products and effective vaccines.[232] If the pandemic is the primary catalyst for these innovations, then applying IP rights to them may be counterproductive, since those rights may have been unnecessary for their creation and will make access to the innovations more difficult. And a lack of access to such products is a crucial concern.[233] After all, if people cannot reasonably access the products, then the adversity that gave rise to them remains unaddressed for too many members of society.

Of course, it is difficult to say whether the parties responsible for these healthcare (and other) innovations would have pursued them absent the lure of IP rights. There has always been significant difficulty matching IP theories with reality: it is simply hard to know whether and in what circumstances IP rights are necessary to bring about innovation and creativity.[234] In fact, an entire cottage industry of scholarship has arisen in which areas of innovation where IP rights do not appear to play a significant role in incentivizing parties to innovate have been identified.[235]

In the COVID-19 crisis specifically, some innovators, even absent IP rights, almost certainly would have still pursued their innovations for altruistic, intrinsic, and similar reasons.[236] Indeed, as discussed above, much sociological research shows that calamities often lead

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231. *Id.*

232. *See, e.g.*, Laura Dyrda, *The Legacy of COVID-19: How Key Innovations Will Outlive the Pandemic*, BECKER'S HEALTH IT (May 4, 2020), https://www.beckershospitalreview.com/digital-transformation/the-legacy-of-covid-19-how-key-innovations-will-outlive-the-pandemic.html [https://perma.cc/95XW-PEE9] (discussing some of these innovations).

233. *See* Ashoka, *An Entrepreneur's Quest to Fix Drug Patents and Save Lives*, FORBES (May 26, 2020, 11:00 AM), https://www.forbes.com/sites/ashoka/2020/05/26/an-entrepreneurs-quest-to-fix-drug-patents-and-save-lives/#5ea6e867308b [https://perma.cc/U5H6-RDR4] (discussing how patents can restrict access to medical innovations).

234. *See, e.g.*, Michael Abramowicz & John F. Duffy, *The Inducement Standard of Patentability*, 120 YALE L.J. 1590 (2011) (providing recommendations about how the U.S. Patent Office and courts could better focus on the inducement standard of patentability).

235. *See, e.g.*, Elizabeth L. Rosenblatt, *A Theory of IP's Negative Space*, 34 COLUM. J.L. & ARTS 317, 322 (2011) (reviewing some of the relevant literature relating to intellectual property's "negative spaces," a term first coined and defined by Christopher Jon Sprigman and Kal Raustiala); Kal Raustiala & Christopher Sprigman, *The Piracy Paradox: Innovation and Intellectual Property in Fashion Design*, 92 VA. L. REV. 1687, 1764 (2006).

236. *See generally* Wee-Liang Tan et al., *Defining the 'Social' in 'Social Entrepreneurship': Altruism and Entrepreneurship*, 1 INT'L ENTREPRENEURSHIP & MGMT. J. 353 (2005) (defining social entrepreneurship and citing forms of altruism as an important component of such entrepreneurship).

people to engage in "prosocial, helping behaviors" and form "therapeutic communities."[237] With such norms in place, people may frequently pursue innovations simply in order to lend a helping hand in the midst of societal upheaval.[238] Even typically profit-focused companies are sometimes reluctant to be perceived as profiteering in the midst of societal distress and will innovate (or provide access to preexisting innovations) without concern for their IP rights.[239] In fact, we have seen some of that happen in the midst of COVID-19.[240]

But other parties, such as vaccine manufacturers, would almost certainly be reluctant to invest significant time and resources in developing innovations without a clear ability to recoup the costs of research and development. After all, pharmaceutical products typically cost their manufacturers hundreds of millions of dollars to develop, and IP rights are a significant means by which pharmaceutical companies recoup these costs.[241] Besides vaccine manufacturers, other parties may similarly face financial constraints that make it difficult, if not impossible, to innovate in response to adversity, even if they would like to, without the aid of IP rights or some other subsidy. For instance, parties without deep pockets may wish to innovate to help address problems associated with adverse conditions but may not be in a financial position to develop and bring to market innovations absent an ability to at least recoup their costs. Hence, while the pandemic and other adverse conditions may certainly help motivate parties' innovative efforts, in many cases IP rights may also remain an important part of the equation.

Linking these points to IP theory, many commentators have argued that IP rights provide not only important ex ante incentives to create things, but also important ex post incentives for the further development of those creations.[242] For instance, Edmund Kitch's well-known

237. Sun, *supra* note 135, at 1137-38.

238. *See, e.g.,* Amy Feldman, *Meet the Italian Engineers 3D-Printing Respirator Parts for Free to Help Keep Coronavirus Patients Alive*, FORBES (Mar. 19, 2020, 3:57 PM), https://www.forbes.com/sites/amyfeldman/2020/03/19/talking-with-the-italian-engineers-who-3d-printed-respirator-parts-for-hospitals-with-coronavirus-patients-for-free/ [https://perma.cc/H6MS-KQKM] (describing some Italian engineers' innovative efforts to use 3D printers to make up for respirator shortfalls).

239. *See* Scott Graham, *Tech Giants Pledge Their IP to COVID-19 Fight*, LAW.COM (Apr. 21, 2010, 1:17 PM), https://www.law.com/therecorder/2020/04/21/tech-giants-pledge-their-ip-to-covid-19-fight [https://perma.cc/U7H4-SZPQ] (detailing how many large companies have pledged their intellectual property for free use by anyone seeking to use the intellectual property to combat COVID-19).

