ANTISOCIAL INNOVATION

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Innovation is a form of civic religion in the United States. In the popular imagination, innovators are heroic figures. Thomas Edison, Steve Jobs, and (for a while) Elizabeth Holmes were lauded for their vision and drive and seen to embody the American spirit of invention and improvement. For their part, politicians rarely miss a chance to trumpet their vision for boosting innovative activity. Popular and political culture alike treat innovation as an unalloyed good. And the law is deeply committed to fostering innovation, spending billions of dollars a year to make sure society has enough of it. But this sunny vision of innovation as purely beneficial is mistaken. Some innovations, like the polio and Covid-19 vaccines, are unquestionably good for society. But many innovations are, on balance, neutral, and many more are simply bad for society (cigarette additives, worker surveillance, firearm bump stocks), or potentially catastrophic (artificial intelligence). Moreover, some neutral innovations transfer wealth from one group to another in ways that might be morally objectionable (pricing algorithms).

This Article argues that a fuller conception of innovation's costs and benefits counsels a reorientation of law and policy. It begins with a taxonomy of various kinds of antisocial innovation, cataloging and describing individual, environmental, competition, labor, privacy, and societal

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harms. Then, the Article presents a series of policy recommendations to begin addressing antisocial innovation's risks. We also consider further opportunities for law to engage in ex ante regulation of some kinds of innovation, to prevent harms before they arise.

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I. INTRODUCTION

Americans have an enduring love affair with innovation. In a nation starkly divided on so many issues, we remain unified in our devotion to the novel product, the new service. Even Presidents Obama and Trump agreed on this point, if on little else. In 2011, President Obama used his State of the Union speech to highlight the importance of innovation to the American economy. He asserted that "[t]he first step in winning the future is encouraging American innovation."[1] Some years later, candidate Donald Trump promised that, if elected president, he would ensure that "America will become the world's great magnet for innovation and job creation."[2] Within months of taking office in 2017, President Trump established the White House Office of American Innovation, which he asserted would "develop innovative solutions to many problems our country faces."[3] In politics, maximizing innovation is one of the few remaining areas of strong bipartisan agreement, even if disagreements about how to achieve that goal remain.[4]

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[1] Barack Obama, Remarks of President Barack Obama in State of Union Address—As Prepared for Delivery (Jan. 25, 2011), https://obamawhitehouse.archives.gov/the-press-office/2011/01/25/remarks-president-barack-obama-state-union-address-prepared-delivery.

[2] Tessa Berenson, *Read Donald Trump's Speech on Jobs and the Economy*, TIME (Sept. 15, 2016), https://time.com/4495507/donald-trump-economy-speech-transcript.

[3] Press Release, White House, President Donald J. Trump Announces the White House Office of American Innovation (OAI), (Mar. 27, 2017), https://trumpwhitehouse.archives.gov/briefings-statements/president-donald-j-trump-announces-white-house-office-american-innovation-oai.

[4] Indeed, more than 60% of Presidential State of the Union speeches have mentioned innovation since the beginning of President Reagan's first term, and seventeen of the last twenty-one have done so. *See Annual Messages to Congress on the State of the Union (Washington 1790–the Present)*, AM. PRESIDENCY PROJECT, https://www.presidency.ucsb.edu/documents/presidential-documents-archive-guidebook/annual-messages-congress-the-state-the-union#Table%20of%20SOTU (last visited Sep. 17, 2023). President Obama's 2011 address holds the record with eleven mentions of innovation. Obama, *supra* note 1; *see also* Adam Thierer & Connor Haaland, *The Clinton-Bush-Obama-Trump Innovation Vision*, MERCATUS CTR. (Nov. 21, 2019), https://www.mercatus.org/economic-insights/expert-commentary/clinton-bush-obama-trump-innovation-vision ("[D]espite some differences from one administration to the next, America has had a fairly consistent innovation policy vision over the past 25 years, especially as it pertains to the modern digital economy and information technology sectors.").

This political consensus reflects broad agreement among the general public about the importance of innovation.[5] A recent survey on Americans' views toward innovation found that 92% of respondents "believe that innovation is a big part of American culture and history" and that 77% believe the U.S. is "one of the world's leaders in innovation."[6] And in a 2017 poll asking Americans what has improved life the most over the past half-century, "technology" was the number one response, chosen by 42% of respondents; advances in medical care was number two, chosen by 14%.[7] By contrast, "Civil and equal rights" and "Peace/End of wars" polled at 10% and 1%, respectively.[8]

Of course, in the business community, innovation is pursued with an almost religious fervor.[9] The management consultancy McKinsey contends that "[i]nnovation is critical to growth, particularly as the speed of business cycles continues to increase."[10] It touts its "Eight Essentials of Innovation" and observes that the "best companies find ways to embed innovation into the fibers of their culture, from the core to the periphery."[11] Among the bestselling business books are many that focus on innovation and how to achieve it, including Clayton Christensen's *The Innovator's Dilemma* and Bernadette

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[5] *See, e.g.*, Roberta B. Ness, *Promoting Innovative Thinking*, 105 AM. J. PUB. HEALTH S114, S114 (2015) ("Americans love innovation.").

[6] *Americans Report Positive Attitudes and Optimism Toward Technology,* IPSOS (Mar. 1, 2019), https://www.ipsos.com/en-us/news-polls/americans-report-positive-attitudes-and-optimism-toward-technology.

[7] Mark Strauss, *Four-in-Ten Americans Credit Technology with Improving Life Most in the Past 50 Years*, PEW RSCH. CTR. (Oct. 12, 2017), https://www.pewresearch.org/fact-tank/2017/10/12/four-in-ten-americans-credit-technology-with-improving-life-most-in-the-past-50-years.

[8] *Id.*

[9] However, reverence for innovation also extends to the non-profit sector. *See, e.g.*, Judith Rodin, *The Power of Innovation*, ROCKEFELLER FOUND. (Oct. 4, 2013), https://www.rockefellerfoundation.org/blog/the-power-of-innovation ("The social sector has the capacity to use many of the same traits that have made us successful for the last century—characteristics that position us to continue to be a driver of innovation for the next 100 years.").

[10] *Growth and Innovation*, MCKINSEY & CO., https://www.mckinsey.com/business-functions/strategy-and-corporate-finance/how-we-help-clients/growth-and-innovation (last visited Sep. 17, 2023).

[11] Marc de Jong, Nathan Marston & Erik Roth, *The Eight Essentials of Innovation*, MCKINSEY Q. 11 (Apr. 1, 2015), https://www.mckinsey.com/business-functions/strategy-and-corporate-finance/our-insights/the-eight-essentials-of-innovation.

Jiwa's *Meaningful: The Story of Ideas that Fly*.[12] Top business publications compile lists of the most innovative business leaders,[13] and business schools offer popular courses on becoming an innovative executive.[14]

The scholarly literature on innovation focuses overwhelmingly on how innovation occurs and ways to increase it.[15] Typical of this approach is the business school literature on fostering innovation, which is voluminous.[16] Scholars have identified an emerging field in innovation studies, whose proponents focus on the sources of innovation, including at the firm and national levels, and the

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[12] *20 Best-Selling Business Books of All Time*, BOOKAUTHORITY, https://bookauthority.org/books/best-selling-business-books (last visited Sep. 17, 2023); *see also* Dan Dzombak, *The 12 Best Business Books of All Time*, USA TODAY (Nov. 8, 2014), https://www.usatoday.com/story/money/business/2014/11/08/the-12-best-business-books-of-all-time/18659453 (promoting two books focusing on innovation: *The Innovator's Dilemma* and *Zero to One* by Peter Thiel and Blake Masters).

[13] *See, e.g.*, *America's Most Innovative Leaders*, FORBES (2019), https://www.forbes.com/lists/innovative-leaders/#7f48730126aa (listing 100 business leaders); Melissa Stanger & Melia Robinson, *The Most Innovative People Under 40*, BUS. INSIDER (Nov. 7, 2013, 1:05 PM), https://www.businessinsider.com/most-innovative-people-under-40-2013-10 (listing innovative business leaders under forty years old).

[14] *See, e.g.*, *Corporate Innovation: Strategies for Leveraging Ecosystems*, MIT MGMT. EXEC. EDUC., https://www.getsmarter.com/products/mit-sloan-corporate-innovation-strategies-for-leveraging-ecosystems-online-program (last visited Sept. 15, 2023) (stating that students will "walk away with . . . [t]he tools and frameworks to facilitate ongoing innovation in [their] compan[ies]"); *Innovative Product Leadership: The Emerging Chief Product Officer*, STANFORD GRADUATE SCH. BUS., https://www.gsb.stanford.edu/exec-ed/programs/innovative-product-leadership (last visited Sept. 15, 2023) (promising to help students "[l]earn product management strategies, innovative approaches, and bold leadership required in the C-suite").

[15] *See* Gianluca Biggi & Elisa Giuliani, *The Noxious Consequences of Innovation: What Do We Know?*, 28 INDUS. & INNOVATION 19, 19 (2021) ("Most of the scientific work in the field of innovation studies starts from the assumption that innovation contributes to firm growth and survival and to the growth of the economic system more broadly.").

[16] *See, e.g.*, Daniela Adreini, Cristina Bettinelli, Nicolai J. Foss & Marco Mismetti, *Business Model Innovation: A Review of the Process-Based Literature*, 26 J. MGMT. & GOVERNANCE 1089, 1090 (2022), (reviewing research in 114 papers on business model innovation processes); Michael Boyles, *Innovation in Business: What It Is and Why It's So Important*, HARV. BUS. SCH. ONLINE (Mar. 8, 2022), https://online.hbs.edu/blog/post/importance-of-innovation-in-business (providing "an overview of innovation in business, why it's important, and how you can encourage it in the workplace"); Gary P. Pisano, *The Hard Truth about Innovative Cultures*, HARVARD BUS. REV. Jan.–Feb. 2019, at 62, 65 (2019), https://hbr.org/2019/01/the-hard-truth-about-innovative-cultures (discussing the "tougher and frankly less fun behaviors" needed for an innovative culture).

relationship between innovation and economic growth.[17] Economists studying innovation also tend to focus on its origins and its role in propelling economic expansion. Classic examples in this field include Joseph Schumpeter's work on creative destruction[18] and Kenneth Arrow's contributions on competition and innovation.[19] More recent work is in a similar vein.[20]

And this isn't just cheap talk. Far from it. The United States and other western nations spend trillions of dollars a year encouraging innovation.[21] Some of this money comes in the form of direct research grants and subsidies.[22] Another significant percentage involves tax rebates.[23] And one of the largest innovation incentives is patent law, which gives inventors exclusive rights to their

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[17] *See, e.g.*, Jan Fagerberg & Bart Verspagen, *Innovation Studies—the Emerging Structure of a New Scientific Field*, 38 RSCH. POL'Y 218, 221–22 (2009) (describing the subject matter of innovation studies).

[18] *See* JOSEPH A. SCHUMPETER, CAPITALISM, SOCIALISM, AND DEMOCRACY 82 (3d ed. 1950) (discussing the "process of industrial mutation . . . that incessantly revolutionizes the economic structure *from within*, incessantly destroying the old one, incessantly creating a new one" and stating that "[t]his process of Creative Destruction is the essential fact about capitalism").

[19] For examples of Arrow's contributions, see generally Kenneth J. Arrow, *Economic Welfare and the Allocation of Resources for Invention*, *in* THE RATE AND DIRECTION OF ECONOMIC ACTIVITIES: ECONOMIC AND SOCIAL FACTORS 609 (1962); Kenneth J. Arrow, *Innovation in Large and Small Firms*, 2 J. SMALL BUS. FIN. 111 (1993). *See also* Jonathan B. Baker, *Beyond Schumpeter vs. Arrow: How Antitrust Fosters Innovation*, 74 ANTITRUST L.J. 575, 576 (2007) (analyzing Schumpeter's and Arrow's approaches on how best to encourage innovation and concluding that "antitrust rules and enforcement today are appropriately focused to promote innovation").

[20] This literature is far too vast to canvas, but see generally, for example, WILLIAM BAUMOL, THE FREE-MARKET INNOVATION MACHINE (2002); SUZANNE SCOTCHMER, INNOVATION AND INCENTIVES (2006).

[21] In 2020, the United States spent over $720 billion on efforts to spur innovation. JOHN F. SARGENT JR., CONG. RSCH. SERV., R44283, GLOBAL RESEARCH AND DEVELOPMENT EXPENDITURES: FACT SHEET 2 tbl.1 (2022). Globally, $2.352 trillion was spent. *Id.*

[22] *See* Daniel J. Hemel & Lisa Larrimore Ouellette, *Innovation Policy Pluralism*, 128 YALE L.J. 544, 551 (2019) ("In the United States, direct funding from the federal government through grants and national laboratories accounts for nearly one-quarter of the five hundred billion dollars spent on research and development (R&D) each year.").

[23] *See id.* at 551–52 (stating that tax incentives meant to promote innovation cost the federal government over $20 billion annually).

discoveries, enabling them to price access to innovations at supracompetitive rates.[24]

According to all these perspectives, the biggest concern with innovation is that society might not get enough of it. Without massive government funding or monopolistic patent pricing, we may miss out on the next round of innovations that will increase economic growth, propel society forward, and improve human well-being. But what if that's not the whole story? What if it turned out that a substantial portion of innovative activity was actually bad for society as a whole? In this Article, we make just this argument.

While we are, of course, thrilled to be able to research and write this Article on internet-enabled computers, with access to clean water, indoor plumbing, antibiotics, vaccines, and a host of other modern conveniences, we don't view these transformational innovations as typical. No doubt, many innovations have radically transformed human lives, prolonging and improving them. But we shouldn't let these breakthroughs distort our view of innovation as a whole. Vanishingly few innovations dramatically improve society, while many don't really affect it at all. And, we argue, a distressingly high number make life worse. We call these antisocial innovations.

Almost no innovations are purely antisocial, in the sense that they produce only harms and no benefits. Bump stocks, which enable semi-automatic firearms to operate like fully automatic weapons, may come close, in the sense that they have no meaningful military use and exist primarily to evade regulation of machine guns.[25] More typical are innovations where the benefits to one group are outweighed by the costs to other interests. Consider the following examples.

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[24] Dan L. Burk & Mark A. Lemley, *Policy Levers in Patent Law*, 89 VA. L. REV. 1575, 1618 (2003) ("[T]he prospect of even a modest supracompetitive reward will provide sufficient incentive to innovate.").

[25] Julie Vitkovskaya & Alex Horton, *Trump Recommended Outlawing Bump Stocks. Here's What They Are*, WASH. POST, (Feb. 20, 2018, 5:12 PM), https://www.washingtonpost.com/news/checkpoint/wp/2017/10/05/what-are-bump-stocks (noting that bump stocks enable rapid gunfire but can hinder a weapon's accuracy); *see also A U.S. Appeals Court Blocks a Ban on Rapid-Fire 'Bump Stocks*,*'* NPR, (Jan. 7, 2023, 11:01 AM), https://www.npr.org/2023/01/07/1147698112/bump-stocks-ban-struck-down-court (detailing how bump stocks operate and the Fifth Circuit's holding that "bump stock weapons do not qualify as machine guns under federal law").

When California prohibited cigarette manufacturers from adding flavorings, including menthol, to their products, some producers adopted a synthetic chemical that generates menthol's cooling sensation but that does not add unlawful flavor.[26] Obviously, this change is valuable for the cigarette manufacturers, but it is almost certainly going to reduce the effectiveness of the flavor ban and, accordingly, social welfare.[27]

Pricing algorithms are another example. For centuries, merchants relied on their own judgment to set prices for their goods.[28] They were able to consider their costs, estimate their customers' willingness to pay, and perhaps apply a limited knowledge of what their competitors were charging. Before the twentieth century, merchants typically did not advertise their prices; instead, prices were based on the outcome of bargaining with individual customers.[29] With the advent in the twentieth century of convenient methods for displaying and changing prices, most retail prices were standardized: almost all consumers paid the same price for the same goods.[30] Now, many sellers, including the most powerful merchants—Amazon, Walmart, and the big airlines—rely on computer programs to set their prices.[31] These pricing algorithms generate prices based on traditional inputs like cost of goods and demand, but they can also account for the prices of multiple rivals, the time of day, day of the month, and time of year a sale is made,

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[26] *See* Christina Jewett & Emily Baumgaertner, *R.J. Reynolds Pivots to New Cigarette Pitches as Flavor Ban Takes Effect*, N.Y. TIMES (Jan. 11, 2023), https://www.nytimes.com/2023/01/11/health/cigarettes-flavor-ban-california.html (reporting R.J. Reynolds' efforts to circumvent California's ban on cigarette flavoring).

[27] For an extensive discussion of whether smokers make rational or irrational decisions to smoke, see W. KIP VISCUSI, SMOKING: MAKING THE RISKY DECISION (1992).

[28] *See* Franck Cochoy, Johan Hagberg & Hans Kjellberg, *The Technologies of Price Display: Mundane Retail Price Governance in the Early Twentieth Century*, 47 ECON. & SOC'Y 572, 577 (2018) (describing merchant pricing practices prior to the twentieth century); Alexander MacKay & Samuel N. Weinstein, *Dynamic Pricing Algorithms, Consumer Harm, and Regulatory Response*, 100 WASH. U. L. REV. 111, 153–54 (2022) (same).

[29] *Id.* at 578 ("During the bargaining era, prices were fully flexible . . . [and] were adjustable, but at the individual level only.").

[30] *Id.* ("With the new price display regime, prices were largely available . . . but at the expense of becoming more fixed. . . . [P]rices were now the same for every customer and worked according to a new 'take it or leave it' logic.").

[31] MacKay & Weinstein, *supra* note 28, at 125–26 (explaining the increased power and reach of algorithmic pricing technology).

and, with the advent of big data, they can personalize prices for individual consumers.[32] This technology is a huge step forward for sellers, but on the whole consumers will almost certainly pay more for algorithmically priced goods.[33] The same is also true for apartment rents, which may be getting more expensive because large landlords use algorithms to set prices.[34] A significant wealth transfer from consumers to sellers is the most likely result, reinforcing already alarming wealth distribution disparities in the United States.

Consider too the vast array of surveillance technologies that companies are employing in the workplace to track laborers' motion, bathroom breaks, keystrokes, and eye movements.[35] While firms may claim that surveilling workers will make them more efficient and, ultimately, reduce consumer prices, technology's impact on workers' health, privacy, and autonomy is alarming. Employees at Amazon warehouses face greater physical risks than do police officers,[36] and surveilling workers' behavior is especially damaging for labor organizers, women, and people from historically marginalized communities.[37]

Finally, take artificial intelligence (AI). Recent stunning breakthroughs in AI have created tools, like ChatGPT, that can mimic human speech and writing or create accurate images based

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[32] *See id.* at 113 (explaining the various types of data pricing algorithms use); *see also* Oren Bar-Gill, *Algorithmic Price Discrimination when Demand Is a Function of Both Preferences and (Mis)perceptions*, 86 U. CHI. L. REV. 217, 218 (2019) (noting that big data allows firms to "set personalized pricing, marching down the demand curve and setting a different price for each consumer").

[33] *See* MacKay & Weinstein, *supra* note 28, at 114 (suggesting that pricing algorithms enable firms to charge higher prices).

[34] *See, e.g.*, Rose Gilbert, *Should Algorithms Set Rent Prices? An Antitrust Trial with National Implications Is Underway in Nashville*, WPLN (June 1, 2023), https://wpln.org/post/should-algorithms-set-rent-prices-an-antitrust-trial-with-national-implications-is-underway-in-nashville/ [https://perma.cc/7SYP-GY7C] (reporting on algorithm usage in rent pricing).

[35] We discuss these technologies below. *See infra* section IV.B.*4*.

[36] *See* ATHENA COAL., PACKAGING PAIN: WORKPLACE INJURIES IN AMAZON'S EMPIRE 8 (2019), https://www.nelp.org/wp-content/uploads/NELP-Report-Amazon-Packaging-Pain.pdf [https://perma.cc/X86A-7LQ5] (comparing occupational injuries across industries).

[37] *See, e.g.*, SCOTT SKINNER-THOMPSON, PRIVACY AT THE MARGINS 9 (2021) ("[The] prevailing anti-privacy ethos creates unique problems for members of different marginalized groups.")

on text.[38] AI is likely to have a range of positive impacts for society, including automating mundane tasks humans currently perform, creating new forms of art, and helping solve challenging technical problems in science and medicine. But AI has great potential to harm society. Its ability to take on many human tasks may lead to mass unemployment. And AI machines are likely to act in unpredictable ways, even in ways that physically harm humans. Those who know AI best are among the most concerned. A group of leading AI experts, from Google, Open AI, and other firms involved in developing the technology, signed a statement warning that "[m]itigating the risk of extinction from AI should be a global priority alongside other societal-scale risks such as pandemics and nuclear war."[39]

As these examples attest, many innovations are, on balance, harmful to people. While we don't deny the value of lifesaving breakthroughs like the Covid-19 vaccine, it is important for policymakers to recognize that many, and perhaps most, innovations do not fit the rosy image offered by politicians and tech gurus. This Article begins to challenge that image, and it offers a renewed vision of policymaking in a world where innovation can be beneficial but where it can just as easily be awful.

Our first step in this direction is to categorize and taxonomize antisocial innovations. From a legal and policymaking perspective, our concern is with innovations that are privately beneficial to innovators and their clients but socially harmful. For example, some financial innovations, like credit default swaps, made a lot of money for their creators, but wreaked havoc on the global economy.[40] Similarly, the pricing algorithms just discussed are principally a means to extract money from consumers for the benefit of

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[38] *See, e.g.*, Jennifer Michalowski, *What Powerful New Bots Like ChatGPT Tell Us About Intelligence and the Human Brain*, MIT MCGOVERN INST. (Mar. 27, 2023), https://mcgovern.mit.edu/2023/03/27/smart-bots-what-language-models-like-chatgpt-tell-us-about-intelligence-and-the-human-brain/ [https://perma.cc/K693-8UMW] ("[S]ome language models . . . mimic certain aspects of human language processing.").

[39] *Statement on AI Risk*, CTR. FOR AI SAFETY, https://www.safe.ai/statement-on-ai-risk [https://perma.cc/9NPC-49F9].

[40] *See generally* Adam Davidson, *How AIG Fell Apart*, REUTERS (Sept. 18, 2008, 11:49 AM), https://www.reuters.com/article/us-how-aig-fell-apart/how-aig-fell-apart-idUSMAR85972720080918 (explaining the credit default swap and its role in the 2008 financial collapse).

suppliers.[41] And many chemicals may help firms increase profits at the expense of the environment.[42] With this understanding of what makes an innovation a net benefit or harm, we propose a taxonomy of antisocial innovations according to the kinds of harms that they cause. We categorize and elucidate six main varieties of antisocial innovation harms: individual harms to people's health, wealth, and well-being; environmental harms; harms to competition; harms to labor; privacy harms; and a catch-all category that we label social harms, involving concerns for democracy, stability, and the fair distribution of society's resources. Of course, some technologies will cause multiple varieties of harm.

The taxonomy's purpose is to demonstrate antisocial innovation's distressing breadth. We hope that it offers a valuable corrective to the widely accepted vision of innovation's beneficence. But our goals are not this modest. We also hope to begin reorienting innovation law and policy, and we conclude with a series of proposals for doing so.

We begin by noting that two of society's most important tools for promoting innovation—patents and antitrust law—treat all innovation as socially valuable.[43] Borrowing from administrative law, we refer to this as the Inverse Precautionary Principle.[44] While some regulatory agencies apply the Precautionary Principle, whereby new activities should be regulated if they pose any meaningful risk of harm,[45] patent and antitrust law apply the

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[41] *See* Pascale Chapdelaine, *Algorithmic Personalized Pricing*, 17 N.Y.U. J.L. & BUS. 1, 5–8 (2020) (contending algorithmic pricing strives towards perfect price discrimination and "maximizes suppliers' profits by reaching each consumer's maximum willingness to pay").

[42] *See, e.g.*, Michael Grunwald, *Monsanto Hid Decades of Pollution*, WASH. POST (Jan. 1, 2002), https://www.washingtonpost.com/archive/politics/2002/01/01/monsanto-hid-decades-of-pollution/244d1820-d49d-4145-9913-35644a734936 (charting Monsanto's pursuit of profits from PCBs despite its knowledge of the environmental consequences).

[43] *See* Peter Lee, *Churn*, 99 WASH. U. L. REV. 1, 5 (2021) (acknowledging the role of patent law in generating an environment that provides firms "maximal incentives to innovate"); Herbert Hovenkamp, *Antitrust and Innovation: Where We Are and Where We Should Be Going*, 77 ANTITRUST L.J. 749, 751 (2011) (contending that promoting innovation over competition is a proper objective of antitrust policy in some markets); s*ee also* Herbert Hovenkamp, *Restraints on Innovation*, 29 CARDOZO L. REV. 247, 248 (2007) (identifying antitrust and intellectual property law's shared objective of promoting innovation).

