INTELLECTUAL PROPERTY AND THE END OF WORK

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Abstract

The conventional wisdom is that intellectual property (IP) is good for jobs. Indeed, according to legislators and the U.S. patent office, IP "creates jobs." But this is not quite right. A primary function of IP is to increase the amount of innovation in the economy. Yet a significant subset of the innovations protected by IP rights, from self-service kiosks to self-driving cars, are in fact labor-saving and indeed labor-displacing. They reduce the amount of paid human labor required to complete a task. Therefore, to the extent IP is successful at incentivizing innovation, IP actually contributes to job loss. More precisely, IP contributes to what this Article terms "technological un/employment": job loss and job creation resulting from technological change. Commentators concerned about the "end of work" have suggested using taxation to slow down the pace of automation and to provide aid to displaced workers. But this Article yields another surprising insight: IP law itself could be designed to effectuate similar goals, either alone or in coordination with the tax system. For example, rather than taxing businesses that employ robots, legislators could deny patents on robots or tax IP owners and use the proceeds to fund social programs or a universal basic income. IP's relationship to technological un/employment and the implications for public policy may seem evident in hindsight. Yet the connection has been overlooked. Lawyers and academics who study IP must pay more attention.

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> "In [the year 2014], IP-intensive industries directly and indirectly supported 45.5 million jobs, about 30 percent of all employment."[1]
>
> U.S. Patent & Trademark Office, 2016

> "We are being afflicted with a new disease of which some readers may not yet have heard the name, but of which they will hear a great deal in the years to come—namely, technological unemployment."[2]
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> John Maynard Keynes, *Economic Possibilities for our Grandchildren*, 1930

INTRODUCTION

In 1589, William Lee visited Queen Elizabeth I, seeking a patent for his new stocking frame knitting machine.[3] The machine's major benefit was that it could reduce the number of hours spent hand-knitting clothing and other cloth items.[4] The Queen refused to grant the patent, observing, "Thou aimest high, Master Lee. Consider thou what the invention could do to my poor subjects. It would assuredly bring to them ruin by depriving them of employment, thus making them beggars."[5] Lee thereafter failed to obtain a patent in France and again in England, when Elizabeth's successor James I also denied Lee's patent for the same reason: Mechanization of knitting would put people out of work.[6] A patent to

1. U.S. PATENT & TRADEMARK OFFICE, INTELLECTUAL PROPERTY AND THE U.S. ECONOMY: 2016 UPDATE ii (2016).

2. JOHN MAYNARD KEYNES, *Economic Possibilities for Our Grandchildren*, *in* ESSAYS IN PERSUASION 192, 196 (Classic House Books, 2009) (1931).

3. DARON ACEMOGLU & JAMES A. ROBINSON, WHY NATIONS FAIL: THE ORIGINS OF POWER, PROSPERITY, AND POVERTY 182 (2012).

4. *Id.*

5. *Id.* at 182–83.

6. *Id.*

operate the technology in the realm would therefore be contrary to the public interest.[7]

Move forward in time over four hundred years. The U.S. Patent & Trademark Office (USPTO) recently issued a report on the impact of intellectual property (IP) on the economy and the workforce.[8] According to the USPTO report, "IP-intensive industries"[9] create more jobs than other industries, and wages are forty-six percent higher.[10] The report's conclusions, if true,[11] appear to vindicate the views of many policymakers—that functioning intellectual property laws "create jobs."[12]

Which story is right? Do intellectual property rights "create jobs"? Or do intellectual property rights "depriv[e] [people] of employment, thus making them beggars"?[13] This Article considers this question and seeks to bring the broader discussion of intellectual property's impact on human work into the field.[14] The Article's main insight is as follows: Intellectual property may be partly responsible for job creation for people who work

7. *Id.*

8. U.S. PATENT & TRADEMARK OFFICE, *supra* note 1, at 1.

9. The USPTO report defines IP-intensive industries as industries that rely more heavily on intellectual property than others. The report measures patents, trademarks, and copyrights, but not trade secrets. *See id.* Empirical studies on trade secrets are relatively rare for various reasons. *See* Michael Risch, *Empirical Methods in Trade Secret Research*, *in* II RESEARCH HANDBOOK ON THE ECONOMICS OF INTELLECTUAL PROPERTY LAW (Peter S. Mennell & David L. Schwartz eds., forthcoming 2019) (manuscript at 1, 5), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2658685 [https://perma.cc/6AK3-7RQQ].