240. *Id.*

241. Mirela V. Hristova, *Are Intellectual Property Rights Human Rights?—Patent Protection and the Right to Health*, 93 J. PAT. & TRADEMARK OFF. SOC'Y 339, 357 (2011).

242. *See* Michael J. Burstein, *Exchanging Information Without Intellectual Property*, 91 TEX. L. REV. 227, 237-46 (2012); Mark A. Lemley, *Ex Ante Versus Ex Post Justifications for Intellectual Property*, 71 U. CHI. L. REV. 129, 129-30 (2004) (distinguishing between "traditional economic justification" and "new justifications . . . focus[ed] not on the incentive to create new ideas, but on what happens to those ideas after they have been developed").

prospect theory argues that broad IP rights primarily serve the purpose of spearheading ongoing development of the technologies subject to them.[243] Such a theory is based at least in part on the assumption that without rights in place, excessive market competition will undermine parties' incentives to further develop inventions because that competition will reduce the profits that parties can earn from developing them.[244] Thus, by limiting competition, IP rights encourage parties to pursue development and commercialization of innovations by providing enhanced incentives in the form of greater potential profits.[245] In this narrative, IP rights may not be as much about inspiring initial creation as they are about providing parties with the rights necessary to further develop and commercialize technologies for the benefit of society.[246] In fact, this theoretical impulse underlies the Bayh-Dole Act, a federal law passed in 1980 that allows federally funded research to be patented in hopes that such patents will make it more likely that parties will commercialize the underlying inventions.[247]

Hence, when adversity leads to innovation, in many cases parties may not develop those innovations to their full potential absent IP rights. Though some parties may initially develop innovative ideas for addressing various forms of adversity, a lack of rights associated with those ideas may prevent many such parties from investing the significant time and resources necessary to commercialize or otherwise further develop those ideas for the benefit of society.[248] In some ways, these ex post theories are simply an extension of the same utilitarian

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243. Edmund W. Kitch, *The Nature and Function of the Patent System*, 20 J.L. & ECON. 265, 277-78 (1977) (articulating prospect theory).

244. *Id.*

245. *Id.*

246. *See also* Ted Sichelman, *Commercializing Patents*, 62 STAN. L. REV. 341 (2010) (proposing "commercialization" patents as a means by which to incentivize parties to commercialize patent prospects); Abramowicz & Duffy, *supra* note 219 (proposing rights for "market experimentation" due to a perception that parties may forego experimenting in the market and thereby developing valuable information in the absence of such rights).

247. *See* Michael S. Mireles, Jr., *States as Innovation System Laboratories: California, Patents, and Stem Cell Technology*, 28 CARDOZO L. REV. 1133, 1141 (2006) ("The primary purpose of the Bayh-Dole Act is to ensure that government-funded inventions are commercialized, and thus allow the public to benefit from those inventions.").

248. This is not to say that many parties will not innovate in the absence of IP rights. Some are not as dependent on IP rights as others may be and have other means by which to recoup their costs. *See, e.g.*, Catherine Clifford, *These Are the New Hot Spots of Innovation in the Time of Coronavirus*, CNBC (Jan. 12, 2021, 10:46 AM), https://www.cnbc.com/2020/04/15/hot-spots-of-innovation-as-a-result-of-coronavirus-pandemic.html [https://perma.cc/4Y8Q-UVNM] (discussing a number of innovators whose fortunes may not depend as much on IP rights as some industries such as pharmaceuticals); Karen Sebaski, *International Approaches to Accelerating Innovation and Access in the Pandemic*, IPWATCHDOG (May 26, 2020, 7:15 AM), https://www.ipwatchdog.com/2020/05/26/international-approaches-accelerating-innovation-access-pandemic/id=121878/ [https://perma.cc/L3P3-685K] (discussing how companies in the United States have been reluctant to agree to compulsory licensing schemes with respect to their patented healthcare innovations, presumably because doing so would make it more difficult to recoup their costs of development).

theme that permeates ex ante theories: parties need economic incentives to both invent socially beneficial things and take them to market.[249] And IP rights are one important means by which to provide these incentives.

Yet simply because IP rights are one means by which parties can recoup their costs of invention and development does not mean they are the only, or even necessarily the best, means of doing so. For instance, scholars have long pointed to alternative means for incentivizing innovation,[250] including direct government subsidies in the form of grants, tax breaks, and prizes.[251] Depending on the particular set of adverse conditions, some of these mechanisms may be preferable to market mechanisms in the form of IP rights for compensating inventors and developers of adversity-inspired innovations.

For example, adverse conditions posing severe consequences to large groups of people may be one of the better candidates for direct government interventions—in the forms of grants, prizes, and/or tax breaks—for a number of reasons. For starters, the severity of the situation makes leaving solutions to the market undesirable because a market failure would entail too much societal risk. Furthermore, adverse conditions posing severe societal consequences often provide a fairly clear picture of what is needed. For instance, in the case of the COVID-19 pandemic, a vaccine (or vaccines) is the dominant innovation society needed. In such scenarios, rather than letting markets play out, government interventions such as prizes, grants, and other direct government funding appear to work well when the innovation society needs is already well understood.[252]

Finally, and vitally, such government interventions may be preferable to IP rights because they would help provide a fair (but not excessive) return to developers of the products while also helping ensure that those products make their way into the hands of as many parties as possible. Indeed, as discussed above, the issue of access is crucial; otherwise, the adversity-inspired innovations in a sense become futile because they fail to address the adverse conditions that gave rise to their development.