[44] *See infra* section V.A.

[45] *See* Steven L. Schwarcz, *System Risk*, 97 GEO. L.J. 193, 234–35 (2008) ("In [certain] cases, regulators often apply a precautionary principle that presumes benefits will outweigh costs.").

inverse—all innovations should be promoted irrespective of their risks.[46] Outside of pharmaceuticals and some other chemicals, our innovation governance approach is one of "beneficial until proven harmful."

A more nuanced framework, however, is required. Policymakers should realize that innovation governance involves risk-risk tradeoffs.[47] While excessive regulation may deprive society of valuable new inventions, insufficient regulation poses serious, even catastrophic risks to society. Innovation necessarily produces new and, thus, unknown pathways. It may be difficult for policymakers and regulators to know, early on, whether an innovation will be salutary, harmful, or neither. But once they recognize that society's only compelling interest in innovation currently is to generate more of it, their strategies should change.

More concretely, our account of the magnitude of antisocial innovation counsels a shift from patent incentives towards more targeted incentives like grants and prizes. Patent law is agnostic to an invention's utility.[48] A patent on a vaccine is just as valid and lasts just as long as one on a bump stock or a chemical that devastates the planet. Patent law relies on markets to sort out good innovations from bad ones.[49] Due to distortions, externalities, and cognitive biases, however, markets are often not great at picking society-wide winners and losers.[50] Accordingly, policymakers should consider spending a greater proportion of their innovation-incentivizing dollars on grants and prizes that are devoted to prosocial developments.

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[46] *See infra* Part V.A.

[47] *See* Jonathan B. Wiener, *Learning to Manage the Multirisk World*, 40 RISK ANALYSIS 2137, 2137 (2020) (introducing the "risk-risk trade-offs" concept).

[48] *See* Sean B. Seymore, *Making Patents Useful*, 98 MINN. L. REV. 1046, 1047 (2014) ("Congress has never defined 'useful' in the patent statute, or even specified from whose perspective utility is to be determined."); Michael Risch, *Reinventing Usefulness*, 2010 BYU L. REV. 1195, 1205 ("[B]ecause commercial utility is not required, moral utility is essentially ignored . . . .").

[49] *See* Hemel & Ouellette, *supra* note 22, at 560 (describing the "pure IP system," where the inventor is rewarded by market sales and property rights).

[50] *See* Jon D. Hanson & Douglas A. Kysar, *Taking Behavioralism Seriously: The Problem of Market Manipulation*, 74 N.Y.U. L. REV. 630, 633–40, 745 (1999) (arguing that irrationality and externalities contribute to market failures); Bar-Gill, *supra* note 32, at 219–23 (contending that misperceptions and bias can inflate a consumer's demand for a product).

In addition, policymakers should be open to regulating a broader swath of innovations before they reach the market rather than waiting until they have already caused (potentially irrevocable) harm. Currently, only a strictly limited set of products require governmental pre-approval before they can be marketed to consumers. Food & Drug Administration (FDA) regulation of new pharmaceuticals and Environmental Protection Agency (EPA) regulation of new pesticides and chemicals occur before products reach markets, but those regulatory regimes are the exception.[51] All other harm-causing new products are only regulated ex post, via administrative, tort, or criminal law.[52] Of course, certain categories of products are banned altogether (e.g., lead paint), but that almost always occurs only after a product has already harmed the public, making those regulations ex post.[53] Given the considerable risk of harm that many innovations pose and the challenges of ex post regulation due to agency capture and status quo bias, Congress should consider providing ex ante regulatory authority to cover innovations that have the potential to cause widespread harm, like financial innovations and those that affect privacy and labor. Although it may be too late for AI, the same is likely true of this technology as well.

Finally, antitrust law should adopt a healthy skepticism towards the claims that all innovations are procompetitive and socially beneficial. When monopolists change their products in ways that harm rivals, courts should not credulously accept those changes as valuable. Very often, they undermine competition, increase prices, and harm consumers.[54]

Before proceeding to the Article's principal arguments, two caveats are in order. First is the matter of defining innovation. Some innovation scholars might object to our categorization of antisocial activities as "innovations." They might think that bump stocks, cigarette additives, or pricing algorithms do not count as innovations if they are bad for society. We disagree. Innovations on

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[51] *See* discussion *infra* section III.B.*1*.

[52] *See* discussion *infra* section III.B.*2*.

[53] *See* discussion *infra* section III.B.*2*.

[54] *See* discussion *infra* section III.B.*3*.

our view are new goods, services, or processes that solve problems.[55] But whose problems they solve is an open question. A better pricing algorithm may solve a seller's problem while also creating problems for others. Thus, antisocial innovations are not definitionally excluded.

Second, the success of our intervention does not turn on whether we convince every reader that, in each example we describe, the innovation's costs exceed its benefits. We suspect that all these examples will have defenders who believe that they are, in the net, socially valuable. Very often, it will be difficult to know who is correct. This is due, in part, to insufficient regulatory attention to innovation's costs. We simply do not have the data to be confident in all cases. But, more fundamentally, we believe that our intervention succeeds if we convince readers that the distribution of innovation's costs and benefits is more heavily weighted towards the former than they initially believed. If that is the case, then their views about optimal innovation governance should be subject to revision.

We begin, in Part II, with a brief introduction to the mechanisms policymakers use to promote innovation, especially grants, prizes, patents, and antitrust law, and we discuss the scholarly literature on the tradeoffs between these options. Part III starts to introduce antisocial innovation and the regulatory approach that the United States takes to minimizing it. Part IV is the center of the paper. Here we elaborate our approach to understanding innovation in terms of its private costs and benefits versus its social costs and benefits. We explain which sorts of innovations need promoting and which need regulation. Part IV also includes our taxonomy of antisocial innovation, delimiting individual; environmental; competition; labor; privacy; and societal harms. In Part V, we offer a series of proposals for recalibrating innovation governance in light of these arguments. We offer potential modifications for patent, administrative, and antitrust laws.

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[55] This approach is consistent with the way courts in antitrust cases have defined innovation: as long as a design change offers a new benefit to some consumers, any competitive harms it might cause are irrelevant. *See, e.g.*, Allied Orthopedic Appliances, Inc. v. Tyco Health Care Grp., 592 F.3d 991, 1000 (9th Cir. 2010) (holding that "[t]here is no room in [the] analysis for balancing the benefits or worth of a product improvement against its anticompetitive effects").

II. INCENTIVIZING INNOVATION

Everyone loves innovation, from tech gurus to politicians to everyday citizens.[56] Innovation is considered so important to social and economic development that most countries spend enormous amounts of money promoting it.[57] From a policy perspective, the standard concern about innovation is that society will have too little of it. Innovative ideas are rare, research and development can be costly, and copying is often cheap, so policymakers fear that we will produce a suboptimal amount of innovation.[58] Accordingly, governments spend enormous amounts of money and effort, directly and indirectly, to subsidize and promote innovative activity.[59] This part briefly introduces four sets of commonly used innovation-promoting tools: (1) grants, prizes, and tax incentives; (2) patents; (3) antitrust enforcement and competition policy that aim to protect competitive markets; and (4) demand-side regulations that encourage innovative activity.

A. GRANTS, PRIZES, AND TAX INCENTIVES

The most straightforward way in which governments subsidize innovation is by giving money directly to people who will or have produced new discoveries. These are supply-side incentives, in the sense that governments attempt to stimulate innovation by rewarding innovations' suppliers.[60] This can be accomplished in at least three ways. First, government can provide grants for research and development. In the United States the federal government spends over $100 billion annually funding research and

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[56] *See supra* notes 1–14.

[57] *See Main Science and Technology Indicators*, OECD (March 2023), https://www.oecd.org/sti/msti.htm (estimating countries' spending on research as a share of GDP).

[58] *See, e.g.*, Robert P. Merges & Richard R. Nelson, *On the Complex Economics of Patent Scope*, 90 COLUM. L. REV. 839, 875 (1990) (fearing that patent policies "that are too narrow will not provide enough incentive to develop the asset, while overly broad [policies] will preempt too many competitive developments").

[59] *See Main Science and Technology Indicators*, *supra* note 57 (estimating R&D spending).

[60] *See* Christopher Buccafusco, *Disability & Design*, 95 N.Y.U. L. REV. 952, 961–63 (2020) (explaining how government incentives like utility patents and grants result in innovations that might otherwise never occur).

development efforts, including $139 billion in 2019[61] and $137.8 billion in 2020.[62] That 2019 figure represented 21% of the total funds spent on R&D in the United States that year;[63] the 2020 figure was 19.5% of the total.[64] Much of this money goes to higher education institutions and to fund basic research.[65] The bulk of federal R&D investment is directed to the defense and health care sectors.[66] State and local governments also provide grants to support R&D, though in much smaller amounts than the federal government.[67]

Prizes are a second tool governments use to directly fund innovation. Rather than paying to support research efforts ex ante, this approach allows governments (or private organizations) to reward inventors ex post who have met a specific technical challenge.[68] Innovation prizes have a long history, dating back at least to the 1714 Longitude Act, under which the British government offered prize money to anyone who could invent a way to determine longitude while at sea.[69] While the use of innovation prizes declined in the twentieth century, this strategy has been revitalized in recent years, both among private funders and at the federal government.[70] In 2010, Congress passed the American

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[61] NAT'L SCI. BD., THE STATE OF U.S. SCIENCE AND ENGINEERING 2022, at 19 (2022).

[62] SARGENT, *supra* note 21, at 2.

[63] NAT'L SCI. BD., *supra* note 61, at 19.

[64] SARGENT, *supra* note 21, at 4 tbl.1.

[65] *See* NAT'L SCI. BD., *supra* note 61, at 19 (indicating that the federal government provided 41% of funding for basic research and 50% of funding for research by the higher education sector in 2019); SARGENT, *supra* note 21, at 4 tbl.1 (showing that the federal government provided 40.6% of funds for basic research in 2020).

[66] SARGENT, *supra* note 21, at 3 fig.3.

[67] *See id.* at 4 (showing that the total nonfederal government funding for R&D in 2020 was $5 billion).

[68] *See* Michael J. Burstein & Fiona E. Murray, *Innovation Prizes in Practice and Theory*, 29 HARV. J.L. & TECH. 401, 402 (2016) ("Prizes are now actual tools of government innovation policy . . . .").

[69] B. Zorina Khan, *Inventing Prizes: A Historical Perspective on Innovation Awards and Technology Policy*, 89 BUS. HIST. REV. 631, 634–35 (2015). While this is the most famous longitude prize, other European governments had offered similar prizes before 1714. *See id.* at 635 (describing how enormous sums had been offered throughout Europe long before the British introduced their prize in 1714).

[70] This revitalization can be traced in large part to high-profile private prizes, such as the X Prize Foundation's offer of $10 million to a private sector organization that could build "a reliable, reusable, privately financed, crewed spaceship" that was able to carry three people,

COMPETES Reauthorization Act, which empowered the leaders of federal agencies to "award prizes competitively to stimulate innovation."[71] Federal agencies offered almost $250 million in innovation prize money during the 2010s.[72] While not insignificant, prizes are dwarfed by direct R&D grants as a form of government spending on innovation.

The U.S. also subsidizes innovative activity through its tax policy. As Daniel Hemel and Lisa Ouellette have shown, the U.S. government has created a number of tax credits and deductions for research and development.[73] For example, firms engaged in R&D may expense some of the costs of their investments immediately, rather than having to do so over an extended period of time.[74] They may also receive tax credits for increasing research expenditures over preexisting baselines.[75] The tax expensing and credit provisions both apply whether the claimant actually generates any new innovations or not.[76] But they cost the government a substantial sum. The Joint Committee on Taxation estimates that these two research incentives will cost the federal government over $87 billion over the years 2020–2024.[77]

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100 kilometers above the earth's surface, twice within two weeks. *Launching a New Space Industry*, X PRIZE, https://www.xprize.org/prizes/ansari [https://perma.cc/X2VD-4PFH]; Daniel J. Hemel & Lisa Larrimore Ouellette, *Beyond the Patents-Prizes Debate*, 92 TEX. L. REV. 303, 317 (2013) (explaining "recent private competitions have generated renewed interest" in innovation prizes).

[71] 15 U.S.C. § 3719(b).

[72] *See* ALI CRAWFORD & IDO WULKAN, CTR. FOR SEC. & EMERGING TECH., FEDERAL PRIZE COMPETITIONS: USING COMPETITIONS TO PROMOTE INNOVATION IN ARTIFICIAL INTELLIGENCE 8 (2021) (identifying 814 federal prize competitions between 2010 and 2020 offering a total of around $243 million).

[73] *See* Hemel & Ouellette, *supra* note 70, at 322–26 (discussing R&D tax benefits).

[74] *See* I.R.C. § 174(a) (authorizing taxpayers to immediately "charge [experimental] expenditures to capital account").

[75] *See* I.R.C. § 41(d) (detailing the qualified research credit).

[76] *See* Hemel & Ouellette, *supra* note 70, at 326 ("Estimates of the effectiveness of the R&D credit vary widely.").

[77] *See* J. COMM. ON TAX'N, JCX-23-20, ESTIMATES OF FEDERAL TAX EXPENDITURES FOR FISCAL YEARS 2020-2024, at 24 tbl.1 (2020) (totaling research tax expenditures).

B. PATENTS

When innovation scholars think about the means that governments use to encourage R&D, patents are probably the first tool that come to mind. The standard account of patents as innovation incentives is well known.[78] Inventions are public goods that are both expensive to develop and difficult to prevent others from copying.[79] Like other public goods, these features suggest that the market will not optimally supply desired inventions. If an innovator would have to spend a million dollars to develop an invention that could easily be copied by its rivals, the innovator simply won't bother to invest its money in the first place. Patents solve the public goods problem by giving inventors exclusive rights to their inventions for a limited period of time.[80] This period of exclusivity may enable inventors to charge supra-competitive prices for products that embody their inventions, thus allowing them to recoup their R&D costs and make a profit.[81]

Unlike some of the incentives described above, the government only issues patent rights to people who actually produce an invention. In order to obtain patents, inventors must demonstrate that they have generated something that is both novel and non-obvious to other skilled inventors.[82] And, in theory at least, their inventions are required to be "useful."[83]

Patents differ from prizes, grants, and tax incentives in another way. While the latter are paid directly by the government (and, thus, taxpayers) through spending, issuing patents doesn't cost the

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[78] *See, e.g.*, SCOTCHMER, *supra* note 20, at 34–39.

[79] *See* Mark A. Lemley, *Ex Ante Versus Ex Post Justifications for Intellectual Property*, 71 U. CHI. L. REV. 129, 129 (2004) ("Ideas are public goods: they can be copied freely and used by anyone who is aware of them without depriving others of their use. But ideas also take time and money to create.").

[80] *See id.* at 132 (discussing the analogy of patents to mining claims).

[81] *See, e.g.*, *id.* at 131 (discussing "the classic incentive story" of intellectual property).

[82] *See* KSR Int'l Co. v. Teleflex Inc., 550 U.S. 398, 406 (2007) (explaining patent law's obviousness doctrine (citing Graham v. John Deere Co. of Kansas City, 383 U.S. 1, 15–17 (1966))).

[83] *See, e.g.*, *Graham*, 383 U.S. at 12 (noting that "'new and useful' tests . . . have always existed in the statutory scheme"). We say "in theory" because, as we discuss below, patent law's utility requirement is entirely toothless. *See infra* notes 333–335.

government much.[84] But patents definitely have a price. Patent incentives are financed by consumers of products that incorporate patents who must pay higher prices for those goods.[85] By enabling patent owners to charge supracompetitive prices, patents act as a tax paid by consumers for the benefit of innovators.[86] Thus, unlike other innovation expenditures, when governments promote innovation with the exclusive rights patents confer, their expenditures are "off-budget."[87] This means that it is enormously difficult to estimate the size of society's contribution to innovation promotion through higher prices for patented goods.[88]

C. ANTITRUST

Promoting innovation is also among the main aims of antitrust and competition policy.[89] For over a century, U.S. law has regulated the behavior of firms to ensure that their conduct does not unduly hinder competition.[90] One of the guiding principles of this oversight is that when firms must compete, they will be more innovative.[91]

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[84] *See, e.g.*, Hemel & Ouellette, *supra* note 70, at 364 ("[T]he administrative and enforcement costs [of patents] are almost entirely paid by private parties."). The government must pay for the administrative costs of running the Patent Office. *See id.* at 365 ("[F]ees from patent applications fund the $2- to $3-billion [Patent and Trademark Office] budget." (footnote omitted)). And, sometimes, the government will be a consumer of patented technology and be forced to pay supracompetitive prices like any other purchaser. *See id.* at 312 n.25 ("The [cost of] the patent system *does* appear on budgets when the government is the purchaser of patented products.").

[85] *See id.* at 312 (calling "the higher price of patented products . . . a cost ultimately borne by consumers").

[86] *See id.* ("We can think of the higher price of patented products as a 'shadow' tax . . . .").

[87] *Id.* at 371 (footnote omitted).

[88] Hemel and Ouellette refer to a 1999 study that estimated $18 billion in patent-related spending in 1992 dollars. *Id.* at 320. That would be more than $30 billion in 2013 dollars, but there are also many more patents these days. *Id.* at 320.

[89] *See* Giulio Federico, Fiona Scott Morton & Carl Shapiro, *Antitrust and Innovation: Welcoming and Protecting Disruption*, 20 INNOVATION POL'Y & ECON. 125, 125–26 (2020) (praising antitrust policy's promotion of innovation).

[90] *See generally* 15 U.S.C. § 1 (codifying federal antitrust law).

[91] A longstanding scholarly debate persists about whether monopolies or competition are more conducive to innovation, a debate reflected in the work of Josef Schumpeter and Kenneth Arrow. *See, e.g.*, Baker, *supra* note 19, at 575 ("[T]he relationship between competition and innovation is the subject of a familiar controversy in economics."). We agree with Baker's conclusion that "antitrust intervention can systematically promote innovation

Courts and enforcement agencies thus routinely consider innovation effects when analyzing potentially anticompetitive mergers and business conduct.[92] Enforcers and scholars repeatedly emphasize the role that antitrust can and should play in promoting innovative markets.[93] In this way, antitrust law is meant to encourage innovation, not through monetary subsidies, but rather by promoting competitive markets where innovation can flourish.

In the Horizontal Merger Guidelines, for example, the Federal Trade Commission and U.S. Department of Justice assert that "[c]ompetition . . . incentivizes businesses to . . . innovate."[94] They caution that a horizontal merger—one between competing firms—could result in a merged firm reducing its level of innovation.[95] Take, for instance, a proposed merger between two pharmaceutical companies that develop cancer-fighting drugs. Suppose both companies are developing a drug to treat breast cancer. A merger

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competition and pre-innovation product market competition, which will encourage innovation, without undermining those benefits by markedly increasing post-innovation product market competition and, thus, without tending to discourage innovation." *Id.* at 576.

[92] *See* U.S. DEP'T OF JUST. & FTC, HORIZONTAL MERGER GUIDELINES 39 (2023) [hereinafter HORIZONTAL MERGER GUIDELINES], https://www.justice.gov/d9/2023-12/2023%20Merger%20Guidelines.pdf ("[A] merged firm may have a reduced incentive to engage in disruptive innovation . . . ."); Daniel F. Spulber, *Antitrust and Innovation Competition*, 11 J. ANTITRUST ENF'T 5, 5 (2023) ("Antitrust policy makers are placing greater emphasis on innovation in evaluating competitive conduct, licensing of intellectual property (IP), and mergers."); United States v. Microsoft Corp., 253 F.3d 34, 79 (D.C. Cir. 2001) (decrying the effect of "exclusionary conduct" on the "produc[tion] of nascent competitive technologies").

[93] *See, e.g.*, *Antitrust and Harm to Innovation*, *Hearing Before the S. Judiciary Comm., Subcomm. on Competition Pol'y, Antitrust & Consumer Rts.,* 117th Cong. 4 (2021) (testimony of Roger P. Alford, Professor, Notre Dame L. Sch.) https://www.judiciary.senate.gov/imo/media/doc/Alford%20Testimony1.pdf ("[I]nnovation is of particular concern in the context of mergers."); AM. ANTITRUST INST., ENTREPRENEURSHIP, INNOVATION, AND ANTITRUST 4 (2016), https://www.antitrustinstitute.org/wp-content/uploads/2018/08/EntrepreneurshipandInnovation.pdf ("[A]ntitrust merger enforcement can promote innovation in several ways."); Federico, Morton & Shapiro, *supra* note 89, at 155 (arguing for a "more assertive antitrust regime" for incumbent firms who discourage competitors from innovation).

[94] HORIZONTAL MERGER GUIDELINES, *supra* note 92, at 1.

[95] *Id.* at 39. This reduction in innovative activity could stem from "a reduced incentive to continue or initiate development of new products that would have competed with the other merging party, but post-merger would 'cannibalize' what would be its own sales." *Id.*

between them might eliminate the possibility of one of those new drugs reaching the market.

Antitrust doctrine also protects innovation by granting monopolists broad latitude to change their products even when those changes would harm competitors. This approach to innovation is particularly relevant for vertically integrated platform companies and other firms whose offerings interconnect with complementary products. When a monopolist competes with third-party rivals to make the complements, it can gain a competitive advantage by altering its monopoly platform to disadvantage those rivals.[96] Consider, for example, a dominant manufacturer of camera film that is compatible with its own cameras and those of rival camera firms. That manufacturer could decide to change its film to make it incompatible with all competing cameras, putting its downstream rivals at a disadvantage. Courts routinely decline to sanction dominant firms whose product changes harm competitors in this way.[97] To do otherwise, they caution, would require judges to evaluate product designs, a role for which they are thought to be ill-suited, and which would potentially chill desirable innovation.[98]

D. EVALUATING INNOVATION INCENTIVES

A rich scholarly literature has developed analyzing the relative merits of the various innovation incentives.[99] Three principal issues

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[96] *See, e.g.*, John M. Newman, *Anticompetitive Product Design in the New Economy*, 39 FLA. ST. U. L. REV. 681, 683 (2012) ("The archetypical design-conduct challenge alleges that a firm, dominant in one product market, designed a new version of that product so as to maximize interoperability with its own complementary product(s), essentially requiring customers to buy the two together.").

[97] *See id.* at 714–15 (noting courts' history of deference to antitrust defendants).

[98] *See, e.g.*, Allied Orthopedic Appliances, Inc. v. Tyco Health Care Grp., 592 F.3d 991, 998 (9th Cir. 2010) ("[A]s a general rule, courts are properly very skeptical about claims that competition has been harmed by a dominant firm's product design changes." (quoting United States v. Microsoft Corp., 253 F.3d 34, 65 (D.C. Cir. 2001))); ILC Peripherals Leasing Corp. v. Int'l Bus. Mach. Corp., 458 F. Supp. 423, 439 (N.D. Cal. 1978) ("Where there is a difference of opinion as to the advantages of two alternatives which can both be defended from an engineering standpoint, the court will not allow itself to be enmeshed 'in a technical inquiry into the justifiability of product innovations.'" (quoting Response of Carolina, Inc. v. Leasco Response, Inc., 537 F.2d 1307, 1330 (5th Cir. 1976))).

[99] For detailed comparisons of innovation incentives, including tax incentives, see, for example, Hemel & Ouellette, *supra* note 70, at 326–27; Bronwyn Hall & John Van Reenen,

arise with each mechanism: (1) who decides on the beneficiary and size of the payment?; (2) when is the payment received?; and (3) who makes the payment?[100] The answer to the first question, who decides, typically will be either government or the private sector.[101] With government prizes and grants, the government determines who receives funding. [102] With tax incentives and patents, while the government provides the benefit (a tax break or the right to exclude others from using an invention), private actors decide whether to avail themselves of these opportunities.[103] Those same actors or the market determine the magnitude of the reward: the size of a tax incentive is based on how much a company invests in tax-deductible research; the value of a patent is derived from the market value of the invention.[104]

Turning to when the payments are made, some mechanisms (grants, tax breaks) provide funds before the innovation occurs (ex ante).[105] Patents and prizes are designed to reward innovation that has already taken place (ex post).[106] These categories are somewhat fluid; grants could be structured so the money is delivered over several discrete periods, based on promising early results.[107]

Who pays for these innovation incentives is related to who decides in the first place. When the government decides on the

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How Effective Are Fiscal Incentives for R&D? A Review of the Evidence, 29 RSCH. POL'Y 449, 450–51 (2000); Brett Frischmann, *Innovation and Institutions: Rethinking the Economics of U.S. Science and Technology Policy*, 24 VT. L. REV. 349–54 (2000); Michael Abramowicz, *Perfecting Patent Prizes*, 56 VAND. L. REV. 115, 200–07 (2003); Michael Kremer, *Patent Buyouts: A Mechanism for Encouraging Innovation*, 113 Q.J. ECONOMICS 1137, 1146–48 (1998).