10. U.S. PATENT & TRADEMARK OFFICE, *supra* note 1, at 1; *see also* Stuart J.H. Graham et al., *Business Dynamics of Innovating Firms: Linking U.S. Patents with Administrative Data on Workers and Firms*, 27 J. ECON. & MGMT. STRATEGY 372, 373 (2018) ("We find patenting firms, particularly young patenting firms, disproportionally contribute jobs to the U.S. economy.").

11. The USPTO report's conclusions and methodology have been critiqued by several commentators. *See, e.g.*, Lisa Larrimore Ouellette, *Patent Experimentalism*, 101 VA. L. REV. 65, 121 (2015); *see also* Camilla A. Hrdy, *Intellectual Property and Jobs*, WRITTEN DESCRIPTION (Mar. 5, 2018), https://writtendescription.blogspot.com/2018/03/intellectual-property-and-jobs.html [https://perma.cc/A8BU-CMGT] (discussing the ways in which the report was flawed).

12. In a representative quote, Senator Leahy stated to his colleagues that by strengthening the patent system, the Leahy–Smith America Invents Act of 2011 (AIA) would "create jobs, improve products, and reduce costs for American companies and American consumers." *See* Patrick Leahy, *Leahy: Now is the Time to Act on Patent Reform*, PATRICK LEAHY (Mar. 8, 2011), https://www.leahy.senate.gov/press/leahy-now-is-the-time-to-act-on-patent-reform [https://perma.cc/23U4-ZJ7U].

13. ACEMOGLU & ROBINSON, *supra* note 3, at 183.

14. The impact of intellectual property on employment is rarely considered in the legal literature. Professor Mark Lemley recently tackled a related issue: What is the role of intellectual property in producing artificial scarcity when technology effectively eliminates the cost of production? Lemley briefly considered the impact of "post-scarcity" technologies like 3D printing on employment. *See* Mark A. Lemley, *IP in a World Without Scarcity*, 90 N.Y.U. L. REV. 460, 511 (2015).

within IP-intensive industries such as motion pictures, software, and computer systems design.[15] But a significant subset of the innovations protected by intellectual property, from self-service kiosks to self-driving cars, are labor-saving, and in many cases also *labor-displacing*. These innovations drastically reduce the amount of paid human labor required to complete a task. These innovations, in turn, are partly responsible for what economists call technological unemployment: job loss resulting from technological change.[16]

Autonomous vehicles provide a striking example. Companies like Alphabet, Uber, Tesla, and General Motors are competing to perfect "self-driving" vehicles that can drive and navigate without human drivers.[17] These companies rely on intellectual property rights (including but not limited to patents) in order to achieve the excess rents of a right to exclude others.[18] The result is greater profits for owners of intellectual property covering self-driving vehicles, and higher wages for the roboticists and engineers whose skills are necessary to generate this intellectual property.[19] But self-driving vehicles, if widely adopted, could spell the end of paid employment for taxi drivers, Uber drivers, truck drivers, and millions of other people whose jobs entail driving for a living.

Are the intellectual property rights that helped give rise to self-driving vehicles in some sense responsible for these lost jobs? Are they in some sense responsible for the unequal division of rewards between, say, Uber, which owns significant intellectual property relating to self-driving vehicles,[20] and Uber drivers, whose jobs those same inventions will one day replace? This Article asserts that to the extent intellectual property is successful at incentivizing innovation, the answer to both questions must be "yes." Intellectual property facilitates the process by which technology replaces certain jobs and increases the returns from doing so.[21]

Yet this does not mean that intellectual property, or innovation itself, is bad for jobs. It simply means that intellectual property is not *all good* for jobs. When legislators highlight intellectual property's "job creation" potential, they must be clearer that intellectual property's impact on employment is double-sided. Both sides of this process—what this

15. *See* U.S. PATENT & TRADEMARK OFFICE, *supra* note 1, at 25–29 (listing the major industries identified as being "IP-intensive").