To think about these tradeoffs more concretely, consider a vaccine for COVID-19. If a pharmaceutical company successfully develops a COVID-19 vaccine and obtains a patent for it, the company would be

249. *See* Michael J. Burstein, *Reply—Commercialization Without Exchange*, 92 TEX. L. REV. 45 (2013) (suggesting that ex ante and ex post justifications for intellectual property rights are largely similar in their economic logic).

250. *See, e.g.*, Daniel J. Hemel & Lisa Larrimore Ouellette, *Beyond the Patents-Prizes Debate*, 92 TEX. L. REV. 303 (2013) (comparing and contrasting prizes, intellectual property rights, grants, and R&D incentives).

251. *Id.*

252. Lisa Larrimore Ouellette, *Patentable Subject Matter and Nonpatent Innovation Incentives*, 5 U.C. IRVINE L. REV. 1115, 1126 (2015).

able to prevent others from manufacturing its patented vaccine without its permission, allowing the company to set its price for access.[253] That price may be high enough to prevent access by many parties in need of it, in which case the adverse conditions that helped give rise to the vaccine remain unaddressed.[254] Of course, the company may act altruistically and make the vaccine available at a relatively low cost. But the company has its investment costs, as well as shareholders, to think about. Furthermore, examples abound of pharmaceutical companies setting their prices so high that many people in need of their products are unable to afford them.[255] In the COVID-19 context, commentators have pointed out that IP rights are preventing production of vaccine doses at greater scale.[256]

On the other hand, if the vaccine was not subject to patent rights, the main obstacle to widespread access to the vaccine would be the marginal cost associated with manufacturing each additional unit of the vaccine.[257] Access in such a scenario would be much greater because the marginal cost is much less than whatever price the vaccine manufacturer sets in hopes of profiting from its innovation.[258] Hence, so long as the government provides direct funding, grants, prizes, tax breaks, or some combination thereof sufficient to incentivize development of the vaccine (i.e., by allowing the manufacturer to cover its costs and even profit some from the innovation), society would be better off without IP rights applying to the vaccine because access thereto would be greater.

Of course, in adverse conditions falling short of a pandemic or a similar situation, limiting IP rights may make less sense. For instance, we may prefer to allow market mechanisms such as IP to direct

253. FRANK L. LICHTENBERG & GAUTIER DUFLOS, TIME RELEASE: THE EFFECT OF PATENT EXPIRATION ON U.S. DRUG PRICES, MARKETING, AND UTILIZATION BY THE PUBLIC (2009), https://media4.manhattan-institute.org/pdf/mpr_11.pdf [https://perma.cc/U9ED-EPFS] (discussing the effects of patents on drug access and pricing).

254. *Id.*

255. *See* Ezekiel J. Emanuel, *Big Pharma's Go-To Defense of Soaring Drug Prices Doesn't Add Up*, ATLANTIC (Mar. 23, 2019), https://www.theatlantic.com/health/archive/2019/03/drug-prices-high-cost-research-and-development/585253/ [https://perma.cc/B6B3-7V6A] (discussing such examples).

256. Nasos Koukakis, *Countries Worldwide Look to Acquire the Intellectual Property Rights of COVID-19 Vaccine Makers*, CNBC (Jan. 22, 2021, 11:15 AM), https://www.cnbc.com/2021/01/22/countries-look-to-acquire-the-ip-of-vaccine-makers-to-fight-pandemic.html [https://perma.cc/RK87-8CLR] (discussing how countries are seeking compulsory licenses from the WHO so that they can make enough vaccine for their countries).

257. Mark Eccleston-Turner, *The Economic Theory of Patent Protection and Pandemic Influenza Vaccines: Do Patents Really Incentivize Innovation in the Field?*, 42 AM. J.L. & MED. 572 (2016) (discussing how economies of scale operate in the context of vaccine manufacturing).

258. John F. Duffy, *The Marginal Cost Controversy in Intellectual Property*, 71 U. CHI. L. REV. 37 (2004) (discussing generally the issue of marginal cost production in the context of intellectual property).

innovative activities when the consequences of doing so are less severe and it is not entirely clear what society needs in response to specific adverse conditions.[259] Typical market turbulence that poses adversity to some parties may thus be a poor candidate for the type of "command and control" government interventions for which some advocate in response to disaster events.[260]

Yet we may still generally consider limiting IP rights, even in times of less pressing adverse conditions, when industries are not as dependent on IP rights as a means of recoupment as in the pharmaceutical industry.[261] For instance, firms and other parties in the technology sector frequently do not directly monetize their IP rights, even if they use them for other purposes.[262] Instead, in some technological sectors, parties often largely depend on first-mover, data, resource, and other advantages for purposes of generating profits.[263] This is not to say that parties in these and other industries do not obtain and profit from IP rights.[264] They do. But for many parties in industries outside of the pharmaceutical industry, IP rights do not appear to be as crucial for their livelihoods. Hence, to the extent that adversity inspires their creative efforts, society may be better off in many cases limiting IP rights as they apply to those efforts, for all the reasons discussed above.

Of course, we urge caution in limiting IP rights haphazardly, whenever adversity appears to have been part of the equation. After all, given how broadly we have defined adversity, doing otherwise may amount to a call to eliminate IP rights entirely. That is not our project here, though others have taken it up.[265] Nor is our project to provide formal proposals for exactly how to limit rights. Instead, our project focuses on elucidating adversity's frequent role in directing the pace and direction of innovation, and how that role may undercut some of

259. *Id.* (discussing how efforts to achieve marginal cost production of goods and services can backfire if the government doesn't have enough information to know what society needs).