[100] *See* Hemel & Ouellette, *supra* note 70, at 327–28 (introducing key questions in innovation policy).

[101] *Id.* (discussing government and private sector roles in providing innovation incentives).

[102] *See id.* at 329 (discussing government decision-making with awarding grants and prizes).

[103] *See id.* at 327–28 (explaining how private actors interact with both patents and tax incentives).

[104] *See id.* at 328 (arguing that both tax incentives and patents "cause innovators to pursue inventions that will succeed in the market").

[105] *See id.* at 333 ("Rewards can . . . be transferred to potential innovators *ex ante*, as with grants and R&D tax incentives . . . .").

[106] *See id.* (adding that ex post rewards, such as prizes and patents, are transferred to successful innovators).

[107] *See id.* ("[A]nswers to the *when* question (reward timing) fall along a spectrum, as transfers may occur at various junctures.").

recipient and size of an incentive via a grant or a prize, those costs are socialized.[108] The costs of R&D tax incentives are also socialized, though private actors determine who receives those benefits and their magnitude.[109] When an invention is patented, however, the market decides on the size of the incentive and the costs are borne by consumers of the patented product.[110]

Scholars have debated the relative efficacy of these innovation incentives, especially prizes and patents. These debates focus mainly on the "who decides" question: is government or the private sector better situated to determine how research dollars should be spent?[111] Underlying this debate is the assumption that the private sector typically has an informational advantage over government when it comes to understanding what consumers want.[112] Where that assumption holds, patents and tax incentives are likely superior to prizes and grants in efficiently dispersing research funds. As Hemel and Ouelette argue, "[g]overnment-set rewards are inefficient when the government cannot foresee a potential invention or evaluate its costs and benefits."[113] But there are many settings where the social value of an invention outstrips its market value. Private actors are unlikely to invest in inventions that they do not expect to be profitable (or that they expect to be less profitable than other potential investments) regardless of their beneficial

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[108] *See id.* at 345 ("In the case of government grants, the answer to *who pays* is generally taxpayers.").

[109] *See id.* at 307 (noting that tax incentives depend on private actors to determine which projects are prioritized and how much is invested).

[110] *See id.* at 327 ("[W]ith the patent system, the government merely sets the ground rules . . . and the reward size is then based on the forces of supply and demand.").

[111] *See supra* note 99 and accompanying text.

[112] *See, e.g.,* Hemel & Ouellette, *supra* note 22, at 555 ("Government-set rewards entail an informational burden that bureaucrats may be ill equipped to handle, even with mechanisms like peer review and expert panels for consolidating information. Markets, by contrast, aggregate widely dispersed information regarding consumers' willingness to pay for new knowledge goods."); Brian D. Wright, *The Economics of Invention Incentives: Patents, Prizes, and Research Contracts*, 73 AM. ECON. REV. 691, 703 (1983) ("The special advantage of patents arises only from *ex ante* researcher information relating to the value of the invention.").

[113] Hemel & Ouellette, *supra* note 70, at 327.

social impact.[114] In these circumstances, government is better situated to determine where research funds should go, making grants and prizes the superior tools.[115]

To a considerable extent, contemporary innovation research has come down on the side of markets and patents as opposed to the government and grants or prizes as the superior incentive regime.[116] In these debates, markets' superior knowledge of what people want is the key to their success.[117] Markets generate information about what goods and services people desire, and patents enable innovators with new ideas to compete successfully against copyists.[118] Governments and their bureaucrats, by contrast, may not know what people desire, and they may be subject to biases or industry capture.[119] The role for grants and other ex ante incentives is largely reserved for early stage research and other areas that are not subject to commercialization.[120]

We return to these issues below when we discuss the various ways that policymakers should respond to a world in which innovations may produce both social value and social harms. We address the nature of those social harms now.

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[114] *See id.* at 329 ("[E]ven if private actors can identify the projects with the highest social benefit, they may instead pursue projects that allow them to capture the largest chunk of that benefit.").

[115] *See id.* at 328 ("Both patents and tax credits fare poorly when market signals are weak proxies for social value . . . ."); Burstein & Murray, *supra* note 68, at 416. ("Patents may therefore perform particularly poorly as incentives in industries where the social value of innovation greatly exceeds the private value accessible in a market.").

[116] *See, e.g.*, Nancy Gallini & Suzanne Scotchmer, *Intellectual Property: When Is It the Best Incentive System?*, 2 INNOVATION POL'Y & ECON. 51, 70 (2002) ("IP [such as patents] is probably the best mechanism for screening projects when value and cost are not observable by the sponsor.").

[117] *See, e.g.*, *id.* at 55 ("An investor knows that he will be punished by the market if he does not invest wisely.").

[118] *See, e.g.*, *id.* at 63 (arguing that "the optimal patent policy minimizes" the "social cost . . . of imitation").

[119] *See id.* at 56 (discussing the limits of government-sponsored innovation).

[120] *See id.* at 55 (noting the "virtues" of prizes when "an investment's prospective value is known to the sponsor").

III. INNOVATION'S DARK SIDE

Given the extensive investment that society directs towards innovation, one might conclude that it's a uniformly wonderful thing. Certainly, we are all grateful for anesthesia, clean drinking water, and indoor plumbing. But just because some innovations improve the quality of life doesn't mean that all—or even most—do. In this Part, we begin to explore innovation's dark side, the ways in which new developments and technologies can make people's lives worse. First, we describe the developing scholarly literature on antisocial innovation in contexts ranging from health and medicine to telecommunications and investing. Our goal here is simply to introduce the fundamental concern. We elaborate on it more thoroughly in the next Part. This Part concludes by addressing the mechanisms that policymakers have used to combat antisocial innovation, including regulation and tort law.

A. ANTISOCIAL INNOVATION

Unconditional love of innovation is a relatively recent phenomenon; innovation was not always viewed in such a positive light.[121] Indeed, before the Industrial Revolution in the nineteenth century, innovation often had negative connotations.[122] Between the middle of the nineteenth century and the middle of the twentieth, humanity was treated to a series of what Robert J. Gordon calls "Great Inventions."[123] Innovations in electricity, pasteurization, clean running water, transportation, and communication radically

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[121] Certainly, the Dowager Countess Grantham was no big fan of innovation. When being shown a telephone, she asked "Is this an instrument of communication or torture?" *Downtown Abbey*: *Episode Five* (ITV television broadcast Oct. 16, 2011). Gaia Bernstein has argued that "the contemporary celebration of innovation is a recent trend." Gaia Bernstein, *In the Shadow of Innovation*, 31 CARDOZO L. REV. 2257, 2273 (2010).

[122] *See, e.g.*, John Patrick Leary, *The Innovation Cult*, JACOBIN (Apr. 16, 2019), https://jacobin.com/2019/04/innovation-language-of-capitalism-ideology-disruption ("For most of its early life, the word 'innovation' was a pejorative, used to denounce false prophets and political dissidents."); Jill Lepore, *The Cult of Disruptive Innovation: Where America Went Wrong*, BIG THINK (Oct. 14, 2018), https://bigthink.com/the-present/disrupt-innovation-business/ ("Innovation historically as a word means progress without any concern for morality. Innovation in the 18th century sense is bad.").

[123] ROBERT J. GORDON, THE RISE AND FALL OF AMERICAN GROWTH 2 (2016).

altered people's lives, extending them and making them far more pleasurable.[124] According to Gordon, these inventions represent a "unique clustering" that made possible a period of unparalleled economic and social growth.[125] Since the 1970s, innovations have not kept up with the transformations brought about by the great inventions, and growth in our standard of living has slowed.[126]

Recently, a handful of scholars have gone further and pushed back on current notions of innovation as an unalloyed good, or what economist Paul David calls "the innovation fetish."[127] Alex Coad, Paul Nightingale, Jack Stilgoe, and Antonio Vezzani have argued for a more nuanced understanding of innovation, which recognizes that it "can have good and bad effects."[128] They identify various types of harmful innovation, including those unintentionally leading to environmental harm (e.g., pesticides, air conditioning), those intended to be harmful (e.g., the atomic bomb), and those intended to deceive consumers or allow firms to avoid regulation (e.g., certain financial products and e-cigarettes).[129] Similarly, Ariel Ezrachi and Maurice Stucke have recognized that innovation is not inherently good.[130] Indeed, they argue, there are many examples of what they term "negative innovation," which "work[s] against the interests of consumers and society [and] reduces overall welfare."[131] Framing the debate in moral terms, Ned Snow has argued that "some creations promote actions that are wrong, or in other words,

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[124] *See id.* at 4–5 (outlining the major inventions of the late 19th and early 20th centuries).

[125] *Id.* at 2.

[126] *See id.* at 566 ("The slower growth rate of measured productivity since 1970 constitutes an important piece of evidence that the Third Industrial Revolution (IR #3) associated with computers and digitalization has been less important that IR #2.").

[127] Paul A. David, *The Innovation Fetish Among the* Economoi*: Introduction to the Panel on Innovation Incentives, Institutions, and Economic Growth*, *in* THE RATE AND DIRECTION OF INVENTIVE ACTIVITY REVISITED 509, 509 (Josh Lerner & Scott Stern eds., 2012).

[128] Alex Coad, Paul Nightingale, Jack Stilgoe & Antonio Vezzani, Editorial, *The Dark Side of Innovation*, 28 INDUS. & INNOVATION 102, 103 (2020).

[129] *Id.* at 105–06.

[130] *See* Ariel Ezrachi & Maurice E. Stucke, *Digitalisation and Its Impact on Innovation* 53 (Eur. Comm'n Rsch. & Innovation Paper Series, Working Paper No. 2020/07, 2020), https://wbc-rti.info/object/document/20829/attach/KIBD20003ENN_en.pdf (arguing that innovation "is not an end by itself" but is an "independent variable, which . . . can lead to positive, negative, or mixed outcomes").

[131] *Id.*

they promote immoral behavior."[132] He concludes that "works that are harmful to society should not be incentivized or rewarded."[133]

Gianluca Biggi and Elisa Giuliani performed a literature review on scholarship analyzing the "noxious effects of innovation."[134] Using a custom search query, they found 125 articles published between 1991 and 2017 on harmful innovation.[135] The authors divided this body of scholarship into five "clusters": the negative impact of technology on workers; innovation's unintended negative effects on the environment; innovation's negative effects on economic growth and economic equality; the dangers of emerging technologies, such as big data and social media; and the negative effects of "open innovation" on firm performance.[136]

Other scholars have focused on the negative impact of innovation in specific economic sectors, including financial services and health care. After the 2008 financial crisis, which was linked in part to financial innovations like collateralized debt obligations and credit default swaps, some researchers questioned the benefits of financial innovation. Simon Johnson and James Kwak argued that financial innovations are different than many other types of innovation in that they do not necessarily make the world a better place.[137] In their view, the "principal purpose" of financial innovation is to facilitate "financial intermediation"—the movement of capital from unproductive uses to productive uses.[138] But not all financial intermediation is good for society. When evaluating financial innovation, the authors urged that policy makers consider whether

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[132] NED SNOW, INTELLECTUAL PROPERTY AND IMMORALITY: AGAINST PROTECTING HARMFUL CREATIONS OF THE MIND 1 (2022).

[133] *Id.* at 318.

[134] Biggi & Giuliani, *supra* note 15, at 21.

[135] *Id.* at 23. The authors "used search terms such as harm* OR unpredictable OR negative OR hazard* AND innovat* OR technolog* and several combinations of related and similar terms." *Id.* at 21.

[136] *See id.* at 25–29 (detailing the study's findings in each of these five clusters).

[137] *See* Simon Johnson & James Kwak, *Is Financial Innovation Good for the Economy?*, 12 INNOVATION POL'Y & ECON. 1, 2–3 (2012) ("[F]inancial innovation . . . does not make the world better in and of itself.").

[138] *Id.* at 2–3.

the financial intermediation it facilitates is "beneficial" or "excessive and destructive."[139]

Scholars have also studied the effects of harmful innovation in the health care sector. Shobita Parthasarathy has shown how certain health care innovations can be socially harmful, at least in some populations.[140] The pulse oximeter is an example. Parthasarathy explained that the company that commercialized this technology failed to test it on patients with different skin tones, with the result that the oximeter is less accurate for Black users than for white users.[141] These oximeters sometimes produced results for Black users showing inflated blood oxygen levels, potentially causing those users to decide against seeking medical attention when such attention was warranted.[142] Patents on the oximeter prevented competing devices from being developed, exacerbating the problem.[143]

The foregoing provides a brief sense of the scope and scale of antisocial innovation. But while some recent scholarship has explored the potential for innovation to harm society, the bulk of the scholarly literature across disciplines continues to treat innovation as a purely salutary goal and seeks to unlock ways to increase the production of new inventions.

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[139] *Id.* at 4. An example of beneficial financial innovation is the development of microfinance in the 1970s, which provided funds to poor people who otherwise had no access to capital. *See, e.g.*, *id.* (describing how Grameen Bank's microcredit loans were "economically productive"). Johnson and Kwak argued that collateralized debt obligations and credit default swaps are examples of harmful innovations, which ultimately destroyed value for investors. *See id.* at 6 (calling CDOs and CDSs "value-destroying activities"); *see also* Chris Brummer & Yesha Yadav, *Fintech and the Innovation Trilemma*, 107 GEO. L.J. 235, 243 (noting that, while financial innovations "present the possibility for welfare gains, . . . the longer-term effects of many innovations remain unclear.")

[140] *See* Shobita Parthasarathy, *Health Innovation Policy for the People*, DEMOCRACY COLLABORATIVE 7 (2021), https://thenextsystem.org/sites/default/files/2021-11/Health-innovation-policy-FINAL.pdf (arguing that U.S. health policy "creates innovation incentives that are actually harmful for marginalized communities").

[141] *See id.* at 12 (recounting the testing failures).

[142] *See id.* (recounting that Black users "might erroneously delay needed trips to the hospital for supplemental oxygen" due to the oximeter failures).

[143] *Id.*

B. REGULATING ANTISOCIAL INNOVATION

We do not mean to suggest that policymakers are unaware of the potential for innovations to cause harm. Nuclear disasters and the birth defects caused by thalidomide are well-known cautionary tales of innovation gone wrong.[144] And, of course, a range of regulatory mechanisms exist to protect the public from harmful products.[145] While some of these mechanisms operate before products have reached the market, most of them arise only after—sometimes long after—people have suffered harm. Here we catalogue the principal regulatory tools for minimizing antisocial innovation.

1. Ex Ante Regulation of New Products. In some markets, firms are required to seek regulatory pre-approval before marketing new products. Pharmaceuticals are probably the best-known example. When a firm wants to introduce a new drug, the Food, Drug and Cosmetic Act requires that the firm file a New Drug Application with the U.S. Food and Drug Administration.[146] The filing requirements can be onerous, especially the mandate that the applicant conduct clinical trials to demonstrate that the new drug is "safe" and "effective."[147] The goal is to mitigate the risk that unregulated new drugs could cause severe harm to many patients.[148]

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[144] *See* Akira Ohtsuru et al., *Nuclear Disasters and Health: Lessons Learned, Challenges, and Proposals*, 386 LANCET 489, 489 (2015) (summarizing key lessons to be learned from nuclear disasters); Neil Vargesson, Review, *Thalidomide-Induced Teratogenesis: History and Mechanisms*, 105 BIRTH DEFECTS RSCH. (PART C) EMBRYO TODAY 140, 140 (2015) (recounting how thalidomide prescriptions to pregnant people in the 1950s and 60s resulted in over 10,000 children born with severe malformations).

[145] *See* discussion *infra* section III.B.*1–3*.

[146] *See* 21 U.S.C. § 355(a) ("No person shall introduce . . . any new drug, unless an approval of an application . . . is effective with respect to such drug.").

[147] *See id.* § 355(b)(1)(A)(i) (requiring that any person filing a New Drug Application must submit "full reports of investigations which have been made to show whether any such drug is safe for use and whether such drug is effective in use"); *see also* FTC v. Actavis PLC, 570 U.S. 136, 142 (2013) ("[A] drug manufacturer, wishing to market a new prescription drug, must submit a New Drug Application to the federal Food and Drug Administration (FDA) and undergo a long, comprehensive, and costly testing process.").

[148] *See* Richard A. Posner, *Regulation (Agencies) Versus Litigation (Courts)*, *in* REGULATION VS. LITIGATION: PERSPECTIVES FROM ECONOMICS AND LAW 11, 16 (Daniel P. Kessler ed., 2010) (explaining the rationale for ex ante regulation of drugs, including that "[a] drug sold to millions of people can, if it is unsafe, wreak enormous harm . . . .").

Certain environmental laws take a similar ex ante approach to protecting the public from harmful new products. For example, the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) requires firms that want to sell a new pesticide to register it with the EPA first.[149] To secure EPA registration, applicants must show that the pesticide "will not generally cause unreasonable adverse effects on the environment."[150] The Act also gives the EPA authority to cancel a pesticide's registration ex post if it turns out to pose unacceptable risks which the manufacturer has not or cannot remediate.[151]

Similarly, the Toxic Substances Control Act requires firms to provide the EPA with pre-manufacture notification of any "new chemical substance" ninety days before manufacturing the chemical.[152] The EPA is then required within a certain time period to review the notification and determine whether the chemical substance "presents an unreasonable risk of injury to health or the environment . . ." (or if it does not pose such a risk).[153] The EPA can also determine that it lacks sufficient information to evaluate the new chemical and request additional information from the manufacturer.[154]

These examples of ex ante approval requirements for new products are notable for their rarity.[155] Manufacturers are

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[149] *See* 7 U.S.C. § 136a ("[No] person in any State may distribute or sell any person any pesticide that is not registered. . . .").

[150] *Id.* § 136a(c)(5)(D). These potential effects include "(1) any unreasonable risk to man or the environment, taking into account the economic, social, and environmental costs and benefits of the use of any pesticide, or a (2) human dietary risk from residues that result from a use of a pesticide in or on any food." *Id.* § 136(bb).

[151] *See id.* § 136d (allowing the Administrator to cancel or change a pesticide's classification if it causes "unreasonable adverse effects on the environment").

[152] *See* 15 U.S.C. § 2604(a)(1) (establishing the requirement).

[153] *Id.* § 2604(a)(3)(A), (C).

[154] *See id.* § 2604(a)(3)(B) (describing review and determination that the information available is insufficient to evaluate the health and environmental effects of the substances).

[155] Other forms of ex ante regulations protect consumers of services. For example, most states require licensure for individuals who want to provide specific types of services, such as legal or medical services. *See, e.g.*, Aaron Edlin & Rebecca Haw, *Cartels by Another Name: Should Licensed Occupations Face Antitrust Scrutiny?*, 162 U. PA. L. REV. 1093, 1102–04 (2014) (discussing the expansion of "[s]tate-level occupational licensing"). In some cases, these licensing requirements appear to function more as anticompetitive barriers to entry designed

otherwise free to introduce almost any other type of new product without seeking government approval first. In doing so, however, manufacturers still must comply with any regulations pertaining to the type of product they are producing. Certain products are simply banned by existing regulations. Examples include toys that present mechanical hazards[156] and paint that contains lead.[157] We characterize these regulations as ex post interventions, because they are almost always enacted after a product has already harmed consumers. Other products must meet specified regulatory standards that have been implemented because previous versions of those products have been deemed unsafe. Examples abound and include the requirement that "[h]and supported hair dryers . . . provide integral immersion protection"[158] and that extension cords intended for outside use be jacketed.[159] These sorts of regulations limit ex ante the types of new products that can be marketed, but again, they typically are operating after harmful versions of those products already reached the market.

2. Ex Post Regulation of Harmful Products. For the vast universe of new products that are not subject to regulatory pre-approval (or not banned altogether), regulation of any harmful effects must occur after such products are already in the hands of consumers. Two main forms of ex post regulation predominate: government intervention in the form of monetary penalties or recalls and private intervention via tort law.

Starting with governmental tools, many regulatory regimes grant agencies authority to recall dangerous products. Indeed, the Food, Drug, and Cosmetic Act and the Federal Insecticide, Fungicide, and Rodenticide Act, discussed above, also empower the FDA and EPA to recall products that receive initial approval but turn out to be dangerous.[160] The National Traffic and Motor Vehicle

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to limit competition than as consumer safety measures. *See id.* at 1148–49 (providing examples of licensing requirements which do not promote consumer safety).

[156] *See* 16 C.F.R. § 1500.18 (2013) (describing "[b]anned toys and other banned articles intended for use by children").

[157] *See id.* § 1303.4 (2008) (establishing the ban).

[158] *Id.* § 1120.3(a) (2022).

[159] *See id.* § 1120.3(d)(6) (establishing the requirement).

[160] *See* 21 U.S.C. § 360h-1 (allowing device recall under the Federal Food, Drug, and Cosmetic Act); 7 U.S.C. § 136a(c)(5)(D) (registering pesticides "when used in accordance with widespread and commonly recognized practice it will not generally cause unreasonable

Safety Act of 1966 includes a recall regime familiar to many automobile owners. That law empowers the Secretary of Transportation to determine that specific automobiles or automobile parts are defective and to mandate recall of such defective cars or car parts.[161] Some regulators also have the authority to ban products that turn out to be dangerous. In 2010, the FDA barred the sale of cigarettes and tobacco to minors,[162] and in 2022, voters in California passed a ballot measure approving a 2020 law that banned the sale of most flavored tobacco products.[163] The U.S. Consumer Product Safety Commission (CPSC) has broad authority to recall dangerous consumer products and to issue fines to firms that violate consumer product safety laws.[164] In January 2023, for example, the CPSC announced that it had levied a $19 million civil penalty against Peloton for failing to report a defect in its Tread+ treadmill that had caused multiple injuries and a death.[165]

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adverse effects on the environment"). For additional discussion of chemical regulation, specifically DDT and thalidomide, see David E. Adelman, *A Cautiously Pessimistic Appraisal of Trends in Toxics Regulation*, 32 WASH. U. J.L. & POL'Y 377 (2010).

[161] *See* 49 U.S.C. § 30118(b)(1) ("The Secretary may make a final decision that a motor vehicle or replacement equipment contains a defect related to motor vehicle safety or does not comply with an applicable motor vehicle safety standard . . . ."); *id.* §§ 30118(b)(2), 30120(a)(1) (stating that when the Secretary determines that a car or part is defective, the Secretary must order the manufacturer to notify consumers and dealers of the defect and remedy the defect, including by repairing or replacing the vehicle or part); *see also* Matthew Wansley, *Regulating Automated Driving*, 73 EMORY L.J. (forthcoming 2024), 11–13 (describing the recall authority created by the National Traffic and Motor Vehicle Safety Act of 1966).

[162] *See* 21 C.F.R. § 1140.14(a)(1) (2016) ("No retailer may sell cigarettes or smokeless tobacco to any person younger than 18 years of age.").

[163] *See* Hannah Wiley, *California Voters Approve Ban on Sale of Flavored Tobacco Products*, L.A. TIMES (Nov. 8, 2022), https://www.latimes.com/california/story/2022-11-08/2022-california-election-prop-31-ban-flavored-tobacco-results ("California voters on Tuesday passed a ballot measure to uphold a 2020 law that banned the sale of most flavored tobacco products, giving anti-tobacco advocates an expected victory in a multiyear fight against the industry to mitigate a youth vaping crisis."); CAL. HEALTH & SAFETY CODE § 104559.5 (codifying the prohibition).

[164] *See What Is the Consumer Product Safety Commission, and How Does it Protect Consumers from Hazards?*, U.S. GOV'T ACCOUNTABILITY OFF. (Mar. 5, 2021), https://www.gao.gov/blog/what-consumer-product-safety-commission%2C-and-how-does-it-protect-consumers-hazards (describing the CPSC's recall and civil penalty authority).

[165] *Peloton Agrees to Pay $19 Million Civil Penalty for Failure to Immediately Report Tread+ Treadmill Entrapment Hazards and for Distributing Recalled Treadmills*, U.S CONSUMER PROD. SAFETY COMM'N (Jan. 5, 2023), https://www.cpsc.gov/Newsroom/News-

Taxation also can serve as a form of ex post regulation.[166] Once government determines that a product is dangerous, it can tax it with the goal of reducing consumption. Cigarette taxes are an example.[167] Taxation also has an ex ante regulatory function. By making products more expensive to sell, taxation discourages innovation.[168] A tax on sales of vapes, for example, reduces the number of potential purchasers of new types of vapes, and disincentivizes manufacturers from expending resources to create innovations in this product.

Turning to private law, tort liability is another ex post regulatory tool for managing the risk of harmful products.[169] By requiring manufacturers to compensate individuals harmed by dangerous products, tort law incentivizes firms to make their products safer.[170] Rather than blocking a new product before it can be sold to consumers or taxing the product as it is sold—measures that take effect before or at the same time a product enters the market—the impact of tort law on manufacturers comes after, sometimes long after, a product is sold.[171]

3. Comparing Ex Ante and Ex Post Regulation. Society would obviously be better off if regulators could prevent dangerous products from ever reaching consumers, because no one would have to suffer the grievous harms they cause.[172] Unfortunately,

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Releases/2023/Peloton-Agrees-to-Pay-19-Million-Civil-Penalty-for-Failure-to-Immediately-Report-Tread-Treadmill-Entrapment-Hazards-and-for-Distributing-Recalled-Treadmills.

[166] *See* Brian Galle, *In Praise of Ex Ante Regulation*, 68 VAND. L. REV. 1715, 1720 (2015) (referring to the tax system as a "standard tool[] of ex ante regulation").

[167] *See generally* Pearl Bader, David Boisclair & Roberta Ferrence, *Effects of Tobacco Taxation and Pricing on Smoking Behavior in High Risk Populations: A Knowledge Synthesis*, 8 INT'L J. ENV'T RSCH. & PUB. HEALTH 4118 (2011) (analyzing the tobacco control policy effects of cigarette taxes); W. Kip Viscusi, *Cigarette Taxation and the Social Consequences of Smoking*, 9 TAX POL'Y & ECON. 51 (1995) (discussing the relationship between cigarette taxes and negative externalities).

[168] *See generally* Ufuk Akcigit, John Grigsby, Tom Nicholas & Stefanie Stantcheva, *Taxation and Innovation in the Twentieth Century*, 137 Q.J. ECONOMICS 329 (2022) (analyzing taxation's negative effect on innovation); Viscusi, *supra* note 167 (discussing the individual and societal effects of cigarette taxes).

[169] *See* Posner, *supra* note 148, at 11 ("Economic analysis of law treats common law fields, especially tort law . . . as forms of regulation.").

[170] *See id.* (discussing the "deterrent effect of the threat of liability" under tort law).

[171] *See id.* at 13 (contrasting ex ante regulation from ex post regulation).

[172] *See id.* at 15–17 (discussing the downsides of ex post regulation).

regulators rarely know which products are going to be dangerous until people use them.[173] In order to prevent harmful innovations before they have been released to the public, regulators would need solid information about the risks and benefits involved and how these were distributed among both producers and consumers.[174] Accordingly, regulating ex post often seems like the only viable alternative.[175]

Because policymakers believe that obtaining reliable information about a new product's effects on safety and well-being is difficult if not impossible before it hits the market, our regulatory system has enormously favored ex post regulation.[176] How would regulators know if a new piece of software will be beneficial or harmful at the moment of its release? After all, the product is new, so its future effects seem unknowable.

Unavailable or inaccurate information is especially costly if you believe that most innovations are at worst socially neutral and that most are socially beneficial. If most innovations are good, then any delay that regulatory review creates will diminish social welfare because people will have to wait for the new product.[177] And if some

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[173] *See* Galle, *supra* note 166, at 1725–29 (describing scholarship contending that "correcting externalities ex ante . . . requires government to make decisions before it has full information"); *see also* Posner, *supra* note 148, at 14 ("Ex ante regulation narrows the information base because when it takes the form of rules, it buys precision at the cost of excluding case-specific information that the promulgators either did not anticipate or excluded in order to keep the regulation simple . . . .").

[174] *See* Jon D. Hanson & Kyle D. Logue, *The Costs of Cigarettes: The Economic Case for Ex Post Incentive-Based Regulation*, 107 YALE L.J. 1163, 1271 (1998) ("As cigarette taxes are currently designed, however, all manufacturers are taxed the same amount per pack regardless of the specific risks posed by their particular brands.").

[175] *See* Risch, *supra* note 48, at 1207 ("In practice, however, limiting patents to those that meet a pre-determined degree of utility would likely be too costly and unworkable."); Michael W. Carroll, *One Size Does Not Fit All: A Framework for Tailoring Intellectual Property Rights*, 70 OHIO ST. L.J. 1361, 1374 (2009) (criticizing "the utility of any ex ante competition policy" through rewards or prizes because "the government will have difficulty . . . calibrating the reward to the social value contributed by the creator"); *see also* Eric E. Johnson, *Calibrating Patent Lifetimes*, 22 SANTA CLARA COMPUT. & HIGH TECH. L.J. 269, 298 (2006) (recognizing that "an *ex ante* calculation of social welfare value is impracticable or impossible").

[176] *See, e.g.*, Samuel Issacharoff, *Regulating After the Fact*, 56 DEPAUL L. REV. 375, 377 (2007) ("What really sets the United States apart is the fact that its basic regulatory model is ex post rather than ex ante . . . .").

[177] See, for example, President Trump's attempt to speed up FDA approval of drugs:

people end up getting hurt by the new product, tort law or other ex post regulations can step in.

Accordingly, in the views of most scholars and policymakers, it's too hard to learn anything meaningful about the social effects of innovative products or services ex ante; most of those innovations will turn out to be good anyway, so regulation just delays benefits; and ex post regulation can clean up any problems that do arise.[178]

Further, ex ante regulation is expensive. It requires an expert government agency to continuously evaluate new products in a timely manner. To remain effective, ex ante regulations also must be consistently updated to reflect changes in technology and the marketplace.

In sum, the relative merits of ex ante and ex post regulation of new products will depend on several factors, including the products' potential for mass harm, the importance of any informational advantage ex post regulation enjoys in a particular case, and the strength of the assumptions supporting the disciplining effect of tort law on manufacturers.

IV. A TAXONOMY OF ANTISOCIAL INNOVATION

In this Part, we offer a taxonomy of innovations based on their contributions to society. As we have seen, most popular and scholarly discussion of innovation treats it as an unalloyed good. But many innovations don't improve the world; they make it worse. Here, we categorize various types of antisocial innovation, focusing particularly on the kinds of harms that innovations may cause. With this categorization in hand, we will be able to turn next to policy mechanisms for limiting antisocial innovation.

> We're going to streamline the FDA. We have a fantastic person that I think I we'll [sic] be naming fairly soon. He's going to streamline the FDA and you're going to get your products either approved or not approved but it's going to be a quick process. It's not going to take 15 years.

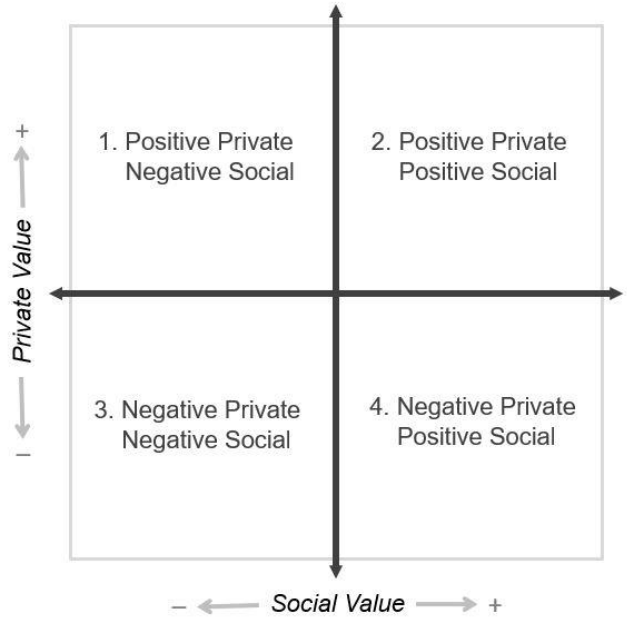
Maggie Fox, *Speed Up Drug Approvals? FDA Already Did*, NBC NEWS (Feb. 1, 2017), https://www.nbcnews.com/health/health-news/speed-drug-approvals-fda-already-did-n715481.

[178] *See, e.g.*, Posner, *supra* note 148, at 14 (discussing the cons of ex ante regulation).

A. WHO BENEFITS? WHO IS HARMED?

Our innovation taxonomy begins with an assessment of the groups who may be benefited or harmed by a given innovation. We begin by dividing the world into two classes of interests: private and social. In the category of private interests, we include the benefits and harms that flow to innovators, innovative firms, and their clients. Thus, if a firm develops a new production technique that lowers its costs, the innovative technique conveys (at least) a private benefit. Included in the category of social interests are the benefits and harms that flow to the consumers of innovative goods and services and to society at large when it is affected by them. Accordingly, if the same production technique results in lower prices for consumers and, thus, more access to the good, the innovation conveys a social benefit (assuming for the moment that the good itself is not harmful). We represent this categorization of interests below:

Figure 1: Private Value and Social Value



Each of the quadrants in the figure represents a particular relationship between the private value and the social value that a given innovation may generate. The *x* and *y* axes that cut through the middle of the figure enable us to plot any innovation in terms of its effects on private and social value. From a policymaking perspective, the principal variable is the *x* axis—social value. The law's goal is to encourage the production of innovations that fall into Boxes 2 and 4, and to discourage or regulate those that fall into Boxes 1 and 3. But, policymakers also need to be aware of the *y* axis in order to properly calibrate innovation incentives.

Before exploring the boxes in detail, it's worth explaining a little more about our conceptions of private and social value. By private value, we certainly mean to include the value that innovators themselves receive from their innovations. Thus, if innovators can use their innovations to reduce their costs, increase their prices, or improve their market share, they receive private value from their innovations. For ease of classification, we also include in the concept of private value the benefits accruing to parties that purchase innovations for use in the market. For example, if a firm develops a piece of software like a pricing algorithm that it sells to clients who then use it to manipulate the price of airline tickets, we include the value that the clients receive in our measure of private value.

Social value, in our classification, includes the net harms and benefits that society as a whole experiences from an innovation.[179] This could include the innovation's consumers who may benefit (or be harmed) by using it. It would also encompass the innovation's effects on non-consumers, including the innovator's competitors and

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[179] We do not argue in favor of any particular conception of social welfare or social benefits here. People will, of course, differ in their views on the nature and determinants of social welfare. We believe that, on any plausible definition of social welfare, there are a cohort of innovations that, on net, reduce rather than increase it. Different conceptions of social welfare will affect which innovations are in that cohort, but we argue that the cohort exists and is larger than has been previously appreciated. For one of our justifications for a particular conception of social welfare and its application to the law, see generally John Bronsteen, Christopher Buccafusco & Jonathan S. Masur, *Welfare as Happiness*, 98 GEO. L.J. 1583 (2010); John Bronsteen, Christopher Buccafusco & Jonathan S. Masur, *Well-Being Analysis vs. Cost-Benefit Analysis*, 62 DUKE L.J. 1603 (2013); *see also* MATTHEW ADLER, MEASURING SOCIAL WELFARE: AN INTRODUCTION (2019) (establishing a "social welfare function" as a "methodology for assessing government policy").

other members of society. If a firm develops a new, high-quality, low-cost digital movie camera, the innovation's social value would include both the filmmakers who use the camera and the moviegoers who get to experience their films. Or, if a firm introduced a new product whose manufacture increased air pollution, the innovation's social value would be measured by the net effect of whatever benefits the product provided to its consumers minus the health and environmental harms it caused to others.

Returning to the boxes, consider first Box 2, which should need the least attention from policymakers. These innovations generate positive value for both their innovators and society at large. Here reside innovations like the production technique mentioned above. It reduces the innovator's costs of production, so it is privately beneficial. And, at least if some of those cost savings get passed on to consumers, it is socially beneficial. Assuming that the innovator is sufficiently motivated to produce these sorts of innovations, policymakers have little work to do. Similarly unimportant are innovations that fall into Box 3. Although these are antisocial innovations, the private costs of producing them should mean that we see relatively few of them. Why would a firm invest resources in developing an innovation that made itself worse off?

Policymakers tend to pay a lot of attention to the innovations in Box 4—those that produce positive social value but that have negative private value to innovators.[180] Here, the concern is that innovators won't incur substantial costs in developing socially valuable innovations if they risk losing money on the effort.[181] The classic problem involves a situation in which developing the innovation is expensive but copying the innovation is cheap.[182] If an innovator has to spend millions of dollars creating a new innovation but then, once the innovation is disclosed, the innovator's competitors can easily copy it, the innovator won't be motivated to invest in the innovation in the first place. Innovations are often public goods, and, like many public goods, there is a risk that they

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[180] *See supra* notes 57–88 and accompanying text.

[181] *See* Lemley, *supra* note 79, at 129 (explaining how most would rather copy than create ideas for fear of being unable to recoup the investment).

[182] *Id.*

will be underproduced because innovators will not be able to recoup their investments in creating them.[183]

There are various solutions to the Box 4 problem that we have already discussed. Intellectual property rights give innovators exclusivity for a time where they can charge supracompetitive prices for access to their innovations, thereby recouping their investments.[184] Prizes, grants, and tax incentives are other mechanisms to decrease or compensate for innovators' costs to make the innovation privately valuable and worth pursuing.[185] In effect, these incentives turn Box 4 innovations into Box 2 innovations.

Importantly, though, innovation incentives create two major risks. First, if they are awarded to innovators who already find themselves in Box 2, where they have sufficient private motivation to pursue the innovation, the incentives are unnecessary and socially costly. Giving patents to firms that would be willing to pursue inventions in the absence of exclusive rights simply drives up costs for consumers and competitors without generating any innovation benefits.[186]

Second, and more important from this article's perspective, is the risk that we will give innovation incentives to Box 3 innovations and turn them into Box 1 innovations. That is to say, offering patents, prizes, grants, or tax incentives to negative private value-negative social value innovations that would not otherwise be pursued may make them sufficiently lucrative to be worth developing. Now, the innovation has positive private value, but it still has negative social value. For example, tobacco companies might not be willing to engage in the additional research and development to create a new menthol substitute on their own, but if the first company to develop one receives a lucrative patent, the calculus could change.

This is a serious problem and one that has not been explored in the literature previously. As the patent story goes, R&D is expensive, so, in the absence of supramarginal prices, innovators may not be willing to invest in new products. Patents tip those

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[183] *See id.* (discussing the difficulty innovators have in recouping their investments).

[184] *See id.* at 131 ("We grant creators exclusive rights in their works – permitting them to charge a supracompetitive price – to encourage them to make such works in the first place.").

[185] *See* Hemel & Ouellette, *supra* note 70, at 306 (discussing how tax credits, prizes, and grants encourage the production of new knowledge).

[186] *See id.* at 312 (explaining how patents result in consumers paying higher prices).

investments into the realm of cost-justified, and products get produced. But, again, the assumption is that the innovations are socially valuable. If they're socially costly, however, the existence of a patent causes an otherwise undeveloped harm to arise. They become Box 1 innovations.

In this article, we're especially concerned with innovations in Box 1—those that generate private value for innovators but negative social value. Subsequent sections will further elaborate on the various kinds of antisocial innovations that may arise, and we will sketch out the options that policymakers possess for dealing with them.[187] For present purposes, it's enough to say that these are the sorts of innovations that the law should disincentivize ex ante and/or regulate ex post. Figure 2 depicts the appropriate policy responses to innovations that fall into Boxes 1 and 4 where the goal is to decrease and increase their respective numbers. The area with the vertical lines depicts where most people currently think innovation typically lies, a view that tends to ignore the vast body of antisocial innovation.

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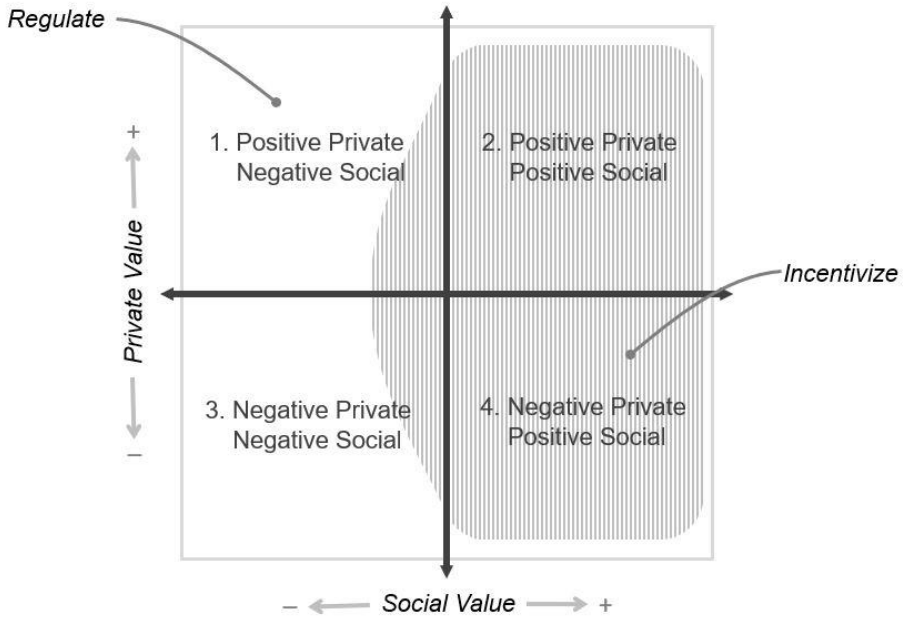
[187] *See infra* Part III & section V.C.

Figure 2: Policy Responses to Private and Social Value



B. TAXONOMIZING ANTISOCIAL INNOVATION

We now turn to elaborating different varieties of antisocial innovation, placing them into categories based on the kinds of harms that they create. We focus on harms to individuals, the environment, competition, privacy, labor, and society, as well as distributive harms that innovations may foster. Before we begin, two caveats are in order. First, the taxonomic exercise is never straightforward, and others might have different views about which harms should be lumped together or split off from others. And some innovations entail harms in multiple categories. Accordingly, we offer the following taxonomy as a foundation for further study rather than a complete account of all innovation effects. Second, our goal isn't to convince readers that in every case described below the innovation's net effects are harmful rather than beneficial. If we include some examples that readers think are net beneficial, that's fine. We will consider this effort a success if readers now believe

that the distribution of prosocial versus antisocial innovations is more skewed towards the latter than previously thought.

1. Individual Harms. Perhaps most obviously, innovations can hurt the people who are exposed to them, and they can hurt them in a variety of different ways—physically, emotionally, and financially.[188] Harms to individuals can come about in many different fashions, some of which are intentional while others are accidental by-products of other goals.

Often it may be beneficial for innovative firms to hurt people directly and intentionally. As the figures above indicate, harms to individuals will arise when firms have not been made to internalize the costs of their innovations to others in society.[189] Although the innovation is privately beneficial to the firm, it imposes net social costs on others exposed to it. For example, the pricing algorithms firms use to obtain greater profits by marking up goods to specific customers clearly benefit the firms employing them at the expense of consumers who will pay higher prices.[190] The whole point of pricing algorithms is to extract value from consumers, and consumers may have little choice but to interact with them.[191]

In other cases, new innovations may benefit some people at the expense of others. Consider, for example, the substantial increases in the size and weight of passenger trucks and SUVs over the past couple of decades.[192] In recent years, trucks and SUVs have grown significantly, with the best-selling trucks now over fifty-five inches tall—the average height of an eight-year-old.[193] They are also far heavier—more than half a ton—than they were in 2000.[194] Larger

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[188] We set out privacy harms as a distinct category below. *See infra* section IV.B.*5*.

[189] *See* Lars Noah, *Time to Bite the Bullet? How an Emboldened FDA Could Take Aim at the Firearms Industry*, 53 CONN. L. REV. 787 (2022) (evaluating whether the FDA can and should regulate harms caused by gunmakers).

[190] *See* MacKay & Weinstein, *supra* note 28, at 112 (discussing how retailers "use[] their pricing algorithms to extract wealth from you and your fellow consumers and shift it to themselves").

[191] *See id.* at 124–28 (discussing markets using pricing algorithms).

[192] Gregory H. Shill, *Should Law Subsidize Driving?*, 95 N.Y.U. L. REV. 498, 557 (2020) (stating that vehicle production has "shift[ed] since the 1990s towards larger vehicles").

[193] *See* Grant Hermes, *Size Does Matter: As Trucks and SUVs Get Bigger, More Pedestrians are Being Killed*, CLICK ON DETROIT (Aug. 7, 2022), https://www.clickondetroit.com/news/2022/08/08/size-does-matter-as-trucks-and-suvs-get-bigger-more-pedestrians-are-being-killed (providing the statistics).

[194] *Id.*

trucks are safer for their occupants,[195] and their size and aggressive styling may appeal to some consumers. But these vehicles are horrifically more dangerous than smaller ones to people outside of them, like other motorists, cyclists, and pedestrians.[196] Their larger blind spots increase the probability of accidents, because drivers can't see as well.[197] And when accidents do happen, they are much more deadly, because the vehicles weigh so much more.[198] Thus, we have a situation in which a smaller number of people are made better off at the expense of a larger number who are put in more danger.

Sometimes, innovations may harm consumers of the product themselves. In some cases, this can happen because the product's risks aren't known at the time of purchase. When it was first developed, thalidomide was thought to be a safe treatment for morning sickness during pregnancy.[199] Only later did it become apparent that the drug could cause serious birth defects.[200] The list of such examples is long.

But headline-grabbing examples like thalidomide may not be the most troublesome pharmaceuticals from a social welfare perspective. Recent research in both the United States and Europe indicates that an astonishingly large percentage of FDA-approved new drugs provide no meaningful therapeutic benefit over their predecessors, and, in many cases, they are worse.[201] These studies

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[195] *See, e.g.*, *Vehicle Size and Weight*, INS. INST. FOR HIGHWAY SAFETY (June 2023), https://www.iihs.org/topics/vehicle-size-and-weight (asserting that "[a] bigger, heavier vehicle provides better crash protection than a smaller, lighter one, assuming no other differences between them" for "the people inside them").

[196] *See* Shill, *supra* note 192, at 558 (comparing the danger of larger and smaller vehicles).

[197] *See* Hermes, *supra* note 193 ("All that extra size also means it's harder to see things in front of or behind the trucks when the wheel.").

[198] *See* B.S. Roudsari et al., *Pedestrian Crashes: Higher Injury Severity and Mortality Rate for Light Truck Vehicles Compared with Passenger Vehicles*, 10 INJ. PREVENTION 154, 158 (2004) (light-truck vehicles "were associated with 3.0 times higher risk of severe injuries in comparison with passenger vehicles").

[199] *See supra* note 144 and accompanying text.

[200] *See supra* note 144 and accompanying text.

[201] For studies concerning this phenomenon, see James D. Chambers et al., *Estimating Population Health Benefits Associated with Specialty and Traditional Drugs in the Year Following Product Approval*, 15 APPL. HEALTH ECON. & HEALTH POL'Y 227, 228–30 (2017); David S. Abrams & Bhaven N. Sampat, Pharmaceutical Patent Citations and Real Value 1, 8 (Jan. 2017) (unpublished manuscript),

cover a wide variety of pharmaceuticals in different countries. Their estimates for the percentage of zero and negative value drugs range from a quarter to a half of the sample.[202]

Along similar lines, Robin Feldman, David Hyman, W. Nicholson Price, and Mark Ratain have argued that patents can sometimes represent "negative innovation."[203] Their work focuses on situations in which the structure of patent law encourages innovation that harms consumers.[204] They show, for example, how a pharmaceutical manufacturer offered a drug with toxic side effects at higher doses than necessary because lower doses were considered obvious and therefore not patentable.[205]

Obviously, if a drug is worse for patients than the previous technology, there is clear antisocial harm. But the true harm is even greater. Many of these pharmaceuticals are so-called "me too" drugs that mimic already existing options.[206] In so doing, they reduce the demand for the original valuable drug and, thereby, undermine the incentives to achieve truly beneficial innovations.[207] This phenomenon is an example of the risks that we described above. But for the existence of a patent, firms wouldn't invest in the me-too

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https://www.law.nyu.edu/sites/default/files/upload_documents/David%20Abrams%20AND%20Bhaven%20Sampat.pdf; James D. Chambers et al., *Despite High Costs, Specialty Drugs May Offer Value for Money Comparable to That of Traditional Drugs,* 33 HEALTH AFFS. 1751, 1753 (2014); Margaret K. Kyle, *Are Important Innovations Rewarded? Evidence from Pharmaceutical Markets*, 53 REV. INDUST. ORG. 211, 211 (2018).

[202] *See* sources cited *supra* note 201.

[203] *See* Robin C. Feldman, David A. Hyman, W. Nicholson Price II & Mark J. Ratain, *Negative Innovation: When Patents Are Bad for Patients*, 39 NATURE BIOTECH. 914, 914 (2021) (stating that "negative innovation" can be "scenarios whereby patents create incentives to bring a product to market in a way that is relatively harmful to consumers").

[204] *See id.* (identifying the problem of "'negative innovation', in which patent law drives innovation into spaces that are affirmatively harmful to patients.").

[205] *See id.* at 914–15 (discussing the development of Ibrutinib, an anticancer drug).

[206] *See* Brita Pekarsky, *Should Financial Incentives Be Used to Differentially Reward 'Me-Too' and Innovative Drugs?,* 28 PHARMACOECONOMICS 1, 4 (2010) (explaining that me-too drugs are "follow-on drugs that are molecularly similar to the lead drug"); Margaret K. Kyle, *Are Important Innovations Rewarded? Evidence from Pharmaceutical Markets*, 53 REV. INDUS. ORG. 211, 212 (2018) (indicating that me-too drugs can be just as profitable for pharmaceutical companies as lead drugs).