260. *See, e.g.*, Gilbert B. Siegel, *Human Resource Development for Emergency Management*, 45 PUB. ADMIN. REV. 107, 108 (1985) (discussing the importance of command and control interventions when disasters occur).

261. Burk & Lemley, *supra* note 22, at 1615-30 (2003) (arguing that patent rights are most justified in the pharmaceutical and biotechnology industries, less so in others).

262. Mark A. Lemley & A. Douglas Melamed, *Missing the Forest for the Trolls*, 113 COLUM. L. REV. 2117, 2135 (2013) (indicating that many companies in the IT industry do not seek to directly monetize their patents).

263. Stuart J.H. Graham et al., *High Technology Entrepreneurs and the Patent System: Results of the 2008 Berkeley Patent Survey*, 24 BERKELEY TECH. L.J. 1255, 1290-92 (2009) (indicating that first-mover advantages, complementary assets, and trade secrecy are the most important means for obtaining competitive advantages among software and e-commerce startups).

264. *See, e.g.*, Clark D. Asay, *The Informational Value of Patents*, 31 BERKELEY TECH. L.J. 259 (2016) (discussing a variety of reasons companies may obtain patents beyond direct monetization purposes); J. Jonas Anderson, *Nontechnical Disclosure*, 69 VAND. L. REV. 1573, 1575 (2016) (similar).

265. *See, e.g.*, Brian Martin, *Against Intellectual Property*, 21 PHIL. & SOC. ACTION 7 (1995) (discussing arguments in favor of abolishing intellectual property rights).

the theoretical need for IP rights. Overall, we believe limiting IP rights makes the most sense in response to major adverse conditions (such as a pandemic) or in particular industries, where IP rights do not appear to be vital to innovative sustainability but where adverse conditions frequently play a role in stimulating innovation.

2. More Intellectual Property?

On the other hand, the role of adversity in affecting innovation may mean that additional incentives, including bolstered IP rights, are sometimes necessary to help bring about innovation in underserved areas. For instance, while much of our discussion has focused on the types of adversity most likely to inspire innovation, that same discussion also highlights that certain kinds of adversity are more likely to inhibit or fail to motivate innovation. In such cases, the justifications for government intervention, in the form of IP rights or otherwise, may be at their peak.

Parties may sometimes lack incentives to pursue socially beneficial innovations in part because the risk of pursuing the innovation is too high. Mimicking others' innovations is often the safer route and is, indeed, the more typical path.[266] Taking bold action into uncharted waters, conversely, often poses too much uncertainty, even with typical IP rights in place.[267]

This may be particularly true in situations where adverse conditions are unlikely to inspire innovation. For instance, if a set of adverse conditions are not (yet) widely experienced, an innovator may be particularly reluctant to pursue solutions to those conditions because she is unsure to what extent society will value her solution. Similarly, fleeting or mild adverse conditions may be too risky for innovators to tackle, in part because the fleeting and mild nature of the adverse conditions make the innovator doubt that others would value such an innovation. Furthermore, in situations of long-standing, entrenched adversity, an innovator may wish to pursue something completely outside the box as a potential solution. But the "outside-the-box" character of the solution may cause her to question whether such a solution has any market viability. In such cases, the proposed innovations may be socially beneficial—and we should thus desire them—but significant uncertainty quells them. One way to incentivize parties to pursue such solutions, despite the increased uncertainty surrounding them, is to offer those innovators enhanced IP incentives.

For instance, some scholars have argued that we should offer parties a period of market exclusivity when those parties are the first to

266. *See, e.g.*, Marvin B. Lieberman & Shigeru Asaba, *Why Do Firms Imitate Each Other?*, 31 ACAD. MGMT. SCI. 366 (2006) (discussing the prevalence of imitation in the private sector).

267. *Id.*

introduce new goods and services to the market.[268] According to this line of reasoning, we should grant such parties this exclusivity because otherwise third parties could freeride on the information the first party generates about the feasibility of the market for such goods and services, thereby reducing the first entrant's profits and their incentive to take such risks in the first place.[269]

The desirability of granting such rights as a matter of course is debatable. But such rights may be particularly helpful in galvanizing socially beneficial innovation that parties would otherwise be hesitant to undertake because the adversity they face significantly increases the uncertainty surrounding their innovative efforts (e.g., the market demand is too uncertain). In other words, the period of market exclusivity may help such innovators take the plunge despite the significant market uncertainty. Similarly, it may make sense to identify other underserved areas and craft legislation similar to the Orphans Drug Act—which grants drug makers extra incentives to pursue treatments for rare diseases—so as to incentivize parties to pursue innovation where typical market mechanisms are insufficient.

In sum, bolstered IP rights make some sense in promoting innovation that we may never realize if left to the forms of adversity most conducive to innovation. Bolstered IP rights can help offset the greater uncertainties associated with innovating in areas where the market remains, as yet, undeveloped.

3. Increased Funding of Basic Research?

When adverse conditions affect only a small number of people, that adversity may fail to trigger an innovative response for obvious reasons: the adversity simply fails to impact enough people to spark a societal response. This is one of the reasons that U.S. lawmakers bolstered incentives for companies to develop treatments for rare diseases by passing the Orphans Drug Act in 1983; pharmaceutical companies had traditionally failed to pursue treatments for such diseases given the rather meager commercial opportunities associated with them.[270]

Yet developing innovations for problems that affect only small groups of people may still be socially beneficial, not only for the affected parties, but for society as a whole. For instance, those treated for a rare disease may have much to contribute to society in their

268. Abramowicz & Duffy, *supra* note 219 (proposing rights for "market experimentation" due to a perception that parties may forego experimenting in the market and thereby developing valuable information in the absence of such rights).