[207] *See* Christopher Buccafusco & Jonathan S. Masur, *Drugs, Patents, and Well-Being*, 98 WASH. U. L. REV. 1403, 1431 (2021) ("[C]ompetition created by 'me too' drugs may fail to benefit consumers through greater access while simultaneously reducing returns to the pioneer drugs that made significant innovations.").

drug because R&D costs would exceed expected returns (Box 3: negative private/negative social). Once they can patent their discoveries, though, copycat firms can expect profitable returns, so they will invest in R&D even though the social benefits are negative (Box 1: positive private/negative social). While it is socially valuable to award a patent to the initial groundbreaking pharmaceutical in the field, awarding patents to all trivially different follow-on drugs is socially harmful.

Finally, people may be harmed by innovations when they affirmatively choose to consume products that are bad for them, even though the risks are widely known. The most obvious examples include addictive products like opioids and nicotine. Social media usage also may fall into this category.[208] An increasing number of studies show that social media is bad for people's well-being, that people appreciate its harms, but that they struggle to give it up.[209]

At other times, people may not initially realize the risks of a new technology. For example, Apple's AirTags, which were created to help find lost keys or luggage, have been called "a gift to stalkers."[210] These devices pose an additional threat to victims of intimate partner violence, even beyond stalkerware apps and compromised accounts, because they rely on a global network of billions of Apple devices to track whereabouts.[211] Once Apple realized (in response to outcry) how easily AirTags enable cheap, efficient stalking, they modified them to try to prevent "unwanted tracking," but this ex post self-regulation is only a partial solution and is easy to circumvent.[212]

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[208] *See* Jean M. Twenge, Jonathan Haidt, Thomas E. Joiner & W. Keith Campbell, *Underestimating Digital Media Harm*, 4 NATURE HUM. BEHAV. 346, 348 (2020) ("[H]eavy use of social media is consistently associated with negative mental health outcomes . . . especially for girls.").

[209] *See generally, e.g.*, *id.* at 346–48 (analyzing a study on social media's harms). For a comprehensive discussion of addictive digital technologies and the harms they can cause, see GAIA BERNSTEIN, UNWIRED (2023).

[210] Albert Fox Cahn & Eva Galperin, *Apple's AirTags Are a Gift to Stalkers*, WIRED (May 13, 2021, 9:00 AM), https://www.wired.com/story/opinion-apples-air-tags-are-a-gift-to-stalkers [https://perma.cc/KQ3G-QAXD].

[211] *Id.*

[212] *See* Geoffrey A. Fowler, *Apple's AirTag Trackers Made it Frighteningly Easy To 'Stalk' Me in a Test*, WASH. POST (May 5, 2021, 8:00 P.M.), https://www.washingtonpost.com/technology/2021/05/05/apple-airtags-stalking (illustrating the deficiencies of Apple's anti-stalking modifications).

2. Environmental Harms. It is abundantly clear that innovations can harm the environment. Scientists attribute a substantial portion of global climate change to human activities, many of which are the result of previous innovations.[213] Obviously, coal-based electricity plants and gasoline-powered internal combustion engines are responsible for an enormous share of environmental pollution.[214] This is not to say that electricity and automobiles have been a net negative for society. We don't think so. But there are many innovations that have generated substantially fewer benefits while producing meaningful environmental degradation.

Sometimes, innovations can harm the environment directly. For example, hydraulic fracturing, also known as fracking, is believed by many scientists to cause increases in air toxins and substantial harm to groundwater.[215] In addition, mining scarce minerals that are required for contemporary computing devices may be destroying environments in already ecologically stressed parts of the globe.[216] And, of course, many innovations generate enormous amounts of air and water pollution.

Innovations don't only harm the environment directly, however. In a range of industries, innovations contribute to environmental harms through *planned obsolescence*, the phenomenon in which people are encouraged to discard perfectly useful items once a new

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[213] *See Causes of Climate Change*, EPA, https://www.epa.gov/climatechange-science/causes-climate-change [https://perma.cc/F2YM-VDAK] (describing the impact of human behavior since the Industrial Revolution on climate change).

[214] *See Sources of Greenhouse Gas Emissions*, EPA, https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions [https://perma.cc/X5MP-CLHD] (explaining that electricity production accounts for 25% of greenhouse gas emissions and transportation accounts for 28%).

[215] *See generally* Nicole C. Deziel, Bhavna Shamasunder & Liba Pejchar, *Synergies and Trade-Offs in Reducing Impacts of Unconventional Oil and Gas Development on Wildlife and Human Health*, 72 BIOSCIENCE 472 (2022) (describing the environmental and public health harms that can be caused by Unconventional Oil and Gas Development (UOGD)).

[216] *See, e.g.*, James Conca, *Blood Batteries – Cobalt and the Congo*, FORBES (Sept. 26, 2018), https://www.forbes.com/sites/jamesconca/2018/09/26/blood-batteries-cobalt-and-the-congo/?sh=7587ac70cc6e [https://perma.cc/L9WW-N73P] (describing the impact of cobalt mining on the Democratic Republic of the Congo); *see also* Amit Katwala, *The Spiralling Environmental Cost of Our Lithium Addiction*, WIRED UK (May 8, 2018), https://www.wired.co.uk/article/lithium-batteries-environment-impact (explaining the environmental impact of lithium mining).

version is released.[217] For example, over 100 million cell phones and over 300 million personal computers are discarded each year.[218] Millions of new televisions are purchased, but very few are refurbished.[219] Many of these products are still fully functional, but consumers have been induced into desiring new versions of them.[220] Often, the new version may not represent any real upgrade in the product's quality.[221] In other cases, manufacturers intentionally limit a product's lifetime in order to encourage new purchases.[222] For example, light bulb filaments have been designed to burn out more quickly than necessary, and smartphone companies have designed software updates that degrade the phone's battery.[223] Finally, manufacturers can shorten product lifetimes by limiting consumers' ability to repair their devices.[224]

By inducing unnecessary consumption of new products and generating unnecessary waste, planned obsolescence causes environmental harm. While the existence of cell phones may be

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[217] Joseph Guiltinan, *Creative Destruction and Destructive Creations: Environmental Ethics and Planned Obsolescence*, 89 J. BUS. ETHICS 19, 19–20 (2009).

[218] *Id.* at 19.

[219] *Id.*

[220] *See* Kal Raustiala & Christopher Jon Sprigman, *Faster Fashion: The Piracy Paradox and its Perils*, 39 CARDOZO ARTS & ENT. L.J. 535, 540 (2021) (describing planned obsolescence in the fast fashion industry and how a lack of copyright protection contributes to obsolescence); *see also* WILLIAM SHAKESPEARE, MUCH ADO ABOUT NOTHING act 3, sc. 3, ll. 139–40 ("All this I see, and I see that the fashion wears out more apparel than the man.")

[221] *See* Derrick S. Boone, Katherine N. Lemon & Richard Staelin, *The Impact of Firm Introductory Strategies on Consumers' Perceptions of Future Product Introductions and Purchase Decision*, 18 J. PROD. INNOV. MGMT. 96, 96 (2001) ("[F]irms maybe able to induce purchase [of a new generation of a product] on the basis of introductory frequency and pattern alone.").

[222] *See* Guiltinan, *supra* note 217, at 19 ("[F]requent introductions of replacement products increase opportunities and motivation to replace functioning durables.").

[223] *See* John P. Vail, *The Need for A Sustainability Pledge: Fighting Planned Obsolescence*, 13 GEO. WASH. J. ENERGY & ENV'T L. 1, 5 n.34 (2022) (describing a business cartel's plan to decrease the efficacy of lightbulbs); Ewan Spence, *Apple Confirms It Degrades Your Old iPhone's Performance*, FORBES (Dec. 20, 2017, 6:36 PM), https://www.forbes.com/sites/ewanspence/2017/12/20/apple-iphone-kill-switch-ios-degrade-cripple-performance-battery [https://perma.cc/48QW-F9NQ] (reporting on Apple's use of code patches to slow performance of older iPhones).

[224] *See* AARON PERZANOWSKI, THE RIGHT TO REPAIR: RECLAIMING THE THINGS WE OWN 12 (2022) ("Device makers design components that are difficult to replace; charge unreasonably high prices for authorized repairs; squeeze independent repair providers out of the market; and construct digital locks meant to keep us out of the products we own.").

socially valuable, the incessant versioning of new cell phones with trivially different features is likely not justified in light of the substantial ecological cost.[225] Many otherwise durable goods, from digital technologies to fast fashion, likely generate net negative social value.[226]

3. Competition Harms. Some innovations are designed to harm the competitive process itself. Many innovations, of course, are created to give the inventor a competitive advantage.[227] When superior new products or processes harm competitors but benefit consumers, that is typically a sign of healthy competition.[228] The Google search engine, for example, resulted in the quick demise of lesser search companies like AltaVista and Ask Jeeves.[229] But internet users were better off. The economist Joseph Schumpeter referred to this process as "creative destruction."[230] In some cases, though, innovations are employed to harm competitors in ways that do not make consumers better off.

Predatory pricing algorithms are an example of anticompetitive antisocial innovation. Lina Khan has argued that Amazon has used its sophisticated pricing algorithm to selectively undercut the prices of rivals selling on the Amazon marketplace in an effort to eliminate or co-opt competitors.[231] But the threat of algorithmic predatory

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[225] *See* BBC, *Are Phone Upgrades Environmentally Friendly?*, (Sept. 20, 2019), https://www.bbc.co.uk/newsround/49664021 (emphasizing that "many modern smart phones contain substances that can be harmful to biodiversity if they end up in landfills").

[226] *See generally* Kirsi Niinimäki et al., *The Environmental Price of Fast Fashion*, 1 NATURE REVS. EARTH & ENV'T 189 (2020) (detailing the negative environmental, social, and economic impacts of fast fashion).

[227] *See* Baker, *supra* note 19, at 579 ("Firms engage in R&D because innovation may allow them to escape competition, and so earn greater profits."). Hugo Lesser, *The Role of Innovating in Competitive Success and How to Do It,* FORBES (Oct. 3, 2022), https://www.forbes.com/sites/forbescommunicationscouncil/2022/10/03/the-role-of-innovating-in-competitive-success-and-how-to-do-it/?sh=7b5a80bd83ae (explaining that innovation is key to gaining competitive advantage in an industry).

[228] Lesser, *supra* note 227.

[229] *See* Alina Selyukh, *The Big Internet Brands Of The '90s—Where Are They Now?*, NPR (July 25, 2016, 4:41 PM), https://www.npr.org/sections/alltechconsidered/2016/07/25/487097344/the-big-internet-brands-of-the-90s-where-are-they-now [https://perma.cc/5CWN-8PTM] (noting AltaVista's shutdown in 2013 and AskJeeves's abandoning its search engine business).

[230] SCHUMPETER, *supra* note 18.

[231] *See* Lina M. Khan, *Amazon's Antitrust Paradox*, 126 YALE L.J. 710, 768–70 (2017) (showing how Amazon used its "pricing bots" to maintain a below-cost pricing campaign

pricing is broader than Amazon. Indeed, Christopher Leslie has shown how pricing algorithms facilitate predatory pricing more generally.[232] In particular, artificial intelligence can make price wars easier to win by allowing predatory firms to target their rivals' customers for exclusionary below-cost pricing while continuing to profit off their own loyal customers.[233] This type of algorithmic predatory pricing will harm competition and ultimately make consumers worse off. Firms can also use pricing algorithms to collude and raise consumer prices. For example, tenants' groups have alleged that corporate landlords use a pricing algorithm offered by software company RealPage to inflate rental prices across the country.[234] The U.S. Department of Justice weighed in on the tenants' side, observing that "[t]oday, software algorithms can be employed to fix prices—and this modern machinery may be easier and more effective than past methods of price fixing."[235]

In other instances, firms with market power alter their products to damage rivals. One setting where this occurs is when a firm produces a monopoly product that interconnects with complementary products. If the dominant firm also produces the complements in competition with third-party rivals, it might decide to alter its monopoly product to make it incompatible with competing downstream products. This was the allegation in *C.R. Bard, Inc. v. M3 Systems*.[236] Bard manufactured biopsy guns for

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against Quidsi's Diapers.com brand, harming Quidsi and ultimately resulting in its sale to Amazon).

[232] Christopher R. Leslie, *Predatory Pricing Algorithms*, 98 N.Y.U. L. REV. 49, 67 (2023) ("Coupled with big data, algorithmic pricing makes predatory pricing significantly more feasible than imagined in the pre-internet era.").

[233] *See id.* at 51 (describing the advantage that artificial intelligence gives dominant firms in price wars).

[234] Class Action Complaint at 11, Sherry Bason v. RealPage Inc., No. 3:22CV1611 (S.D. Cal., Oct. 18, 2022) (alleging that corporate landlords have "agreed to set prices using RealPage's coordinated algorithmic pricing"); Heather Vogel, Haru Coryne & Ryan Little, *Rent Going Up? One Company's Algorithm Could Be Why*, PROPUBLICA (Oct. 15, 2022) ("[B]y RealPage's own admission, its algorithm is helping drive rents higher.").

[235] Memorandum of Law in Support of the Statement of Interest of the United States, *In Re*: RealPage, Rental Software Antitrust Litig. (No. II) at 2, No. 3:23-MD-3071 (M.D. Tenn. Nov. 15, 2023), ECF No. 628.

[236] C.R. Bard, Inc. v. M3 Systems, Inc., 157 F.3d 1340, 1382 (Fed. Cir. 1998) (Bryson, J., concurring in part and dissenting in part) ("The jury considered evidence that Bard modified

taking tissue samples.[237] The guns required needles, which both Bard and third-party firms produced.[238] Bard redesigned its guns so that they no longer were compatible with third-party needles.[239] The evidence showed that the redesigned guns were no more effective than the older model.[240] The design change—i.e., the innovation—was intended only to exclude Bard's rivals.[241]

Altering products to harm competition is a common strategy in the pharmaceutical sector too. Firms with successful drugs whose patents are near expiration will sometimes modify the drugs in minor ways to extend their patent rights and exclude generic rivals poised to enter the market.[242] For example, a drug maker might change the form of its drug, say from a tablet to a capsule, or alter the number of doses required by changing from an immediate-release to an extended-release formulation.[243] These changes might offer no (or limited) real benefits to consumers, but the manufacturer is able to secure a patent on the new formulation and extend its ability to charge monopoly prices for the drug. This strategy, termed "product hopping," has faced antitrust scrutiny in a number of cases.[244]

In each of these scenarios, firms create products that, while new, offer little or nothing in the way of consumer benefits. Instead, these innovations serve primarily to exclude competitors, ultimately making consumers worse off. One might argue that these types of product changes are not innovation at all. But, as we discuss below, antitrust law tends to treat any change to a product, unless it is

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its Biopty gun to prevent its competitors' non-infringing [products] from be used in Bard's guns.").

[237] *Id.* at 1346.

[238] *Id.*

[239] *Id.* at 1347.

[240] *Id.* at 1370–72.

[241] *Id.*

[242] *See* ROBIN FELDMAN & EVAN FRONDORF, DRUG WARS: HOW BIG PHARMA RAISES PRICES AND KEEPS GENERICS OFF THE MARKET 69–78 (2017) (detailing this phenomenon, referred to as "evergreening" or "product hopping," and new examples in the pharmaceutical market).

[243] *See generally* New York v. Actavis PLC, 787 F.3d 638, 642 (2d Cir. 2015) (involving a company introducing a once-daily version of its prior twice-daily Alzheimer's drug to prevent generic competitors from entering the market).

[244] FELDMAN & FRONDORF, *supra* note 242, at 69.

clearly not an improvement, as an innovation requiring immunity from liability.[245]

4. Labor Harms. At least since the Industrial Revolution, people have been anxious about technology's impact on workers—that they would be displaced by machines or, perhaps worse, turned into them.[246] While most scholars believe that productivity gains from innovation outweigh the costs to workers in the long run, some recent research has been less sanguine.[247] Artificial intelligence innovations may be displacing workers and suppressing wages at higher rates than in previous eras.[248] In addition, new developments in worker surveillance are threatening workers' health, privacy, and well-being.[249]

It is natural for innovation to make some jobs obsolete. The widespread adoption of automobiles had a devastating effect on buggy whip manufacturers.[250] And while fewer people are needed to build a car than in the 1960s, the social benefits from productivity gains have historically been valuable.[251] As robots increasingly replace human workers, however, displacement effects may exceed productivity gains. Recent research shows that increased use of robots, especially in manufacturing fields, significantly depressed both wages and employment.[252] Economists now worry that the

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[245] *See infra* section V.C.*3*.

[246] *See, e.g.*, METROPOLIS (Universum Film AG 1927) (depicting a robot, designed in the image of a person, who dupes a class of people, leading them into a revolution).

[247] *See* Camilla A. Hrdy, *Intellectual Property and the End of Work*, 71 FLA. L. REV. 303, 306–07 (2019) (arguing that some innovations are labor-displacing, leading to technological unemployment).

[248] *See* Cynthia Estlund, *What Should We Do After Work? Automation and Employment Law*, 128 YALE L.J. 254, 259–61 (2018) (noting that many economists believe that automation is "a central reason why median wages have been stagnant in the US over the past decade," despite the fact that earlier advances in technology did not ultimately have large-scale labor displacement effects (quoting *Robots*, Chi. Booth: IGM F. (Feb. 25, 2014, 1:55 PM), http://igmchicago.org/surveys/robots [https://perma.cc/QY4Y-MPUY])).

[249] *See* discussion *infra* accompanying notes 254–283.

[250] *See* Theodore Levitt, *Marketing Myopia,* 38 HARV. BUS. REV. 45, 52 (1960) (discussing the plight of buggy whip manufacturers).

[251] *See* WILLIAM J. BAUMOL, THE COST DISEASE: WHY COMPUTERS GET CHEAPER AND HEALTH CARE DOESN'T 72–73 (2012) (noting the increased access to cars as a result of increased productivity).

[252] *See* Daron Acemoglu & Pascual Restrepo, *Robots and Jobs: Evidence from U.S. Labor Markets*, 128 J. POL. ECON. 2188, 2190 (2020) (finding that "[i]mprovements in robotics technology negatively affect wages and employment owing to a displacement effect").

potential productivity gains from automation may not be strong enough to outweigh losses to labor. Darren Acemoglu and Pascaul Restrepo have recently warned of the possibility of excessive automation which "could reduce GDP and welfare."[253]

Innovation also has the potential to benefit a firm while harming that firm's employees. Surveillance technology is a salient example of an invention that has benefitted companies at the expense of labor.[254] Employers' desire to supervise their employees through intense monitoring is certainly not new.[255] But firms have a newfound capability to conduct surveillance for longer durations and with a more expansive scope.[256] And surveillance is becoming more intrusive as boundaries between work and home blur.[257] These developments raise concerns for employee privacy, autonomy, and safety.

Privacy concerns are a central focus of recent work examining harms stemming from workplace surveillance.[258] This is unsurprising since employer surveillance has become remarkably commonplace. Survey data suggests that nearly seventy percent of employers track employee internet use, almost half log keystrokes, and over forty percent monitor emails.[259] Further, electronic

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[253] Daron Acemoglu & Pascual Restrepo, *Artificial Intelligence, Automation, and Work*, *in* THE ECONOMICS OF ARTIFICIAL INTELLIGENCE: AN AGENDA 197, 226 (Ajay Agrawal, Joshua Gans & Avi Goldfarb, eds. 2019).

[254] *See* Ifeoma Ajunwa, Kate Crawford & Jason Schultz, *Limitless Worker Surveillance*, 105 CAL. L. REV. 735, 776 (2017) (concluding that surveillance technologies have allowed firms to pursue efficiency gains while eroding worker privacy).

[255] *See* Jeffrey M. Hirsch, *Future Work*, 2020 U. ILL. L. REV. 889, 928 ("[Employers] have frequently used emerging technologies to obtain [information]. But past advances like the time clock and aptitude tests pale in comparison to what is already occurring now, which in turn is a far cry from what is on the horizon." (footnote omitted)).

[256] *See* Ajunwa, Crawford & Schultz, *supra* note 254, at 743 (listing technological advancements that have "magnified the invasiveness of surveillance activities").

[257] *See* Pauline T. Kim, *Electronic Privacy and Employee Speech*, 87 CHI.-KENT L. REV. 901, 912 (2012) (noting that the devices used to make work more flexible make it unclear when an employee might be under their employer's scrutiny).

[258] For sources addressing privacy concerns stemming from workplace surveillance, see generally Ajunwa, Crawford & Schultz, *supra* note 254; Bradley A. Areheart & Jessica L. Roberts, *GINA, Big Data, and the Future of Employee Privacy*, 128 YALE L.J. 710 (2019); Scott R. Peppet, *Regulating the Internet of Things: First Steps Toward Managing Discrimination, Privacy, Security, and Consent*, 93 TEX. L. REV. 85, 112–14 (2014); Kim, *supra* note 257.

[259] *See* Ajuna, Crawford & Schultz, *supra* note 254, at 743 ("[A]t least 66 percent of U.S. companies monitor their employees' internet use, 45 percent log keystrokes, and 43 percent

applications installed on company devices allow employers to track employees "twenty-four hours a day, seven days a week."[260] Even without the technological developments sure to come in the future, privacy at work is already "largely illusory."[261]

Companies are coupling monitoring capabilities with other innovations designed to boost productivity. A collaboration between two Japanese companies, Daikin and NEC, has developed a system which monitors employees' eye movements and lowers the temperature of an employee's workplace when it suspects the target is becoming drowsy.[262] EdanSafe, an Australian company, produces a brain scanning device called the Smart Cap.[263] Originally developed for the mining industry, the Smart Cap scans the user's brain to detect indicators of fatigue.[264] If the user shows signs of fatigue, audio and visual alarms are activated.[265] Along with accompanying software, the Smart Cap also allows employers to "monitor the output and fatigue levels of numerous cap-wearing employees during past shifts."[266] These kinds of inventions potentially allow employers to ensure workers are putting in optimal effort, but also risk encouraging employees to overexert themselves to avoid reprimands for slacking off.

As companies extract previously private data about their employees using surveillance technologies, they can also employ predictive technologies to make value judgments about those

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track employee emails." (quoting *The Rise of Workplace Spying*, WEEK (July 5, 2015), http://theweek.com/articles/564263/rise-workplace-spying [https://perma.cc/NKP9-VSJZ])).

[260] *Id.* at 769.

[261] *Id.* at 743 (quoting *The Rise of Workplace Spying*, WEEK (July 5, 2015), http://theweek.com/articles/564263/rise-workplace-spying [https://perma.cc/NKP9-VSJZ]).

[262] Johnny Wood, *Feeling Sleepy in the Office? This Japanese Technology Detects Tired Workers and Blasts Cold Air into the Room*, WORLD ECON. F. (July 31, 2018), https://www.weforum.org/agenda/2018/07/feeling-sleepy-in-the-office-this-japanese-technology-detects-tired-workers-and-blasts-cold-air-into-the-room [https://perma.cc/C6XN-TXHU].

[263] Ifeoma Ajunwa, *Algorithms at Work: Productivity Monitoring Applications and Wearable Technology as the New Data-Centric Research Agenda for Employment and Labor Law*, 63 ST. LOUIS U. L.J. 21, 38 (2018).

[264] *Id.*

[265] *Id.*

[266] *Id.*

employees.[267] Microsoft, for instance, has created a program capable of "analyz[ing] data from emails, calendars, and other sources" to "assess whether [employees] are using their time efficiently."[268] Other companies possess more robust predictive capabilities. Sociometric Solutions, which provides its technology to Bank of America among other institutions,[269] makes employee badges that contain "a microphone, location sensor, and accelerometer."[270] Sociometric Solutions' CEO claims that his products allow employers to "divine from a worker's patterns of movement whether that employee is likely to leave the company, or score a promotion."[271] These prospective assessments of employee merit are frequently made with dubious consent or entirely unbeknownst to employees.[272]

New monitoring technologies also threaten employee autonomy.[273] Because of the increasing reach of potential monitoring, employees risk being fired or treated adversely at work based on conduct that occurs solely outside of the workplace.[274]

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[267] *See id.* at 51 ("Employers could use data obtained from wellness programs to run predictive analytics of employee risk of injury.").

[268] Areheart & Roberts, *supra* note 258, at 759 (citing *There Will Be Little Privacy in the Workplace of the Future*, ECONOMIST (Mar. 28, 2018), https://www.economist.com/special-report/2018/03/28/there-will-be-little-privacy-in-the-workplace-of-the-future [https://perma.cc/343W-P69Y]).