269. *Id.*

270. Sarah Jane Tribble & Sydney Lupkin, *Drugs for Rare Diseases Have Become Uncommonly Rich Monopolies*, NAT'L PUB. RADIO (Jan. 17, 2017, 4:59 AM), https://www.npr.org/sections/health-shots/2017/01/17/509506836/drugs-for-rare-diseases-have-become-uncommonly-rich-monopolies [https://perma.cc/L8YE-JZXQ] (describing some of the history of and purposes behind the Orphans Drug Act).

improved conditions.[271] The innovations may also help solve other societal problems that affect larger numbers of people, as accidental discoveries in research are a common phenomenon.[272] Of course, society cannot pursue research into every possible adverse condition it faces. But it remains the case that society may frequently benefit, even significantly, from innovations it chooses not to pursue in part because the adversity those innovations would address directly impacts too few people.

Even adversity that affects large numbers of people may go largely unnoticed for long periods of time. One reason is that the adversity may lack enough immediate intensity to foment innovative action. For instance, while many parties now seek innovative solutions to global warming issues, the reality is that the causes of global warming have long been in play, and parties have been aware of them for some time.[273] Yet despite the long-standing presence of these adverse conditions, society took little action in response to them until rather late in the game (i.e., until the intensity of that adversity quite literally "heated up").[274]

Fleeting adverse conditions may also merit innovative responses, even if they are unlikely to trigger them. For instance, brief bouts of adversity can quickly transform into permanent, all-consuming hardships without early innovative responses.[275] In such cases of adversity, the conditions never satisfy the Goldilocks principle because the adversity quickly goes from one extreme (too little) to the other (too much). Often, the result is a lack of innovative responses early on and greater difficulty in innovating around the now entrenched problem later.[276] In many of these cases, society suffers in consequence.

We should thus encourage innovation that may at some point prove to be socially beneficial, even when adverse conditions and market

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271. In fact, those affected by rare diseases often show innovative capacity in finding solutions to their own problems. *See* Pedro Oliveira et al., *Innovation by Patients with Rare Diseases and Chronic Needs*, 10 ORPHANET J. RARE DISEASES 41 (2015).

272. *See, e.g.*, David Nield, *Statistics Show Half of All Inventions Happen by Accident*, SCI. ALERT (Mar. 7, 2016), https://www.sciencealert.com/the-statistics-say-half-of-all-inventions-happen-by-accident [https://perma.cc/HY6K-9NJX] (estimating that fifty percent of patents are the result of an accident in some regard).

273. *See* SPENCER R. WEART, THE DISCOVERY OF GLOBAL WARMING (Harvard Univ. Press rev. ed. 2008) (discussing early scientific understanding of global warming).

274. *See generally* DAVID. G. VICTOR, THE COLLAPSE OF THE KYOTO PROTOCOL AND THE STRUGGLE TO SLOW GLOBAL WARMING (2001) (describing some of the struggle to find global solutions to global warming).

275. *See, e.g.*, Donald Sull, *Why Good Companies Go Bad*, HARV. BUS. REV. (July-Aug. 1999), https://hbr.org/1999/07/why-good-companies-go-bad [https://perma.cc/7P9J-CQFV] (discussing how companies often perceive problems but then fail to address them by engaging in "active inertia," or simply undertaking the same types of actions they have in the past but failing to innovate around the problems).

276. *Id.* (describing companies that failed to innovate in response to early challenges to their market positions, and how those companies were never able to recover from such setbacks).

mechanisms in the form of typical IP rights are unlikely to incentivize or be conducive to their creation. One way to do this is by devoting more resources to basic research.[277] The National Science Foundation defines basic research as "activity aimed at acquiring new knowledge or understanding without specific immediate commercial application or use."[278] In contrast, applied research is "aimed at solving a specific problem or meeting a specific commercial objective,"[279] while experimental development research aims at "producing new products or processes or to improving existing products or processes."[280] Devoting more resources to basic research is an indirect way of encouraging innovation that typical market mechanisms and innovation-inhibiting adversity fail to promote; it is not meant to address specific problems, but rather to set the stage for innovative responses later on. Hence, by focusing on knowledge production untethered from immediate commercial problems, basic research helps discover information that is relevant to solving a whole host of problems, whether those problems are likely or not to trigger immediate societal action.[281]

For instance, parties are more likely to engage in applied and development research when they are confronted with adversity, both with respect to conditions that are conducive to innovation and those that are not. A company facing stiff market competition is more likely, in the moment, to devote its efforts to researching specific ways to respond to that competition (i.e., applied and development research), not turning to research without a specific commercial objective in mind (i.e., basic research). And that applied and development research may prove successful where the market conditions present manageable challenges in terms of intensity and discreteness. In contrast, if a company is too bogged down in difficulties to effectively respond to its market troubles, its attempts at applied and development research in the moment may simply turn out to be its latest failure. For that downtrodden company, initiating a basic research program *at that moment* may be equally unhelpful and may, in fact, only compound its problems.

277. Jeffrey Mervis, *Data Check: U.S. Government Share of Basic Research Funding Falls Below 50%*, SCIENCE (Mar. 9, 2017), https://www.science.org/content/article/data-check-us-government-share-basic-research-funding-falls-below-50 [https://perma.cc/7LMF-7QBA] (discussing the purposes of basic research and distinguishing it from other types of research).

278. *Id.*

279. *Id.*

280. *Definitions of Research and Development: An Annotated Compilation of Official Sources*, NAT'L SCI. FOUND. (Mar. 2018), https://www.nsf.gov/statistics/randdef/rd-definitions.pdf [https://perma.cc/GQN6-R3TM].