[269] *See* Rachel Emma Silverman, *Tracking Sensors Invade the Workplace*, WALL ST. J. (Mar. 7, 2013, 11:42 AM), https://www.wsj.com/articles/SB10001424127887324034804578344303429080678 (discussing how Bank of America "asked about [ninety] workers to wear badges for a few weeks with tiny sensors to record their movements and the tone of their conversations" using Sociometric Solutions' technology).

[270] Ajunwa, Crawford & Schultz, *supra* note 254, at 743.

[271] Silverman, *supra* note 269.

[272] *See* Peppet, *supra* note 258, at 114 ("Some fear that consent in the employment context is difficult to assess and rarely truly consensual."); Ajunwa, *supra* note 263, at 45 (discussing the possibility that employers could use data collected without employee consent when deciding to retain, fire, or promote them); *see also* Charlotte S. Alexander & Elizabeth Tippett, *The Hacking of Employment Law*, 82 MO. L. REV. 973, 994–95 (2017) (highlighting the information asymmetry that results from employers compiling data profiles on employees and having no duty to disclose their contents).

[273] Hirsch, *supra* note 255, at 928 (suggesting that "emerging technologies" have the capacity to "enhance employers' ability to monitor workers and limit their autonomy")

[274] *See* Kim, *supra* note 257, at 912–13 (discussing the possible repercussions an employee can face at work based on online or other activity outside of work).

Employers regularly monitor employees' social media presence—even when they are not at work.[275] This pervasive oversight may chill employees' willingness to engage in speech outside of work hours and even lead employers to punish workers for what they say off the clock.[276] The unflinching pursuit of efficiency has also led firms to deploy technologies that reduce the amount of time workers spend taking breaks.[277] One startup has developed a toilet that is painful to sit on for more than five minutes in hopes that "the uncomfortable seat will discourage employees from using social media while in the bathroom."[278]

These efforts are typically justified as ways to increase output by enhancing productivity and promoting efficiency.[279] But these prospective benefits are not costless. Efficiency seeking has the potential to generate labor harms that are commensurate with or exceed the benefits to firms.[280] And in some cases, the private gain an invention purportedly seeks to generate may not be actualized. Accordingly, many inventions designed to allow firms to monitor employees deserve particular scrutiny and may ultimately fall into Box 1 (positive private value/negative social value).

Introducing new technology to the workplace also has the potential to physically harm workers. Some risks are relatively

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[275] *See* Ajunwa, Crawford & Schultz, *supra* note 254, at 739, 752 (emphasizing employers' newfound focus on observing social media activity); Alexander & Tippett, *supra* note 272, at 994 (discussing the potential for employers to examine "information culled from social media"); Kim, *supra* note 257, at 914 ("[A]necdotal reports suggest that at least some employers are seeking to monitor their employees' online activities off the job as well.").

[276] Kim, *supra* note 257, at 913–14 (discussing potential instances of employees being disciplined for their social media activity).

[277] *See* Ajunwa, *supra* note 263, at 24 (discussing employers tracking the physical location of employees, including recording the time nurses take breaks or go to the bathroom).

[278] Aaron Holmes, *This Slanted Toilet Was Designed to Increase Productivity and Decrease Smartphone Use by Being Painful to Sit on for More Than 5 Minutes, and People Are Horrified*, BUS. INSIDER, (Dec. 18, 2019, 11:56 AM), https://www.businessinsider.com/slanted-toilet-design-decrease-phone-social-media-use-bathroom-breaks-2019-12 [https://perma.cc/N424-W4EY].

[279] *See* Ajunwa, Crawford & Schultz, *supra* note 254, at 743 ("[E]mployers justify these new privacy invasions on the basis that collection of such data serves the employer's business interest in improving efficiency and innovation.").

[280] *See id.* at 744–45 (noting increased employee monitoring can result in more injuries and negative psychological effects).

minor, like nausea or eye strain.[281] Other workplaces subject workers to more concerning risks. Amazon, notorious both for its emphasis on innovation and penchant for monitoring workers,[282] provides a particularly poignant example. Amazon employees are more likely to be injured on the job than lumberjacks or coal miners.[283]

5. Privacy Harms. Innovation is also to blame for a society-wide loss of privacy in the past few decades. Advances in technology have made it possible for platform companies to compile huge stores of consumer data, which they sell to advertisers and other third parties.[284] Phones and smart watches track users' whereabouts, and this location information is leveraged for ads or sold to other interested parties.[285] Facial recognition software is weaponized not just by law enforcement, but by private companies, too.[286] Our financial histories, our addresses, our buying and reading habits, all are available for purchase in the internet age.[287] Even our

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[281] *See* Hirsch, *supra* note 255, at 906 (discussing how virtual reality increasingly implemented in the workplace "frequently causes eye strain, dizziness, and nausea").

[282] *See* Ajunwa, *supra* note 263, at 34–38 (describing Amazon's patents for wearable devices used to monitor workers).

[283] Kate Gibson, *Most Dangerous Time to Work in Amazon Warehouses? Right About Now*, CBS NEWS, (Dec. 17, 2019, 4:59 PM), https://www.cbsnews.com/news/amazon-warehouse-jobs-most-dangerous-time-of-year-to-work-is-holiday-shopping-season [https://perma.cc/WUE8-8ZP8].

[284] *See* Kevin Litman-Navarro, *We Read 150 Privacy Policies. They Were an Incomprehensible Disaster.*, N.Y. TIMES (June 12, 2019), www.nytimes.com/interactive/2019/06/12/opinion/facebook-google-privacy-policies.html (detailing various privacy policies including advertisers selling information to third-parties).

[285] *See* Stuart A. Thompson & Charlie Warzel, *Twelve Million Phones, One Dataset, Zero Privacy*, N.Y. TIMES (Dec. 19, 2019), www.nytimes.com/interactive/2019/12/19/opinion/location-tracking-cell-phone.html ("Location data is also collected and shared alongside a mobile advertising ID, a supposedly anonymous identifier about 30 digits long that allows advertisers and other businesses to tie activity together across apps.").

[286] *See* Thorin Klosowski, *Facial Recognition Is Everywhere. Here's What We Can Do About It.*, N.Y. TIMES: WIRECUTTER (July 15, 2020), www.nytimes.com/wirecutter/blog/how-facial-recognition-works (criticizing how various private companies use facial recognition software).

[287] *See* Justin Sherman, *Data Brokers and Data Breaches*, DUKE SANFORD SCH. OF PUB. POL'Y (Sept. 27, 2022), https://techpolicy.sanford.duke.edu/blogroll/data-brokers-and-data-breaches [https://perma.cc/F524-YXFL] (explaining the amount of personal data that data brokers collect and sell).

children's names, ages, and internet habits can be discovered, and strangers can contact and converse with them over social media.[288]

Privacy harms can be conceptually difficult to make sense of because they are vast and varied and because, like a death by a thousand cuts, they often accrue slowly and in small amounts. Privacy harms are complicated further because not only are individuals harmed, society is collectively harmed.[289] Because privacy functions like an interconnected network, if one person's privacy is violated, then the privacy of their entire network is also put at risk. Despite these conceptual challenges, it is clear that innovation can harm privacy in physical, economic, reputational, psychological, and discriminatory ways while also jeopardizing one's autonomy and self-expression.[290]

New technologies have expanded the types of economic harms associated with privacy loss by facilitating traditional violations and enabling new ones. A classic privacy harm with economic consequences is identity theft. The development of online databases and reliance on digital storage have led to an exponential increase in identity theft by making the crime much simpler.[291] Not only do victims of identity theft lose money, they also spend a great deal of time—sometimes years—trying to get their money refunded, their identity back, their credit history healed, and their digital reputations restored.[292] But the economic harms of privacy loss are much more wide-ranging now. For example, using a variety of collected data, companies such as retailers, airlines, banks, and

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[288] *See* Shelby Brown, *TikTok, Livestreaming Apps Are 'Hunting Ground' for Abusers, Warn Kids' Advocates*, CNET (Feb. 25, 2019, 11:10 AM), https://www.cnet.com/tech/mobile/tiktok-live-streaming-apps-are-hunting-ground-for-abusers-warn-childrens-advocates [https://perma.cc/5AAS-5Q6Q] (warning that children are especially vulnerable to abuse through livestreaming apps).

[289] *See* Danielle Keats Citron & Daniel J. Solove, *Privacy Harms*, 102 B.U. L. REV. 793, 816 (2022) ("From the standpoint of each individual, the harm is minor, but from the standpoint of society, where the harm to everyone is aggregated, the total amount of harm is quite substantial.").

[290] *See generally id.* at 793–863 (creating a taxonomy of privacy harms).

[291] *See What To Know About Identity Theft*, FTC (Apr. 2021), https://consumer.ftc.gov/articles/what-know-about-identity-theft [https://perma.cc/R8BQ-233A] (describing methods to protect against identity theft).

[292] *See* Sloane v. Equifax Info. Servs., LLC, 510 F.3d 495, 497 (4th Cir. 2007) (describing how, twenty-one months after an identity thief was arrested, Equifax still had not corrected the errors in a victim's credit report).

wireless carriers calculate a score for every consumer.[293] They then use this score to determine an individual's potential value and how to invest in the customer relationship, including what prices or interest rates to offer.[294] These scores are based on unknown factors, entirely unregulated, and usually hidden from consumers.[295] Thus, companies, using an innovative way to evaluate customers, rely on data that is opaque, possibly false, and collected without most people having any idea how it is used. Such innovative uses of data built on privacy harms can cost consumers greatly.

Privacy harms perhaps most acutely threaten autonomy. Unrestrained innovations across many fields have concerning impacts on the ability to develop one's own sense of self and make one's own choices.[296] Autonomy can be harmed in many ways, including through mechanisms such as coercion or manipulation, among others.[297] As Ryan Calo has explained, these kinds of digital market manipulations "create[] subjective privacy harms insofar as the consumer has a vague sense that information is being collected and used to her disadvantage, but never truly knows how or when."[298] In the last few decades, much innovation has been promoted as enhancing online experiences through personalization. But with so much opaque data underpinning these experiences, the line between personalization and manipulation has become fuzzy.

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[293] Khadeeja Safdar, *On Hold for 45 Minutes? It Might Be Your Secret Customer Score*, WALL ST. J. (Nov. 1, 2018, 11:04 AM), www.wsj.com/articles/on-hold-for-45-minutes-it-might-be-your-secret-customer-score-1541084656.

[294] *See id.* ("That secret number is used by all manner of companies to measure potential financial value of their customers").

[295] *See* Kashmir Hill, *I Got Access to My Secret Consumer Score. Now You Can Get Yours, Too.*, N.Y. TIMES (Nov. 5, 2019), www.nytimes.com/2019/11/04/business/secret-consumer-score-access.html (explaining how consumers can get access to some of their scores and the types of data that go into the scores).

[296] *See* Michael P. Lynch, *The Philosophy of Privacy: Why Surveillance Reduces Us to Objects*, GUARDIAN (May 7, 2015, 7:30 AM), www.theguardian.com/technology/2015/may/07/surveillance-privacy-philosophy-data-internet-things [https://perma.cc/DRV9-977K] (arguing that mass surveillance makes us less autonomous as human beings).

[297] Citron & Solove, *supra* note 289, at 845–46.

[298] Ryan Calo, *Digital Market Manipulation*, 82 GEO. WASH. L. REV. 995, 1029 (2014).

Finally, privacy harms can entrench inequalities and exacerbate systemic harms to disadvantaged populations.[299] Historically disadvantaged groups are likely to suffer more from privacy harms because they are less able to absorb the resulting social costs.[300] Algorithms, infected with the biases of the humans who code them and the datasets that fuel them, regularly discriminate against minorities. Surveillance disproportionately targets people of color.[301] Poor people are subject to additional surveillance and privacy harms by private industry and by the government through public assistance programs.[302] As Mary Anne Franks has explained: "For the less privileged members of society, surveillance does not simply mean inhibited Internet searches or decreased willingness to make online purchases; it can mean an entire existence under scrutiny, with every personal choice carrying a risk of bodily harm."[303] Privacy harms are concerning for everyone, but the way they cement systemic inequalities is particularly troubling.

6. Societal Harms. Innovations sometimes do more than harm individuals or competitors; they damage society itself. We enumerate this category to capture a wide variety of antisocial outcomes that are more generalized than the particularized harms described above. We focus on three issues: risks to democracy, risks to the financial system, and distributive harms. Each of these issues is hugely important, and we can do no more than scratch the surface of any one of them in this Article.

The risks that social media poses to democratic values are becoming increasingly apparent. In addition to its addictive qualities, which hurt many users, social media is a conduit for dangerous misinformation and conspiracy theories.[304] Russian

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[299] *See generally* KHIARA M. BRIDGES, THE POVERTY OF PRIVACY RIGHTS (2017) (investigating how poor mothers receive reduced expectations of privacy); DANIELLE KEATS CITRON, THE FIGHT FOR PRIVACY (2022) (arguing for intimate privacy as a civil right).

[300] *See generally* SKINNER-THOMPSON, *supra* note 37 (exploring how a lack of privacy protections leaves minority communities more vulnerable).

[301] Alvaro M. Bedoya, *Privacy as Civil Right*, 50 N.M. L. REV. 301, 306 (2020).

[302] *See* BRIDGES, *supra* note 299, at 12.

[303] Mary Anne Franks, *Democratic Surveillance*, 30 HARV. J.L. & TECH. 425, 453 (2017).

[304] *See, e.g.*, Lan Ha, Timothy Graham & Joanne Gray, *Where Conspiracy Theories Flourish: A Study of YouTube Comments and Bill Gates Conspiracy Theories*, HARV. KENNEDY SCH. MISINFORMATION REV., Oct. 2022, at 2 (highlighting YouTube as a social media platform where misinformation and conspiracy theories affect users); Peter Suciu,

operatives have repeatedly used social media to spread propaganda designed to undermine free and fair elections in the United States and other democracies.[305] Compelling evidence exists that in both 2016 and 2020, Russia used Facebook and other social media outlets to support the Trump campaign and to sow division among Americans.[306] In a post-mortem on the 2016 election, the Senate Intelligence Committee, then led by Republicans, concluded that Russia's social media strategy "was overtly and almost invariably supportive of then-candidate Trump."[307] Committee Chairman Senator Richard Burr explained that Russia "flood[ed] social media with false reports, conspiracy theories, and trolls" to "exploit[] existing divisions" in U.S. society and "breed distrust of our democratic institutions and our fellow Americans."[308]

Social Media Remains a Source for News and a Breeding Ground for Pandemic Conspiracies, FORBES (Sept. 3, 2021, 2:18 PM), https://www.forbes.com/sites/petersuciu/2021/09/03/social-media-remains-a-source-for-news-and-a-breeding-ground-for-pandemic-conspiracies [https://perma.cc/RK8Q-QHXV] ("The spread of misinformation and even disinformation via social media isn't limited to Covid-19, and for years the platforms have been used as a way to share and disseminate all sorts of information—much of it wrong or in other times misleading.").

[305] *See, e.g.*, Jack Stubbs, *Facebook Says Russian Influence Campaign Targeted Left-Wing Voters in U.S., UK*, REUTERS (Sept. 15, 2020, 4:49 PM), https://www.reuters.com/article/usa-election-facebook-russia/facebook-says-russian-influence-campaign-targeted-left-wing-voters-in-u-s-uk-idUSKBN25S5UC [https://perma.cc/SY9G-T9RC] (reporting that a "Russian influence operation posed as an independent news outlet to target left-wing voters in the United States and Britain," including in the period leading up to the 2020 U.S. presidential election); *see also* Shannon Bond, *A Pro-Russian Social Media Campaign Is Trying to Influence Politics in Africa*, NPR: UNTANGLING DISINFORMATION (Feb. 1, 2023, 5:01 AM), https://www.npr.org/2023/02/01/1152899845/a-pro-russian-social-media-campaign-is-trying-to-influence-politics-in-africa [https://perma.cc/RTL8-TFJ9] (reporting on "activists aligned with Russia" utilizing social media to influence politics in Africa).

[306] *See Russia 'Meddled in All Big Social Media' Around US Election*, BBC (Dec. 17, 2018), https://www.bbc.com/news/technology-46590890 [https://perma.cc/WZD3-H77F] (describing a report concluding that "Russia used every social media platform to try to influence the 2016 US election" and to "benefit the Republican Party – and specifically Donald Trump").

[307] U.S. SENATE SELECT COMM. ON INTEL., 116TH CONG., REP. ON RUSSIAN ACTIVE MEASURES CAMPAIGNS AND INTERFERENCE IN THE 2016 ELECTION, VOL. 2: RUSSIA'S USE OF SOC. MEDIA WITH ADDITIONAL VIEWS, S. REP. 116-290, at 4 (2020).

[308] Press Release, Senate Intelligence Committee, Senate Intel Committee Releases Bipartisan Report on Russia's Use of Social Media (Oct. 8, 2019), https://www.intelligence.senate.gov/press/senate-intel-committee-releases-bipartisan-report-russia%E2%80%99s-use-social-media [https://perma.cc/5URS-8AZA].

Social media is easy to weaponize. It is an open system that reaches billions of users worldwide. Anyone can post anything on these sites, and while Twitter (now "X"), Facebook, and other social media outlets employ content moderation teams to various extents to try to limit damaging misinformation, so far these efforts have proved ineffective (and some would say half-hearted).[309] Not surprisingly, these platforms have been used not only by state actors like Russia, and not just to threaten democracy, but also by non-state actors with a variety of antisocial goals like undermining public health through anti-vaccine disinformation and stoking racial division.[310]

Innovation in the financial sector is another common source of social harm. Some financial innovations threaten the nation's systemic stability. Credit default swaps (CDS) are an example. These instruments, created in the 1990s, were initially developed as a tool for institutions and firms to hedge credit risk.[311] A firm that had made a large loan could use a CDS to take out insurance against a default. The lender would pay premiums to another institution for a guarantee that it would cover any losses if the borrower defaulted on the loan. In this form, CDS could be seen as potentially prosocial

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[309] *See, e.g.*, Roger McNamee, *Social Media Platforms Claim Moderation Will Reduce Harassment, Disinformation and Conspiracies. It Won't,* TIME (June 24, 2020, 5:12 PM), https://time.com/5855733/social-media-platforms-claim-moderation-will-reduce-harassment-disinformation-and-conspiracies-it-wont [https://perma.cc/H226-BWVT] (arguing that content moderation is insufficient to "reduce the harm from targeted harassment, disinformation, and conspiracies" on internet platforms).

[310] *See* Talha Burki, *Vaccine Misinformation and Social Media*, 1 LANCET DIGIT. HEALTH e258, e258 (2019) ("[T]he advent of social media has offered an unprecedented opportunity to amplify and spread antivaccination messages."); Molly Wood & Kristin Schwab, *How Social Media Exacerbates the Racial Divide*, MARKETPLACE (Nov. 1, 2017), https://www.marketplace.org/2017/11/01/how-social-media-propaganda-exacerbates-racial-divide [https://perma.cc/QFN5-XBLK] (observing that "[m]isinformation on social media has been aimed at creating division and unrest, especially around race" and reporting that "fake Facebook accounts created by Russian operatives encouraged violence against Black Lives Matter protesters").

[311] *See* John Lanchester, *Outsmarted*, NEW YORKER (May 25, 2009), https://www.newyorker.com/magazine/2009/06/01/outsmarted (recounting the first credit default swaps sold by J.P. Morgan in 1994).

because they allow for spreading credit risk, thereby increasing the flow of capital.[312]

In the run-up to the 2008 financial crisis, however, CDS developed into a means for rampant, unregulated speculation.[313] Instead of being used only to hedge lenders' risks, financial institutions offered CDS to third parties that wanted to bet that specific firms or specific financial instruments would fail.[314] Many of these CDS were taken out against mortgage-backed securities that became worthless when the housing market crashed in 2007.[315] The firms that had guaranteed payouts if these instruments failed were overwhelmed and the financial system reached the brink of disaster before the federal government stepped in. American International Group (AIG), which had been the largest insurance company in the world, held many of these CDS contracts through a subsidiary, and had to be rescued by the government.[316] While CDS did not cause the financial crisis, they worsened it, and the costs of cleaning up the mess were borne by taxpayers.[317]

High-frequency trading is another financial innovation that causes social harm. In certain financial markets fractions of a second make a difference for investors' profits, so some trading firms invest heavily in technology that shaves milliseconds off their

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[312] *See* Frank D'Souza, Nan S. Ellis & Lisa M. Fairchild, *Illuminating the Need for Regulation in Dark Markets: Proposed Regulation of the OTC Derivatives Market*, 12 U. PA. J. BUS. L. 473, 487 (2010) ("[CDS] allow banks to transfer credit exposure to counterparties . . . , which allows banks to lend more money.").

[313] *See* Samuel N. Weinstein, *Financial Regulation in the (Receding) Shadow of Antitrust,* 91 TEMPLE L. REV. 447, 475 (2019) (describing role of credit default swaps in the Global Financial Crisis).

[314] *See, e.g.*, FIN. CRISIS INQUIRY COMM'N, THE FINANCIAL CRISIS INQUIRY REPORT 50 (2011), http://www.gpo.gov/fdsys/pkg/GPO-FCIC/pdf/GPO-FCIC.pdf [http://perma.cc/63QE-NNBA] ("[A] CDS purchaser can use it to speculate on the default of a loan the purchaser does not own.").

[315] *See* D'Souza, Ellis & Fairchild, *supra* note 312, at 490 (describing how the CDS markets were "hard hit by the downturn in housing").

[316] SPECIAL INSPECTOR GEN. FOR THE TROUBLED ASSET RELIEF PROGRAM, AIG REMAINS IN TARP AS TARP'S LARGEST INVESTMENT 1 (2012), https://www.sigtarp.gov/sites/sigtarp/files/Audit_Reports/AIG_Remains_in_TARP_Mini_Book.pdf (describing AIG's "severe liquidity crisis" as a result of "exposures on risky derivatives related to mortgage-backed securities" in a subsidiary and recounting the federal government's bailout of the company).

[317] *See, e.g.*, FIN. CRISIS INQUIRY COMM'N, *supra* note 314, at xxiv ("We conclude over-the-counter derivatives [such as CDS] contributed significantly to this crisis.")

trading speeds.[318] Studies have shown that these advances in speed reduce liquidity in affected markets, raising the costs for other investors.[319] High-frequency trading is yet another example of a clear product improvement making conditions worse for innocent third parties, in this case by distorting financial markets.

Finally, but of enormous importance, is the effect that innovations may have on the distribution of scarce resources in society. Thinking about distributional harms is challenging because many canonically valuable innovations nonetheless cause distributive harm. For example, the introduction of electric lamps in households and workplaces caused a revolution in society's health and well-being.[320] But electric lamps were terrible for whalers and kerosene salesman whose oil sales were displaced.[321] Again, this is the sort of creative destruction that is appropriately lauded by innovation scholars.

In other cases, the normative desirability of an innovation's distributive consequences may be much less clear. Innovations almost always create both winners and losers, so the distributive consequences depend on these parties' identities. On one hand, consider the winners. Electrification's winners were enormously widespread. After its introduction around 1900, electricity reached 80% of the American population by 1940.[322] The winners other innovations create are likely to be less numerous and less well distributed throughout the community. For example, the benefits of financial innovations largely redound to a small class of already wealthy traders and investors.[323] The same is true for pricing

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[318] *See* Eric Budish, Peter Cramton & John Shim, *The High-Frequency Trading Arms Race: Frequent Batch Auctions as a Market Design Response*, 130 Q.J. ECONOMICS 1547, 1548 (2015) (stating that "industry observers remarked that 3 milliseconds is an 'eternity' to high-frequency trading (HFT) firms").

[319] *See id.* at 1590 ("[A]ll of the expenditure by trading firms on speed technology . . . is ultimately borne by investors via the cost of liquidity . . . .").

[320] *See* GORDON, *supra* note 123, at 116–20 (noting the benefits of the advent of electric lighting).

[321] *See* Derek Thompson, *The Spectacular Rise and Fall of U.S. Whaling: An Innovation Story*, ATLANTIC (Feb. 22, 2012), https://www.theatlantic.com/business/archive/2012/02/the-spectacular-rise-and-fall-of-us-whaling-an-innovation-story/253355 (describing how the whale oil industry was displaced).

[322] GORDON, *supra* note 123, at 114 fig.4-1.

[323] *See generally* Roxana Mihet, *Financial Technology and the Inequality Gap* 1 (Swiss Fin. Inst. Rsch. Paper Series, Working Paper No. 21-04, 2022),

algorithms that function to transfer wealth from the great mass of consumers to a smaller class of producers.[324]

Now, on the other hand, consider innovation's losers. The increasing use of algorithms to determine much of our social, work, and political lives may turn out to be net beneficial in the long run, but—at least so far—these technologies may generate exaggerated biases against women, people of color, and people with disabilities, among others.[325] Sometimes this means that socially marginalized groups suffer representational biases at the hands of algorithmic innovations, but they also suffer allocative and interpersonal harms as well.[326] For example, in the employment context, algorithms may give preferences to men, or they may match Black applicants predominantly with Black-owned businesses.[327]

In cases such as these, where an innovation's benefits to men, white people, rich people, or people from the global north technically exceed the innovation's costs to marginalized people, we might still characterize the innovation as antisocial and worthy of regulation. Our goal here is not to defend a particular calculus for trading off welfare versus distributional concerns but merely to point out that there are a host of innovations that appear prosocial if viewed from the perspective of net welfare that may turn out to be antisocial when their distributional impacts are considered.

In this Part we have made the case that the common view of the distribution of innovation is misguided. We depict our argument in

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https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3474720 ("[S]ophisticated investors who already have relatively high levels of wealth are most likely to benefit from many of the new information technologies.").

[324] *See generally* Christopher R. Leslie, *Predatory Pricing Algorithms*, 98 N.Y.U. L. REV. 49 (2023) (describing how predatory pricing algorithms create monopolies at the expense of the consumer); Ziad Buchh, *Online Pricing Algorithms Are Gaming the System, and Could Mean You Pay More*, NPR (July 25, 2022, 5:00 AM), https://www.npr.org/2022/07/25/1113004433/online-shopping-deals-algorithm-pricing-regulation [https://perma.cc/BX9R-P44S] (discussing how pricing algorithms "take[] price competition off the table").

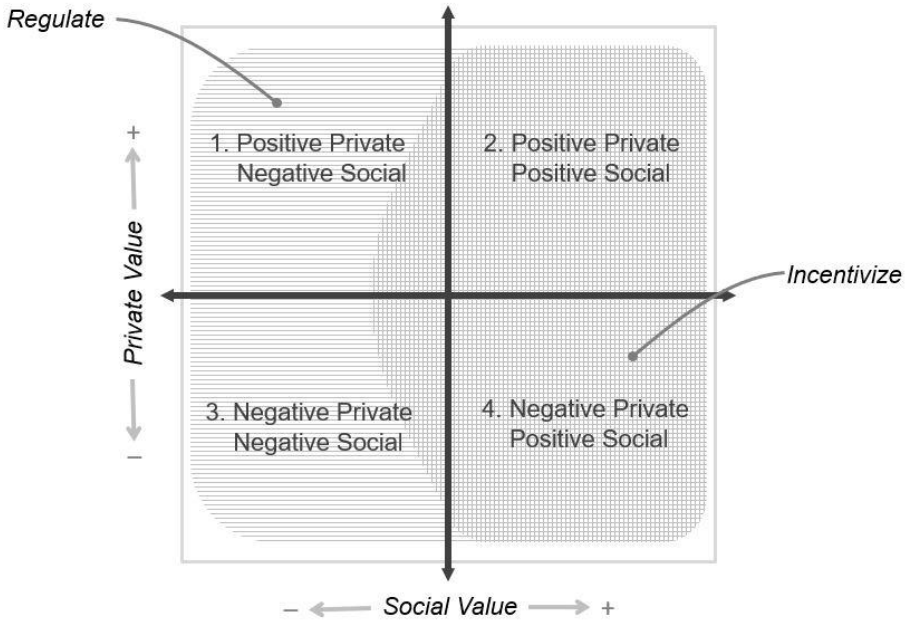
[325] *See* Renee Shelby et al., Sociotechnical Harms: Scoping a Taxonomy for Harm Reduction (July 19, 2023) (conference paper on file with the AAAI/ACM Conference on Artificial Intelligence, Ethics, and Society), https://arxiv.org/abs/2210.05791 [https://perma.cc/E5BZ-KD9Y] (discussing how algorithmic systems exacerbate social inequalities).

[326] *See id.* at 6–9 (analyzing the different types of sociotechnical harms faced by marginalized groups).

[327] *Id.* at 7.

Figure 3. Rather than a world in which most innovations add social value (the crosshatched area below from Figure 2), we live in a world in which much innovation is socially harmful (the fully shaded area). If we've made the case that the circle more accurately depicts innovation's true impact than does the lozenge, we believe the policy proposals in the next Part are an appropriate response.

Figure 3: The Distribution of Innovation



V. POLICY IMPLICATIONS

We hope that this Article serves as a caution against the all-too-easy ascription of positive value to innovation. While we believe that innovations have the capacity to dramatically improve human lives, we also recognize that much of what passes for innovation is dangerous to people, our environment, and our society. So, what can be done? How can policymakers better sort prosocial wheat from antisocial chaff? In this Part, we offer some suggestions, beginning with general reflections on modern innovation policy and then turning towards specific changes that the law can make.

A. THE INVERSE PRECAUTIONARY PRINCIPLE

Part III of this Article catalogued the manifold ways in which innovations can be bad for society. Even in the fields that have best exemplified technological progress, like pharmaceuticals, many new innovations are harmful. And the share of antisocial innovations will be even greater in other fields, like workplace surveillance, finance, and tobacco products. But none of this is apparent from two of our most important innovation governance tools—patent law and antitrust law. Both sets of doctrines treat all or almost all innovation as good innovation and worthy of encouragement.[328]

We refer to the uncritical embrace of innovation as the Inverse Precautionary Principle. The term derives from administrative law, where, according to the Precautionary Principle, the state should actively regulate behaviors that pose a risk of harm, even in the absence of empirical evidence of the risk.[329] For example, the Precautionary Principle should be used as a guide for regulating environmental harms; according to the United Nations: "[w]here there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."[330] The guiding intuition is "better safe than sorry." In the face of uncertainty about risks, the Precautionary Principle dictates, it's best to regulate and avoid them.

To a considerable extent, major tools of innovation governance operate under the opposite intuition. In the absence of knowledge about the benefits and risks of an innovation, patent law and antitrust law assume the appropriate path is encouragement and promotion.[331] Patent law ostensibly requires that an invention be "useful" in order to obtain exclusive rights.[332] But in practice, the

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[328] *See supra* sections II.B & II.C.

[329] *See* Cass R. Sunstein, *Beyond the Precautionary Principle*, 151 U. PA. L. REV. 1003, 1003 (2003) ("[T]he [precautionary] principle imposes a burden of proof on those who create potential risks, and it requires regulation of activities even if it cannot be shown that those activities are likely to produce significant harms.").

[330] *Id.* at 1006.

[331] *See supra* sections II.B & II.C.

[332] *See* Michael Risch, *A Surprisingly Useful Requirement*, 19 GEO. MASON L. REV. 57, 57 (2011) ("For 220 years, the Patent Act has required patentable inventions to be 'new and useful.'").

utility requirement is toothless.[333] Only truly "impossible" inventions like perpetual motion machines fail the requirement.[334] Patents on bump stocks and tobacco additives are readily obtainable.[335] This is the Inverse Precautionary Principle at work.

Consider the poster child for patent law as an innovation mechanism: pharmaceuticals. Here, the justifications for patent law exclusivity appear to be strongest, and the potential welfare benefits are potentially the highest.[336] Of all the patented drugs, however, only a small percentage enter FDA clinical trials at all. Presumably the sponsors of the drugs that do not enter trials already know they are unlikely to succeed.[337] Of the drugs that enter FDA trials, fewer than twenty percent ultimately win approval.[338] For example, in 2019 the FDA approved only forty-eight drugs.[339] And, as we described above, as many as half of the drugs that are

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[333] *See id.* at 58, 64 (describing how the utility requirement for patents is "essentially ignored").

[334] *See id.* at 65–66, 99 (describing how the eligible-utility rule is merely intended to "weed[] out theoretically impossible inventions like perpetual-motion machines"); Sean B. Seymore, *Making Patents Useful*, 98 MINN. L. REV. 1046, 1068 n.141, 1097 n.340 (2014) (providing citations for a few "lists of inventions and utilities that should be immediately rejected" which are listed in the *Manual of Patent Examining Procedure*, including the perpetual-motion machine).

[335] *See, e.g.*, U.S. Patent No. 9,297,602 B2 (issuing a patent for a firearm bump stock assembly); U.S. Patent No. 8,955,523 B2 (issuing a patent for tobacco-derived components and materials).

[336] Buccafusco & Masur, *supra* note 207, at 1413, 1419 (explaining that the pharmaceutical industry is "consistently [held] up . . . as the shining example of the success of the patent system" because it "incentiviz[es] breakthrough innovations that would not have come about but for the promise of exclusive rights").

[337] *Id.* at 1426.

[338] *See* Chi Heem Wong, Kien Wei Siah & Andrew Lo, *Estimation of Clinical Trial Success Rates and Related Parameters*, 20 BIOSTAT. 273, 277 (2019) (finding that only 13.8% of drug development programs lead to approval); Michael Hay, David W. Thomas, John L. Craighead, Celia Economides & Jesse Rosenthal, *Clinical Development Success Rates for Investigational Drugs*, 32 NATURE BIOTECH. 40, 48 (2014) (estimating a 10.4% success rate for all indications); DAVID W. THOMAS ET AL., BIOTECH. INNOVATION ORG., CLINICAL DEVELOPMENT SUCCESS RATES 2006-2015, at 7 (2016), https://www.bio.org/sites/default/files/legacy/bioorg/docs/Clinical%20Development%20Success%20Rates%202006-2015%20-%20BIO,%20Biomedtracker,%20Amplion%202016.pdf (estimating a 9.6% success rate).

[339] Asher Mullard, *2019 FDA Drug Approvals*, 19 NATURE REVS. 79, 79 (2020).

approved are no better or affirmatively worse than those that preceded them.[340]

While we're all grateful for the drugs that cure diseases, extend lifespans, and improve health, we shouldn't deceive ourselves into believing that most new patented pharmaceuticals are wonder drugs. They're called wonder drugs for a reason. But that is not patent law's approach. Although patent examiners may not know which drugs are going to turn into breakthroughs and which will be duds, patent law's assumption is that they should all be encouraged. Where the Precautionary Principle dictates regulation in the face of uncertain risks, patent law's Inverse Precautionary Principle offers incentives in the face of uncertain gains—and serious antisocial risks.

Antitrust law, like patent law, seems to apply the Inverse Precautionary Principle, treating all innovation as beneficial and ignoring the risks that it may pose. Laws governing monopolists, agreements among firms, and merger enforcement are designed to safeguard and maximize innovative activity.[341] When firms don't have to compete with rivals, the theory goes, they will become complacent and less likely to offer new products or services to consumers.[342] But, as with patent law, antitrust law pays scant attention to the degree of innovation that firms produce or whether that innovation ultimately benefits consumers.[343]

As a rule, antitrust law is committed to the idea that innovation benefits society.[344] Moreover, the law adopts the same stance as patent law, assuming that consumers and markets are better than

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[340] *See supra* section IV.B.*1*.

[341] *See supra* section II.C.

[342] *See, e.g.*, HORIZONTAL MERGER GUIDELINES, *supra* note 92, at 1 ("Competition . . . incentivizes businesses to . . . innovate.").

[343] *See* Herbert Hovenkamp, *Antitrust and Innovation: Where We Are and Where We Should Be Going*, 77 ANTITRUST L.J. 749, 750 (2011) ("Neither antitrust nor intellectual property has any moral content. Their sole purpose is to make the economy bigger.").

[344] *See, e.g.*, Roger Alford, Deputy Ass't Att'y Gen., Antitrust Div., U.S. Dep't of Just., The Role of Antitrust in Promoting Innovation (Feb. 23, 2018), https://www.justice.gov/opa/speech/file/1038596/download [https://perma.cc/R5KE-LMFD] (discussing antitrust law as a key component in creating a culture of innovation which maximizes efficiency, enhances integrity, and ensures opportunity for everyone); Baker, *supra* note 19, at 576 (discussing how antitrust rules are focused on promoting innovation and presume that it is good for society).

enforcers and courts at sorting out which innovations are valuable.[345] Consider the language the antitrust enforcement agencies use in the 2010 Horizontal Merger Guidelines to discuss innovation. The goal of innovation policy as expressed in the Guidelines is simply to increase the volume of new products firms produce.[346] In this telling, innovation is merely the creation of these new products; the societal benefits or costs of the products are irrelevant. This approach is consistent with the prevailing view among antitrust experts that competition policy should promote competitive markets but not favor any particular market outcomes.[347] As the FTC puts it, the agency "does not choose winners and losers—you, as the consumer, do that."[348]

This sanguine approach to innovation's benefits is especially apparent in the way antitrust courts treat the quality of a claimed innovation in predatory product design cases. These cases demonstrate antitrust's embrace of the Inverse Precautionary Principle. Predatory product design claims typically center on allegations that a vertically integrated manufacturer with monopoly power at one level of the distribution chain has altered its monopoly product with the goal of excluding a downstream competitor. Consider the Ninth Circuit's 2010 decision in *Allied Orthopedic Appliances, Inc. v. Tyco Health Care Group*.[349]

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[345] *See, e.g.*, Allied Orthopedic Appliances, Inc. v. Tyco Health Care Grp., 592 F.3d 991, 1000 (9th Cir. 2010) ("To weigh the benefits of an improved product design against the resulting injuries to competitors is not just unwise, it is unadministrable."); United States v. Microsoft Corp., 147 F.3d 935, 948 (D.C. Cir. 1998) ("Antitrust scholars have long recognized the undesirability of having courts oversee product design . . . .").

[346] *See, e.g.*, HORIZONTAL MERGER GUIDELINES, *supra* note 342, at 23 ("The Agencies may consider whether a merger is likely to diminish innovation competition by encouraging the merged firm to curtail its innovative efforts below the level that would prevail in the absence of the merger.").

[347] *See, e.g.*, Andrew Finch, Principal Deputy Ass't Att'y Gen., Antitrust Division, U.S. Dep't of Just., Concentrating on Competition: An Antitrust Perspective on Platforms and Industry Consolidation (Dec. 14, 2018), https://www.justice.gov/opa/speech/principal-deputy-assistant-attorney-general-andrew-finch-delivers-keynote-address-capitol [https://perma.cc/MH9W-L8NK] ("The whole point of competition is that the market, rather than regulators, pick the winners and losers.").

[348] FTC, COMPETITION COUNTS: HOW CONSUMERS WIN WHEN BUSINESSES COMPETE 1 (2015), https://www.ftc.gov/system/files/attachments/competition-counts/pdf-0116_competition-counts.pdf [https://perma.cc/3GD5-UYN6].

[349] *Allied Orthopedic Appliances*, 592 F.3d 991.

Defendant Tyco is a manufacturer of pulse oximetry systems.[350] These systems include sensors, which are attached to a patient and collect data, and monitors, which receive the data and show a patient's blood oxygenation levels.[351] Tyco's monitors were in widespread use and, due to a patent on Tyco's technology, these monitors used only Tyco sensors.[352] But Tyco's patent was expiring, and the company expected that competitors would soon produce generic sensors compatible with Tyco monitors.[353] To avoid this outcome, Tyco redesigned its system.[354] It created a new patented sensor and moved much of the key technology that had been in the monitors into this new sensor.[355] Tyco introduced its new system and announced that it was retiring the old technology.[356] A group of hospitals and other health care providers sued Tyco claiming that Tyco's product redesign and related marketing and distribution practices violated Sections 1 and 2 of the Sherman Act.[357]

The Ninth Circuit affirmed the district court's grant of summary judgment to Tyco.[358] While conceding that "changes in product design are not immune from antitrust scrutiny," the court held that "a design change that improves a product by providing a new benefit to consumers does not violate Section 2 absent some associated anticompetitive conduct."[359] The court found that Tyco's product redesign was an improvement.[360] It did so despite evidence that a new type of sensor the system made possible was "no more accurate" than older sensors and that doctors had "not found" some of the new features "very useful."[361] The court ignored evidence that Tyco "worried that the market would perceive its new technology as nothing more than a way to lock out generics."[362] Among other forms

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[350] *Id.* at 992.
[351] *Id.* at 994.
[352] *Id.*
[353] *Id.*
[354] *Id.*
[355] *Id.*
[356] *Id.* at 995.
[357] *Id.* at 993–94.
[358] *Id.* at 995–96.
[359] *Id.* at 998–99.
[360] *Id.* at 1000.
[361] *Id.* at 1001.
[362] *Id.*

of evidence the court relied on to conclude that the new Tyco system was an improvement was that the Patent and Trademark Office (PTO) had found the new sensor design "to be sufficiently innovative over the prior art to deserve a patent."[363] Here, patent law's toothless utility standard was used to buttress an antitrust court's decision to ignore evidence of an innovation's low quality.

In addition to setting this low bar for what constitutes a product improvement, the Ninth Circuit rejected out of hand plaintiffs' argument that the district court should have balanced any benefits of Tyco's new product against its anticompetitive impact.[364] Such balancing, the court asserted, would not only be "unwise" it would be "unadministrable."[365] Therefore, "[i]f a monopolist's design change is an improvement, it is 'necessarily tolerated by the antitrust laws.'"[366]

This is the Inverse Precautionary Principle at work. "Innovation" here means barely more than novelty or variation. Any indication by the defendant firm that its product is an improvement along some dimension from what came before is sufficient to shield anticompetitive behavior. Courts in these cases do not consider whether the asserted innovation's benefits likely exceed its anticompetitive costs.[367]

Antitrust law embraces the Inverse Precautionary Principle in other types of cases as well. Indeed, outside the predatory product design context, there is even less indication that the benefits of innovation are a proper subject of antitrust law. Policy makers, courts, and antitrust litigants are concerned with the effects of mergers and conduct on the quantity of innovation, but almost never discuss its quality.[368] Scholars have observed how antitrust's

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[363] *Id.* at 1000.

[364] *Id.* ("There is no room in [the] analysis for balancing the benefits or worth of a product improvement against its anticompetitive effects.").

[365] *Id.*

[366] *Id.* (quoting Foremost Pro Color, Inc. v. Eastman Kodak Co., 703 F.2d 534, 545 (9th Cir. 1983)).

[367] *See id.* (explaining that courts evaluating a predatory product design claim will not weigh the benefits of the product improvement against its anticompetitive impact).

[368] *See, e.g.*, Hovenkamp, *supra* note 343, at 750 ("Neither antitrust nor intellectual property has any moral content. Their sole purpose is to make the economy bigger."); *cf.* Baker, *supra* note 19, at 576 ("Underlying this entire discussion [of the relationship between competition and innovation] is a presumption that more innovation is good for society.").

agnostic approach to innovation can lead to perverse results when the products in question are toxic (like cigarettes) or potentially toxic (like social media).[369] Nonetheless, current antitrust doctrine dictates that whether a new product is good or bad for society is an issue consumers can address in the first instance and, if that approach fails, that sector regulators will eventually confront.

Antitrust's agnostic approach to the quality of innovation has an impact in another arena: it sometimes threatens to limit firms' ability to work together on socially beneficial projects.[370] In 2019, for example, the Department of Justice announced that it was investigating an agreement among four automakers and the state of California that the automakers would meet California's fuel efficiency standards, which were higher than those the Trump administration had promulgated.[371] While this investigation was widely derided as a political stunt and later dropped without further action, the incident served as a reminder that competitors must be careful in entering agreements even when their goal is laudable.[372] Similarly, European antitrust authorities opened an investigation into fashion companies that had signed an open letter calling for

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[369] *See, e.g.*, Daniel A. Crane, *Harmful Output in the Antitrust Domain: Lessons from the Tobacco Industry*, 39 GA. L. REV. 321, 344 (2005) (arguing that "[o]utput maximization remains the dominant goal of antitrust enforcement in the tobacco industry" and that "[i]n general, the antitrust establishment simply ignores the harmful nature of tobacco"); James Niels Rosenquist, Fiona M. Scott Morton & Samuel N. Weinstein, *Addictive Technology and Its Implications for Antitrust Enforcement*, 100 N.C. L. REV. 431, 471 (2022) (arguing that the standard approach of using output as a proxy for consumer welfare "cannot be applied in digital markets given the strong possibility that more output causes consumer harm, not benefit." (emphasis omitted)).

[370] *See* Amelia Miazad, *Prosocial Antitrust*, 73 HASTINGS L.J. 1637, 1644–45 (2022) (explaining that "antitrust law, as currently envisioned, cannot accommodate [the] rising tide of prosocial collaboration" and arguing for "a new standard, the universal consumer standard, which would permit competitor collaboration aimed at mitigating systemic risk").

[371] Juliet Eilperin & Steven Mufson, *Justice Department Launches Antitrust Probe of Automakers Over Their Fuel Efficiency Deal with California*, (Sept. 6, 2019, 5:34 PM), https://www.washingtonpost.com/climate-environment/justice-dept-launches-antitrust-probe-of-automakers-over-their-fuel-efficiency-deal-with-california/2019/09/06/29a22ee6-d0c7-11e9-b29b-a528dc82154a_story.html.

[372] Coral Davenport, *Justice Department Drops Antitrust Probe Against Automakers That Sided with California on Emissions*, N.Y. TIMES (Feb. 7, 2020), https://www.nytimes.com/2020/02/07/climate/trump-california- automakers-antitrust.html.

various measures to make their industry more sustainable.[373] The signatories agreed to "increase sustainability throughout the supply chain and sales calendar through: Less unnecessary product[;] [l]ess waste in fabrics and inventory[; and l]ess travel."[374] The EU subsequently targeted these firms for unannounced inspections as a "preliminary investigative step" into whether they had violated EU antitrust laws.[375]

In sum, patent law and antitrust law, two pillars of innovation policy, systematically ignore the quality of innovations and their potential harms. Our solution to this problem is not to reject the Inverse Precautionary Principle in favor of the Precautionary Principle. We do not advocate assuming that innovations are antisocial until they have been proven prosocial. Rather, we recognize that we live in a multi-risk world, as Jonathan Wiener describes.[376] If we assume that innovations will generally be beneficial, we risk over-incentivizing activities that will prove harmful. By contrast, if we assume innovations will generally be harmful, we risk missing out on the next great inventions.[377] We must recognize that our decisions about incentivizing and regulating innovation can impose risk in both directions.

B. UNCERTAINTY AND THE TIMING OF POLICY INTERVENTIONS

In Parts II and III we catalogued the various ways in which policymakers have generally treated innovation, whether prosocial or antisocial. Our most important innovation incentives primarily operate early in the innovation process and largely ignore an

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[373] *See* Foo Yun Chee, *EU Cartel Raids Target Fashion Designers Proposing Sales Periods, Discount Changes*, REUTERS (June 14, 2022, 9:56 AM), https://www.reuters.com/business/retail-consumer/eu-cartel-raids-target-fashion-designers-proposing-sales-periods-discount-2022-06-14/ (reporting that EU antitrust regulators were investigating signatories of the open letter).

[374] *Open Letter to the Fashion Industry*, F. LETTER, https://forumletter.org/ [https://perma.cc/43UQ-HKBU].

[375] European Commission Press Release IP/22/3134, Antitrust: Commission Carries out Unannounced Inspections in the Fashion Sector (May 17, 2022).

[376] *See* Wiener, *supra* note 47, at 2137 (explaining that humans are always subject to several risks despite the tendency to focus on a single risk at a time).

[377] *See* Sunstein, *supra* note 329, at 1004–08 (discussing the drawbacks of the precautionary principle).

innovation's antisocial effects.[378] By contrast, most of our means for limiting antisocial innovation operate much later in the innovation lifecycle, once the product has already entered the market and caused harm.[379] While this outcome may seem to arise necessarily from our uncertainty about an innovation's consequences, it need not do so. And designing innovation incentives and regulations in this manner will lead to excessive production of antisocial innovations.

The most significant mechanism for encouraging innovation—patent exclusivity—operates early in the new product lifecycle. Innovators can obtain patents the moment they invent something novel and nonobvious.[380] In fact, if they're going to obtain patents, they must do so immediately.[381] But patent law doesn't care whether the invention will improve society or not. For the most part then, antisocial innovations will be weeded out only later in the innovation process, once they have been commercialized. Although FDA regulation is meant to prevent antisocial drugs and medical devices from reaching consumers, the vast majority of innovations will not face any meaningful regulatory scrutiny until they reach the market.[382] Virtually all of our means for limiting antisocial innovation function ex post.[383]

The standard justification for this temporal gap between incentives and regulation is the initial uncertainty surrounding an innovation's social effects.[384] How could regulators know, at the time of patenting, whether an innovation is going to be pro- or antisocial? We don't want to dispute this point. Far from it. Rather we wish to emphasize the particular choice that policymakers have made in

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[378] *See supra* Part II.

[379] *See supra* section III.B.*2*.

[380] *See* 35 U.S.C. § 102 (requiring an invention be novel); *id.* § 103 (requiring an invention be non-obvious).

[381] *See In re* Katz, 687 F.2d 450, 454 (C.C.P.A. 1982) ("Unlike the filing of a patent application, the publication of an article is not deemed a constructive reduction to practice of the subject matter described therein.").

[382] *See supra* section III.B.*2*.

[383] As discussed above, regulators ban some products altogether, like lead paint, but these bans are almost always put in place after the product has already harmed consumers and are therefore best thought of as ex post regulations. *See supra* notes 156–157 and accompanying text.