281. *See generally* Ammon J. Salter & Ben R. Martin, *The Economic Benefits of Publicly Funded Basic Research: A Critical Review*, 30 RSCH. POL'Y 509 (2001) (reviewing and categorizing the benefits of basic research in helping address the "market-failure" rationale for basic research funding).

But consistent, ongoing basic research may be the key to shielding parties from the types of adverse conditions that are unlikely to inspire or be conducive to innovation. In other words, the best means by which to innovate around innovation-inhibiting adversity may be through basic research that helps prevent it from ever arising. For instance, basic research can help innovators unearth new knowledge that enables them to improve existing products or pivot to something entirely new when necessary.[282] For these and related reasons, corporations in the United States have increased their share of basic research funding in the country,[283] with companies like Google adopting policies that allow their employees to devote significant percentages of their working hours to exploratory research with no defined parameters.[284] For similar reasons, the U.S. government's recent decision to cut funding to a research group studying how bat coronaviruses infect human beings was met with significant consternation because many believe this kind of basic research could help prevent future pandemics.[285] Hence, basic research is not a palliative to innovation-inhibiting adversity, but instead may often help parties avoid those types of adverse conditions in the first place (or quickly solve them when they do arise).

Yet according to many sources, basic research funding in the United States has become increasingly inadequate, particularly with respect to funding for scientific research.[286] For instance, over the years the share of the U.S. economy devoted to basic research has "steadily shr[u]nk," with federal funding of basic research stagnating or even

282. Frank Gannon, Correspondence, *Reaping the Benefits of Basic Research*, 392 NATURE 752, 752 (1998) ("One important argument in favour of basic research . . . is that it consistently yields surprises that in turn are converted into products and even whole new industry sectors . . . .").

283. Mervis, *supra* note 277.

284. Adam Robinson, *Want to Boost Your Bottom Line? Encourage Your Employees to Work on Side Projects*, INC. (Mar. 12, 2018), https://www.inc.com/adam-robinson/google-employees-dedicate-20-percent-of-their-time-to-side-projects-heres-how-it-works.html [https://perma.cc/347P-7RJX].

285. Kim Hjelmgaard, *'What About COVID-20?' U.S. Cuts Funding to Group Studying Bat Coronaviruses in China*, USA TODAY (May 10, 2020, 4:43 AM), https://www.usatoday.com/story/news/world/2020/05/09/coronavirus-us-cuts-funding-group-studying-bat-viruses-china/3088205001/ [https://perma.cc/NX2E-HQ78].

286. Ezekiel Emanuel et al., *How the U.S. Surrendered to China on Scientific Research*, WALL ST. J. (Apr. 19, 2019, 5:30 AM), https://www.wsj.com/articles/how-the-u-s-surrendered-to-china-on-scientific-research-11555666200 [https://perma.cc/3GKU-5XGG].

declining in important areas.[287] Corporations also appear to have reduced the amount of basic scientific research they do, preferring the "golden eggs" of research while neglecting the "golden goose."[288]

Naturally, some of this neglect owes to a focus on short-term economic forces. At the federal level, one of the victims of budgetary cuts has been scientific research whose proponents face difficulties demonstrating immediate, commercially valuable applications of their research.[289] Universities, where much of the federal funding goes, have exacerbated the situation (or perhaps simply read the writing on the wall) and in many instances have reoriented themselves to partnering with government and the private sector to focus on developing innovations with clear commercial applications.[290] That trend has been amplified (or perhaps even triggered in part) by the Bayh-Dole Act, which, as mentioned above, allows federally funded research to be patented.[291] Indeed, facing budgetary shortfalls, many universities have focused on monetizing the research of their employees, including via patent licensing and litigation.[292]

Yet as we have discussed, basic research remains key, not only for the types of innovations that adversity is unlikely to inspire, but for innovation and society more generally. Hence, in line with others,[293] we urge policymakers and companies to increase funding for basic research for all the reasons discussed above.

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287. Eduardo Porter, *American Innovation Lies on Weak Foundation*, N.Y. TIMES (May 19, 2015), https://www.nytimes.com/2015/05/20/business/economy/american-innovation-rests-on-weak-foundation.html [https://perma.cc/DJE3-5G2N]; MIT, THE FUTURE POSTPONED: WHY DECLINING INVESTMENT IN BASIC RESEARCH THREATENS A U.S. INNOVATION DEFICIT (2015), https://dc.mit.edu/sites/default/files/Future%20Postponed.pdf [https://perma.cc/X5Z7-33CL]; Jonathan Dworin, *The Changing Nature of U.S. Basic Research: Trends in Funding Sources*, STATE SCI. & TECH. INST. (May 28, 2015), https://ssti.org/blog/changing-nature-us-basic-research-trends-funding-sources [https://perma.cc/6GVY-ALTT].

288. Ashish Arora et al., *Killing the Golden Goose? The Decline of Science in Corporate R&D* (Nat'l Bureau of Econ. Rsch., Working Paper No. 20902, Jan. 2015), https://www.nber.org/papers/w20902.pdf [https://perma.cc/9QAJ-BXP5].

289. Jeffrey Mervis, *Trump's New Budget Cuts All but a Favored Few Science Programs*, SCIENCE (Feb. 11, 2020), https://www.sciencemag.org/news/2020/02/trump-s-new-budget-cuts-all-favored-few-science-programs [https://perma.cc/D6S6-RFWG] (discussing favored areas of research funding because they have more clear "direct commercial applications").