[384] *See supra* section II.D.

light of this uncertainty. That choice is to reward all novel inventions with exclusive rights.

Consider a plausible distribution of inventions based on the foregoing analysis.[385] Assume that out of one hundred inventions, 25% generate net improvements in social welfare, 25% produce net diminutions in social welfare, and 50% don't really change social welfare one way or the other. And assume that the benefits created by the successful inventions are equal in magnitude to the losses created by the harmful ones. Finally, assume that at the time of patenting, it's impossible to know which inventions will fall into which buckets.

Patent law's response to this uncertainty is to give every invention an exclusive right.[386] In an ideal world, we would want patent law to reward only the 25 inventions that improve social welfare. Any additional patents to the other inventions are excessive. But these excess patents aren't costless. First, many of these inventions might have been produced without the additional patent incentive because they were already cost-justified from an R&D perspective (Boxes 1 and 2). Excess patents also increase search and design-around costs for competitors, and they create administrative costs for the PTO.

Second, and perhaps even worse, patent incentives might be encouraging antisocial inventions. As we explained in Part III, the exclusivity patents confer might be sufficient to motivate firms to develop otherwise privately costly inventions that are socially harmful. That is, the patent moves the innovation from Box 3 (Negative Private/Negative Social) to Box 1 (Positive Private/Negative Social).[387] For example, a gun or tobacco innovation that wouldn't be worth investing in if the firm could only obtain competitive prices might be worthwhile at the supracompetitive prices that patents allow.

Thus, while ex ante uncertainty about an innovation's welfare effects may be unavoidable, the government's response to that uncertainty isn't obvious. Patent law assumes that most

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[385] We assume that all these inventions would meet patent law's novelty and non-obviousness requirements.

[386] Call this the Oprah Approach ("You get a patent! You get a patent! Everybody gets a patent!").

[387] *See supra* Figures 1 & 2.

innovations fall into Box 4 (Negative Private/Positive Social) and thus need the benefits of exclusivity to be brought into existence. We believe that the foregoing analysis should cause policymakers to question that assumption. A substantial share of potentially patentable innovations may make society worse off (or at least no better off). Even if we can't tell which ones are which, the appropriate response need not be exclusive rights for all. Rather, we might be better off with a regime that confronted ex ante uncertainty with exclusive rights for none.

C. ADAPTING INNOVATION POLICY

The scale of antisocial innovation should cause us to rethink our commitments to promoting innovation, seemingly at all costs. Innovation incentives are expensive, and policymakers should attempt to get their money's worth. Here, we offer some suggestions that will better align innovation law with social welfare. These proposals are necessarily preliminary, because the empirical data on innovation's costs and benefits is far from complete. Accordingly, we might begin by adopting Stuart Benjamin and Arti Rai's proposal for the creation of a federal Office for Innovation Policy that oversees the various aspects of innovation governance.[388] Such an office could provide research and offer expert guidance on coordinating mechanisms that promote beneficial innovation and discourage antisocial innovation.[389]

1. Modifying Innovation Incentives. Patent law is one of our biggest expenditures on innovation incentives, even though its costs are borne by consumers and competitors rather than by governments.[390] What are we getting from this enormous contribution to innovative activity? The data are decidedly mixed. At least some of the blame for patent law's uneven record should be placed on the doctrine's failure to screen out harmful inventions. As discussed, patent law does virtually nothing to prevent antisocial

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[388] Stuart Minor Benjamin & Arti K. Rai, *Fixing Innovation Policy: A Structural Perspective*, 77 GEO. WASH. L. REV. 1, 6 (2008).

[389] *See id.* at 67–68 (discussing the kind of analysis and procedures an Office of Innovation Policy would use).

[390] *See supra* section II.B.

inventions if they are otherwise novel and nonobvious.[391] The law's utility doctrine is largely meaningless.

But the story is even worse than that because patent exclusivity may be affirmatively encouraging antisocial innovations. Return to Figure 2 above. Innovation is privately costly to firms, and they won't engage in it unless the expected returns exceed their expected costs. In theory, then, we need not worry about potential innovations in Box 3 that have both negative private value and negative social value. The possibility of patent exclusivity and its concomitant monopoly prices could, however, turn Box 3 innovations into Box 1 innovations, because they are now privately beneficial but still socially harmful.

Consider, for example, e-cigarette devices. In the absence of patent law, a firm might be unwilling to develop an e-cigarette device, knowing that if it produces a successful product, its competitors will quickly and cheaply copy it. But the promise of a patent and the ability to limit copying and competition might make the investment in R&D worthwhile. Now the firm has sufficient incentives to develop and market the device, potentially harming thousands of children.[392]

Curtailing patent law's promotion of antisocial innovation is not easy. As we explained above, at the time a patent is granted, the PTO has highly limited information about the patent's likely effects on human welfare. Moreover, most products—whether harmful or beneficial—involve dozens or even hundreds of patents. Pharmaceuticals tend to have many fewer patents than do other products, and there are likely opportunities for the PTO to work with the FDA to minimize harmful drugs.[393] But invigorating the utility doctrine to screen out potentially harmful patents in other industries is almost certainly futile.

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[391] *See generally* Risch, *supra* note 332 (addressing how the lack of a meaningful usefulness requirement when analyzing innovations contributes to inconsistency and guesswork during difficult cases).

[392] We understand that scholars debate the net welfare effects of e-cigarettes, noting that while they increase harmful nicotine usage by children, they also decrease more harmful cigarette smoking by adults. *See, e.g.*, Daniel G. Aaron, *Tobacco Reborn: The Rise of E-Cigarettes and Regulatory Approaches*, 25 LEWIS & CLARK L. REV. 827, 870–71 (2021) ("On the one hand, youth e-cigarette use is mushrooming . . . . On the other hand, vaping may offer tangible benefits for people who wish to transition from smoking . . . .").

[393] Buccafusco & Masur, *supra* note 207, at 1432–37.

One possible response to patent law's inability to screen out antisocial innovation is for the government to rely less on patents as incentives and, instead, to favor more targeted interventions. In other words, the prevalence of antisocial innovation should inform both the "who decides" and "who pays" debates regarding allocation of innovation funding. As we outlined above, policymakers have a range of different mechanisms for encouraging innovation, including—in addition to patents—grants and prizes.[394] Recent consensus has tended to prefer patents to grants and prizes, because the latter have increased informational demands for the government.[395] The government must have a sense of which innovations will be most valuable, how much motivation is needed to pursue them, and, in the case of grants, which innovators are most likely to succeed. Patents, in theory, solve these informational problems by relying on consumers and markets to pick winners and motivate innovation.

This Article has shown, however, that our faith in innovation markets—and thus in patents—is overblown. Many markets are far from perfect and will tend to generate products that do not make people better off on balance. And due to cognitive biases or addiction, consumers may repeatedly purchase products that harm them. Finally, markets will often fail to internalize innovation's costs to the environment and privacy, and its impact on distributional outcomes. To the extent that this is correct, policymakers should, all else equal, tend to prefer more directed innovation incentives like grants and prizes.[396]

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[394] *See supra* Part II.

[395] *See* Hemel & Ouellette, *supra* note 70, at 313 ("According to the conventional wisdom, patents are superior to prizes and grants when the government is at an informational disadvantage relative to market actors.").

[396] In theory, patents on harmful innovations could end up being prosocial to the extent that patents make those products more expensive, meaning that they get into the hands of fewer people. This would be, in effect, a "deadweight gain." Crane has made a similar argument about anticompetitive effects in the tobacco industry. *See* Crane, *supra* note 369, at 362 ("[A]nticompetitive behavior would [not necessarily] increase net social welfare if it decreased cigarette consumption."). We are skeptical that many or any such gains exist. If the occur for addictive products like cigarettes, then people may still pay the added cost of the patent-protected product. In other cases, the parties who are paying the added costs of patent protection are unlikely to be the ones harmed by the product. For example, a firm may be willing to pay for a patented product that allows it to surveil its employees, but the

Assume, for example, that a government is currently spending $1 trillion on innovation incentives, spread equally between patents and grants. If it wanted to keep the overall incentive level the same while boosting the share of grants, two things would have to happen. First, it would have to reduce the patent incentive by shortening patent duration, making patents harder to obtain, or reducing patent scope. Second, the government would have to increase the amount of public funding for innovation. While the latter move might appear politically unpopular, this is only because consumers often fail to recognize the extent to which they are already paying for the innovation incentives of the patent system. Increased education about the costs as well as the benefits of patents would be valuable.

We admit that altering the patent system will have limited impact on many of the antisocial innovations that we discussed above, because many software innovations simply aren't covered by patents.[397] Reducing patent incentives will likely have no effect on the development of pricing algorithms, labor surveillance software, or social media. These innovations are generally covered by trade secret law which has its own pathologies about screening out antisocial rights.[398] Nonetheless, patents represent a massive expenditure on innovation that we have argued is much less valuable than many people believe.

Policymakers may have imperfect knowledge about which innovations are likely to contribute the most to social welfare, but,

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employees' harms are externalities to the exchange. It will be the rare instance, we think, that the patent "tax" on the product operates as a sin tax that reduces consumption.

[397] *See, e.g.*, Alice Corp. v. CLS Bank Int'l, 573 U.S. 208, 213, 221 (2014) (holding that the software innovation of "a computerized scheme for mitigating 'settlement risk'" was an "abstract idea" which could not be "transform[ed] . . . into a patent-eligible invention"); James Hicks, *Do Patents Drive Investments in Software?*, 118 NW. U. L. REV. (forthcoming 2024) (summarizing the negative effect that the Supreme Court's *Alice* decision had on software patenting).

[398] *See, e.g.*, Allison Durkin, Patricia Anne Sta Maria, Brandon Willmore, & Amy Kapczynski, *Addressing the Risks That Trade Secret Protections Pose for Health and Rights*, 23 HEALTH & HUM. RTS. J. 129, 130 (2021) ("[T]he protection of trade secrets and confidential corporate information creates barriers to data and information that the public has vital interests in accessing . . . ."); Rebecca Wexler, *Life, Liberty, and Trade Secrets: Intellectual Property in the Criminal Justice System*, 70 STAN. L. REV. 1343, 1350 (2018) (critiquing "the introduction of trade secret evidence into criminal cases" as causing "tensions between life, liberty, and property interests").

we hope, they are less likely than the utility-blind patent system to favor innovations that are affirmatively harmful to society. We do not intend to seem overly sanguine about the state's ability to direct innovation. Certainly, research grants have supported the development of drugs and chemicals that turned out to cause grave social harms.[399] Our claim is more modest. Once we recognize the existence and scale of antisocial innovation, our confidence in the patent system should decrease.

2. Intensifying Ex Ante Scrutiny. The incidence of antisocial innovation also should affect our thinking about the relative merits of ex ante and ex post regulation of harmful products. Currently only a small set of new products—mostly pharmaceuticals and pesticides—require governmental pre-approval before firms can market them.[400] The vast majority of new products enter the market without any governmental scrutiny.[401] If these products ultimately harm consumers, those harms eventually might be addressed by regulation, though that is likely to take some time. Victims also might be able to seek redress through tort litigation. The regulatory strategy is, effectively, "innocent until proven guilty," or, as we have termed it, the Inverse Precautionary Principle.

Given the scale of antisocial innovation discussed in this Article, that approach begins to look less justifiable. A better approach might be to increase the number of new products subject to ex ante review. Products with the potential to harm large numbers of people are particularly good candidates.[402]

Financial products that pose a systemic risk or that might cause widespread consumer harm are an example. Algorithms that might increase invidious forms of discrimination or shift wealth from consumers to sellers are another.

To address the threat of harmful innovation in financial products, for instance, Eric Posner and Glen Weyl have proposed

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[399] *See supra* section II.A.

[400] *See supra* section III.B.*1*.

[401] *See supra* section III.B.*2*.

[402] As Judge Richard Posner has argued, ex ante regulation is preferable in cases where a product or activity could cause "catastrophic injury." Posner, *supra* note 148, at 16. Posner had in mind regulations to prevent building collapses and to stop the sale of unsafe drugs. *Id.* In both these cases, society has chosen ex ante regulatory tools—building codes and the FDA's new drug regime described above—to try to the limit potential for mass harm.

creating a regulatory agency for the financial sector akin to the FDA.[403] Firms would be required to seek approval from this agency before marketing new financial products.[404] Because financial innovations can be beneficial or harmful, this expert agency's remit would be to prevent harmful innovations from reaching the market.[405] Sadly, the political and regulatory tides seem to be shifting in the opposite direction for fintech.[406] Countries have increasingly favored regulatory "sandboxes" for fintech innovations that allow testing of new technologies with fewer constraints.[407] As Hilary Allen argues, though, regulatory sandboxes should be used, if ever, as opportunities for testing "new regulatory approaches to coping with (rather than promoting) inevitable financial innovation."[408]

We could also imagine a federal agency tasked with evaluating the privacy implications of new products and services before they hit the market. Such an agency, while perhaps not given the broad regulatory authority of the FDA, could still issue guidance or consumer warnings about potentially dangerous products, much like the EPA does for pesticides and other new chemicals. Similarly, the Department of Labor could be given regulatory oversight for innovations that surveil workers.

The European Union is, at the time of this writing, contemplating strategies for AI regulation. According to one proposal, new technologies will be evaluated according to their potential risk, and some uses will be subject to ex ante bans if they are deemed to pose excessive risk to people.[409] The United States

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[403] Eric A. Posner & E. Glen Weyl, *An FDA for Financial Innovation: Applying the Insurable Interest Doctrine to Twenty-First-Century Financial Markets*, 107 NW. U. L. REV. 1307, 1348 (2013).

[404] *Id.* ("The inventor of a financial product will not be able to sell it to the public without first submitting an application to the [Financial Products Agency] and receiving approval.").

[405] *Id.* at 1309 (proposing "a simple test for determining whether a financial instrument is socially valuable or socially costly, and argu[ing] that socially costly financial instruments should be banned").

[406] *See* Hilary J. Allen, *Regulatory Sandboxes*, 87 GEO. WASH. L. REV. 579, 584 (2019) (discussing the Treasury Department's "enthusiastic endorsement of regulatory sandboxes as a method for reducing barriers to entry for 'fintech' innovation").

[407] *See id.* at 580–81 (introducing the adoption of "regulatory sandboxes").

[408] *Id.* at 581.

[409] *See EU AI Act: First Regulation on Artificial Intelligence*, EURO. PARLIAMENT: NEWS (Jun. 14, 2023, 2:06 PM),

has been notably slower in this arena, as it often is in regulatory matters. Note, though, that at least some of AI's risks have been apparent for decades, if not centuries,[410] and it was only *after* the release of ChatGPT and other generative AI technologies that governments began considering regulation in earnest.

None of these interventions are costless. Agencies are expensive to run, and regulation may cause us to miss out on net beneficial products. We are not proposing a wholesale adoption of "guilty until proven innocent" for new products. It's not possible here to estimate the relative costs and benefits of adopting ex ante regulation of any of the above mentioned industries. Rather, based on a more holistic understanding of the range of pro- and antisocial innovations, we embrace a risk-risk framework that acknowledges both the risks of foregone innovation benefits and the risks of human, environmental, social, and distributional harms.[411] These are likely to vary enormously across industries. For example, the lost benefits of delayed financial innovations due to ex ante regulation are likely to be much smaller than those of pharmaceutical innovations. For the former, some people will get richer more slowly, while for the latter, some people will die more rapidly. The downside risks of failing to regulate will differ across fields too. The risk of a new vehicle or pharmaceutical injuring people is limited to the number of people who consume it, but the risk to humanity from financial innovations, privacy violations, environmental harms, and AI could be catastrophic.

3. Adapting Antitrust Law. Finally, the prevalence of antisocial innovation counsels changes to antitrust doctrine. The changes we

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https://www.europarl.europa.eu/news/en/headlines/society/20230601STO93804/eu-ai-act-first-regulation-on-artificial-intelligence [https://perma.cc/4RTT-J8L5] ("The new rules establish obligations for providers and users depending on the level of risk from artificial intelligence. . . . Unacceptable risk AI systems are systems considered a threat to people and will be banned.").

[410] For examples of media portrayals of the risks of artificial intelligence, see MARY SHELLEY, FRANKENSTEIN (1818); SAMUEL BUTLER, EREWHON (1872); 2001: A SPACE ODYSSEY (Metro-Goldwyn-Mayer 1968); WESTWORLD (Metro-Goldwyn-Mayer 1973); THE TERMINATOR (Orion Pictures 1984).

[411] *See* Wiener, *supra* note 47, at 2137 ("The challenge is not only risk and uncertainty, but also multiplicity. We are exposed to multiple risks, and our decisions affect multiple risks."); Sunstein, *supra* note 329, at 1056 ("A better approach would acknowledge that a wide variety of adverse effects may come from inaction, regulation, and everything in between.").

propose need not be radical departures from bedrock antitrust principles. Indeed, they are consistent with the consumer welfare standard. Our proposals all follow the same basic admonition: Antitrust law should abandon the Inverse Precautionary Principle when evaluating liability and should actively weigh the costs and benefits of challenged conduct rather than uncritically accepting innovation as beneficial. We propose that antitrust courts and enforcers take into account the quality of innovation in four scenarios: when a monopolist's product changes harm downstream competitors; when merging parties assert enhanced innovation as a procompetitive justification for a deal; when defendants in conduct cases point to increased output of new products in an attempt to defeat claims of anticompetitive effects; and when competitors agree to measures that would limit antisocial innovation or promote beneficial innovation.

First, in product design cases, courts should more thoroughly evaluate the relative costs and benefits of an allegedly innovative new product design that has the effect of harming rivals. To be clear, this is not a call for a full-blown cost-benefit analysis. Nor do we mean to stack the deck in favor of static rivals who are outpaced by more innovative competitors. Rather, we propose simple changes to the standard for anticompetitive product design, including requiring defendants to demonstrate more than trivial product improvements. When a monopolist's tweaks to its dominant product harm competition and reduce the prospects for more significant innovations, either by the monopolist or its competitors, the quality of those tweaks should matter.

Precedent exists for this approach. In a 2015 opinion, *New York v. Actavis*, the Second Circuit suggested that the quality of an innovation should be considered in determining antitrust liability in a pharmaceutical "product-hopping" case.[412] Situating New

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[412] New York v. Actavis PLC, 787 F.3d 638 (2d Cir. 2015). The court defined "product hopping" as "conduct by a monopolist to perpetuate patent exclusivity through successive products." *Id.* at 643; *see also* Bret Dickey, Kun Huang & Daniel Rubinfeld, *Pharmaceutical Product Hopping: Is There a Role for Antitrust Scrutiny?*, 82 ANTITRUST L. J. 679, 680 (2019) (describing "product hopping" as "a branded manufacturer introducing a minor change to an existing prescription drug product and substantially shifting sales to the reformulated product, with the effect of inhibiting emerging competition from a generic version of the original branded product").

York's product-hopping claim in the Section 2 case law on product redesign, the Second Circuit upheld the district court's injunction against Actavis's conduct involving the creation and marketing of an updated version of an old drug.[413] The defendant argued that antitrust intervention in the pharmaceutical sector would chill innovation.[414] The court rejected this assertion and found that the opposite might well be true: "immunizing product hopping from antitrust scrutiny may deter significant innovation by encouraging manufacturers to focus on [creating] trivial or minor product reformulations rather than investing in the research and development necessary to develop riskier, but medically significant innovations."[415]

This analysis, contrasting "significant innovation" with "trivial or minor product reformulations," is a step in the right direction. Similar language can be found in an early predatory product design case, *In re IBM Peripheral EDP Devices Antitrust Litigation*.[416] The U.S. District Court for the Northern District of California held that to determine if a monopolist's product change is predatory, the fact finder should consider the effect of the design on competitors and consumers, "the degree to which the design was the product of desirable technological creativity," and "the monopolist's intent."[417] We agree that "desirable technological creativity" should be the standard. A monopolist should not enjoy carte blanche to make minor alterations to its dominant product that do nothing to improve it while harming competition and limiting the chances for more significant innovation.

In merger challenges and litigation involving alleged anticompetitive conduct, defendants can attempt to overcome plaintiffs' prima facie showing of competitive harm with evidence of

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[413] Actavis had developed an "extended release" version of a patented Alzheimer's drug, which a patient took once a day, to replace an "immediate release" version, which a patient took twice a day. *Id.* at 642. At the same time, Actavis tried to move patients away from the old version of its drug to the new version. *Id.* at 647–48. Ultimately Actavis discontinued the old version, creating a barrier to entry for generic equivalents poised to enter the market. *Id.* at 642–43.

[414] *Id.* at 659.

[415] *Id.*

[416] Transamerica Comput. Co. v. Int'l Bus. Machines Corp. (*In re* IBM Peripheral EDP Devices Antitrust Litig.), 481 F. Supp. 965 (N.D. Cal. 1979).

[417] *Id.* at 1003.

procompetitive effects.[418] Under the generally accepted consumer welfare standard, such procompetitive justifications typically rely on assertions that a merger or suspect conduct will lower price or increase output, thereby benefiting consumers. Increased output is considered equivalent to an increase in consumer welfare.[419] But this approach assumes that the good or service in question benefits consumers. For antisocial innovations, that assumption might not apply.[420] Indeed, increased output of antisocial innovations could harm consumers and innocent third parties. In these circumstances, courts should consider the quality of an innovation or new product. A defense based merely on an assertion of increased output should fail if that output would be harmful.[421]

Finally, the quality of innovation should matter in cases where competitors agree to make potentially beneficial joint changes to industry practices. Under current law, agreements among competitors that affect pricing typically are per se unlawful. In other words, even when such agreements would reduce antisocial innovation or increase socially beneficial innovation, firms (and individuals) risk criminal antitrust liability if an agreement would result in reduced output or higher prices. During the early days of the coronavirus pandemic, the federal government took measures designed to reduce the risk of antitrust liability for firms that wanted to collaborate on a vaccine.[422] As Amelia Miazad has argued, it is worth considering whether this approach to industry

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[418] *See, e.g.*, FTC v. CCC Holdings Inc., 605 F. Supp. 2d 26, 46 (D.D.C. 2009); United States v. Microsoft Corp., 253 F.3d 34, 59 (D.C. Cir. 2001).

[419] *See* Rosenquist, Morton & Weinstein, *supra* note 369, at 471 ("A common shortcut, or summary statistic, that is often used in enforcement is to use change in output as a proxy for consumer welfare.").

[420] *Id.* at 475 ("Because output is a 'shortcut,' or proxy, for consumer welfare, it does not give an accurate assessment when some consumption creates disutility.").

[421] *See id.* at 484–85 (finding that "the common 'short cut' of using a generalized measure of output as a proxy for consumer welfare fails" in the context of addictive digital products given the harms associated with increased social media consumption, and that a decline in quality of a service constitutes "a harm to consumer welfare.").

[422] *See* Dep't of Just. & FTC, Joint Antitrust Statement Regarding COVID-19, at 1 (March 2020),
https://www.ftc.gov/system/files/documents/public_statements/1569593/statement_on_coronavirus_ftc-doj_3-24-20.pdf (announcing that the antitrust enforcement agencies will expedite review of proposed COVID-19-related competitor collaborations which "address[] public health and safety").

collaboration should be standardized so that firms that want to work together to limit antisocial innovation or increase socially beneficial innovation can do so absent the threat of criminal liability.[423]

VI. CONCLUSION

America's infatuation with innovation is costly. We pour billions of dollars into promoting and protecting innovation, but as this Article has argued, much of what we get is actively bad for humanity. It hurts us directly, and it also undermines our privacy, autonomy, environment, and democracy. These problems may get worse as next-generation innovations like artificial intelligence and the metaverse enter everyday use. This realization should spur a thorough rethinking of our approach to innovation governance.

The nature of this new approach is still far from apparent. We are the first to admit that we do not have all the answers. In part, this is because innovation fetishization has prevented government agencies from collecting the necessary data to weigh the risks of promoting innovation. The first step forward is to invest in more rigorous interagency analysis of innovation's costs and benefits. How much is the patent system costing consumers and competitors, and are those costs worth the benefits they are generating? Can we begin to understand the kinds of innovations that most benefit and most harm society in order to more precisely encourage the former and discourage the latter?

We hope this is the beginning of a wholesale reanalysis of innovation policy. And we look forward to developing this agenda in an interdisciplinary fashion that takes numerous stakeholders into account—not just private-sector tech companies and their investors, but also government regulators; environmental, labor, and privacy advocates; and community groups that represent marginalized populations. Too often, these community groups have been excluded from consideration of innovation's effects or have only been consulted once harms have manifested. The future requires a more

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[423] *See* Miazad, *supra* note 370, at 1694 (proposing that the "fast-tracked review process" the U.S. antitrust enforcement agencies established for collaborations among competitors responding to the COVID-19 pandemic should be extended to firms working together to address the threats posed by climate change).

holistic and egalitarian innovation governance regime that incorporates diverse concerns earlier in the process, and that is guided by the principle that new is not necessarily better.