290. Henry Etzkowitz & Loet Leydesdorff, *The Dynamics of Innovation: From National Systems and "Mode 2" to a Triple Helix of University-Industry-Government Relations*, 29 RSCH. POL'Y 109 (2000).

291. *See* Mireles, *supra* note 247 and accompanying text.

292. *See generally* Mark A. Lemley, *Are Universities Patent Trolls?*, 18 FORD. INTELL. PROP. MEDIA & ENT. L.J. 611 (2008) (discussing universities' increased patent licensing efforts).

293. Art Jahnke, *Who Picks Up the Tab for Science?*, BRINK (April 6, 2015), http://www.bu.edu/articles/2015/funding-for-scientific-research/ [https://perma.cc/LL8J-NJ4A] (discussing shortfalls in federal funding of science).

C. Adversity and Path Dependencies

Another important implication of our study is that innovation-promoting adversity may often result in path dependencies, and those path dependencies can direct innovation away from the most socially beneficial allocation of resources.[294] This point is related to our previous discussions above in that the types of adversity that attract the most innovation attention may often leave other areas underserved.[295] But in this subsection, we wish to draw this line of thinking out further by specifically examining how path dependencies can de facto lock parties into certain innovation avenues that result in a suboptimal use of society's innovative resources.[296]

The idea behind path dependency is relatively straightforward. As parties develop specific products, knowledge, and routines, each of these items ends up influencing the innovation choices parties make in the future.[297] Parties in a sense become "locked-in" by their previous choices because deviating too far from the products, knowledge, and routines they have previously invested in can be more costly and difficult than simply iterating on what they have done before.[298] In fact, some evidence shows that incrementally innovating in the same direction is often more profitable than changing the direction of one's innovative efforts.[299] And this is true not only of individual firms, but innovation ecosystems more broadly as well.[300] In sum, dislodging innovative parties out of path dependencies can be difficult, even if society would benefit if innovators were to explore less charted waters.

As an example, consider smartphone innovation. Once Apple introduced the iPhone, others quickly followed suit.[301] Over time, smartphones, regardless of manufacturer, have come to look and

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294. *See, e.g.*, Liscow & Karpilow, *supra* note 139 (discussing how path dependencies in climate technologies result in more innovation occurring in dirty technologies than clean technologies).

295. *See supra* Section III.B.2.

296. For a more complete discussion of this phenomenon, see Stephanie Plamondon Bair, *Innovation's Hidden Externalities,* 47 BYU L. REV. (forthcoming 2022).

297. Rod Coombs & Richard Hull, *'Knowledge Management Practices' and Path-Dependency in Innovation*, 27 RSCH. POL'Y 237 (1998) (discussing the characteristics of path dependency).

298. *Id.*

299. Philippe Aghion et al., *Carbon Taxes, Path Dependency, and Directed Technical Change: Evidence from the Auto Industry* 3 (Nat'l Bureau of Econ. Rsch., Working Paper No. 18596, 2012), https://www.nber.org/system/files/working_papers/w18596/w18596.pdf [https://perma.cc/4H42-4ZDF] (finding that path dependency results in greater profitability in the energy sector).

300. Thomas Brekke, *Entrepreneurship and Path Dependency in Regional Development*, 27 ENTREPRENEURSHIP & REG'L DEV. 202 (2015) (discussing industry-wide path dependencies in the context of a case study examining Oslo, Norway).

301. Lisa Eadicicco, *This Is Why the iPhone Upended the Tech Industry*, TIME (June 29, 2017, 7:00 AM), https://time.com/4837176/iphone-10th-anniversary/ [https://perma.cc/K3PQ-PH34] (discussing the iPhone's impact on smartphone innovation).

behave very similarly.[302] Furthermore, app development for the various smartphone platforms has proliferated, with millions of innovators devoting their lives to software development for mobile platforms.[303] None of this is to say that smartphones and their apps are a social harm, though some might make that argument.[304] Instead, it is to illustrate that once a major innovation occurs, that innovation tends to dictate much of the trajectory of subsequent innovation, including what lines of development parties choose to pursue. And while we may all benefit from smartphones and their apps, that path dependency has costs, too.

For instance, presumably society could achieve the same benefits of smartphone innovation with fewer of society's innovators devoting themselves to smartphone app development. But the ease with which potential innovators can join the fray, and the possibility of scoring a quick hit, are sufficient lures to attract many innovators into the game.[305] The result may often be excessive focus on some areas of technological development to the detriment of others.

IP rights can exacerbate these concerns. For instance, the prospect of these rights, and the potential financial benefits that they represent, can motivate parties to pursue innovations in already crowded spaces.[306] In fact, some scholars argue that this is a feature, not a bug, of IP rights.[307] While that may be in certain cases, the reality is that IP rights can exacerbate technological path dependencies and lead to wasteful duplication of efforts.[308] And by doing so, many of society's other needs may go underserved.

Now consider path dependencies more specifically in the context of both innovation-promoting and innovation-inhibiting adversity. When adversity promotes innovation, it can help create path dependencies that overly concentrate innovative resources. For instance, COVID-19

302. Mariyan Slavov, *Why Do All Smartphones Look the Same?*, PHONEARENA.COM (May 18, 2020, 6:35 AM), https://www.phonearena.com/news/Why-do-all-smartphones-look-the-same_id124123 [https://perma.cc/G59N-KW8N] (discussing how phone manufacturers tend to copy one another).

303. Amber Bouman, *The Mobile Application Explosion*, INFOWORLD (Feb. 26, 2009, 11:49 AM), https://www.infoworld.com/article/2634055/the-mobile-application-explosion.html [https://perma.cc/7JZ2-XCEY] (discussing the early days of the mobile app explosion).

304. *See generally* Maya Samaha & Nazir S. Hawi, *Relationships Among Smartphone Addiction, Stress, Academic Performance, and Satisfactions with Life*, 57 COMPUTS. HUM. BEHAV. 321 (2016) (examining some of the possible negative effects of smartphones).

305. *See, e.g.*, David Gewirtz, *How to Break into the Mobile App Business with Little Cash and No Programming Skill*, ZDNET (Jan. 3, 2017), https://www.zdnet.com/article/how-to-break-into-the-mobile-app-business-for-free-or-cheap-and-no-programming-skill/ [https://perma.cc/LD53-Q2V3] (discussing the low barriers to entry and high possible rewards of app development).

306. *See generally* Yoo, *supra* note 55.

307. *Id.*

308. Udayan Roy, *Economic Growth with Negative Externalities in Innovation*, 19 J. MACROECON. 155, 156-57 (1997).

has led to a rush to develop an effective vaccine.[309] And while obtaining an effective vaccine is certainly a social good, if excessive numbers of innovators pursue the same thing, other societal needs may go unaddressed, now and in the future. Furthermore, all of the resources devoted to a vaccine may be unnecessary to successfully develop one, leading to a wasteful duplication of innovation efforts.[310] Finally, the tools, knowledge, and routines developed in pursuit of the vaccine frequently constrain parties' future innovation choices, including with respect to ongoing efforts to develop a better COVID-19 vaccine.[311]

Of course, it is difficult to know when too many innovators are pursuing a particular innovation, particularly because multiple parties working on related innovations can result in spillovers that benefit an innovation ecosystem overall.[312] Furthermore, incremental, iterative innovation seems to be how most innovation happens, particularly in this day and age.[313] Nonetheless, in the vaccine context and others, innovation-promoting adversity can both inspire socially beneficial innovation *and* contribute to socially harmful path dependencies by promoting duplicative innovation efforts and effectively constricting future innovation choices.

The other side of the adversity coin is that when innovation-promoting innovation contributes to path dependencies, those path dependencies further seal the neglected fate of the search to find solutions to innovation-inhibiting adversity. In other words, not only does innovation-promoting adversity help direct innovative attention away from innovation-inhibiting adversity in the moment, it also tends to make a future rescue even more unlikely through path dependencies.

In an ideal world, innovative resources would be coordinated in a way that all societal needs receive the appropriate level of attention. That ideal, of course, is impossible to achieve as a practical matter. And how best to address path dependencies occupies an entire field of study, which we cannot canvass here.[314] Some of the ideas that we discussed above, including increasing funding for basic research, could help by ensuring the availability of resources for knowledge production more generally. Furthermore, it may make sense to revisit the premise

309. Tina Hesman Saey, *A COVID-19 Vaccine May Come Soon. Will the Blistering Pace Backfire?*, SCIENCENEWS (Jan. 10, 2020, 6:00 AM), https://www.sciencenews.org/article/coronavirus-covid-19-vaccine-clinical-trials-speed-safety [https://perma.cc/PKK6-ZUYK] (discussing the race to develop a vaccine).

310. *See* Roy, *supra* note 308 at 156.

311. *See* Coombs & Hull, *supra* note 297.

312. Frischmann & Lemley, *supra* note 139, at 257 (discussing spillovers as largely positive).

313. Suzanne Scotchmer, *Standing on the Shoulders of Giants: Cumulative Research and the Patent Law*, 5 J. ECON. PERSP. 29, 31 (1991).

314. *See, e.g.*, Björn Remneland-Wikhamn, *Path Dependence as a Barrier for 'Soft' and 'Open' Innovation*, 5 INT'L J. BUS. INNOVATION & RSCH. 714 (2011) (discussing path dependency barriers to firms adopting open innovation).

of the Bayh-Dole Act, because patenting federally funded research can have the effect of creating path dependencies by steering researchers towards more commercially viable research and away from more abstract or fundamental investigations. Nonetheless, our primary goal in this subsection is to identify path dependence as a key concern when considering adversity's relationship to innovation. Path dependence resulting from adversity-inspired innovation can certainly result in societal benefits, such as a robust smartphone ecosystem and ever-improving vaccine treatments. But it is also vital for policymakers to grapple with the costs of such path dependence, including duplicative, wasteful innovation efforts and a de facto constriction of future innovation avenues.

CONCLUSION

Adversity often stimulates innovation, but it sometimes harms it, too. In this Article, we have sought to separate the wheat from the chaff. In doing so, we highlight the Goldilocks principle: for adversity to have the best chance of stimulating innovative responses, it must be "just right," or somewhere in the middle, in terms of duration, breadth, intensity, commonality, and consequences. Adversity at either of the extremes on any of these dimensions has less of a chance of inspiring innovation, though individual and organizational characteristics also figure into the question.

Our analysis has implications for IP laws and innovation policy more generally. IP rights may be less needed when adverse conditions do most of the work in stimulating innovation. But when innovation-inhibiting adversity is at play, bolstered IP rights and other types of government interventions may have their greatest justification. And even when adversity inspires innovation, policymakers should be cognizant of innovation path dependencies that may result.

We believe this is the beginning of an important research agenda, and we urge other researchers, as well as policymakers, to further explore and account for adversity's relationship to innovation in developing innovation law and policy. For better or worse, future research into these important topics can depend on at least one constant: there will always be plenty of adversity to go around.