16. *See infra* notes 33–36.

17. *See infra* Part II.C.4.

18. Part II.B explains intellectual property's right-to-exclude mechanism.

19. *See infra* Part II.C.4.

20. For a complete list of Uber's patents, see *Patents Assigned to Uber Technologies, Inc.*, JUSTIA PATS. (2018), http://patents.justia.com/assignee/uber-technologies-inc?page=2 [https://perma.cc/5H5K-FJ6B]. For further discussion of self-driving cars, see Part II.C.4.

21. *See infra* Parts III.C.1–4.

Article terms "technological un/employment"—must be considered in order to understand what is happening in the innovation economy, and in order to understand intellectual property's role in this process.

This Article fills a major gap in the literature. Labor and employment law scholars, as well as tax law scholars, have already begun to address workers' uncertain fate in a world of increasing automation, which is arguably one of the major social crises of the day.[22] Intellectual property scholars, in contrast, have not yet seriously considered the impact of intellectual property on human work, despite the fact that intellectual property is the legal regime with the strongest connection to technological innovation.[23] This Article comprehensively covers the topic, and urges lawyers and academics to pay more attention—especially in light of the alarming political possibilities revealed herein.

This Article proceeds as follows: Part I defines what it means for innovations to be "labor-displacing" and explains in detail the double-sided impact that labor-displacing innovations have on employment. This part draws on substantial research by labor economists and economic historians.[24]

Part II explains the underappreciated and surprising role of intellectual property in producing technological un/employment. Since at least the sixteenth century, rulers like Queen Elizabeth I recognized that exclusive "privileges" to practice a certain technology within the realm could adversely impact employment.[25] This part shows that, contrary to conventional wisdom, intellectual property still has this impact today. It increases the overall amount of labor-displacing innovations available for use in the economy (called the "Incentive Effect") and exacerbates the unequal distribution of rewards between the owners and generators of intellectual property and the workers whom those inventions replace (called the "Distribution Effect").[26]

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22. *See, e.g.*, Cynthia Estlund, *What Should We Do After Work? Automation and Employment Law*, 128 YALE L.J. 254, 257 (2018); Brishen Rogers, *The Social Costs of Uber*, 82 U. CHI. L. REV. DIALOGUE 85, 101 (2015); *see also* Ryan Abbott & Bret Bogenschneider, *Should Robots Pay Taxes? Tax Policy in the Age of Automation*, 12 HARV. L. & POL'Y REV. 145, 146–47 (2018) (stating that industry experts are predicting that automation will soon result in substantial "technological unemployment").

23. Professor Lemley's brief analysis is a notable exception. *See* Lemley, *supra* note 14. Several IP scholars have recently drawn attention to the impact of IP on related socioeconomic trends, such as increasing inequality. For an example of this, see generally Colleen Chien, *Inequality, Innovation, and Patents* (Santa Clara Univ. Legal Studies, Research Paper No. 2018-03, 2018), https://ssrn.com/abstract=3157983 [https://perma.cc/BZ2G-ESYA].

24. *See infra* Part I. I am especially grateful to Professor James Bessen's historical research on the impact of automation on human work. *See* JAMES BESSEN, LEARNING BY DOING: THE REAL CONNECTION BETWEEN INNOVATION, WAGES, AND WEALTH 71 (2015).

25. *See* ACEMOGLU & ROBINSON, *supra* note 3, at 182–83.

26. *See infra* Parts II.C.1 & 4.

Part III asks what, if anything, policymakers should do differently in light of the connection between intellectual property and technological un/employment.[27] This Part agrees with prior commentators that distributive justice, if not necessarily efficiency, weighs in favor of some form of intervention.[28] Yet the political possibilities are alarming. Imagine a future Congress deciding to ban all patents on "self-driving" inventions, from cars to data analysis software. This Article rejects such blunt tools,[29] instead urging moderation. It provides a framework for policymakers and concludes that the most promising option may be to institute a small tax on certain intellectual property rights that cover labor-displacing inventions. This would both marginally slow down the pace of automation and permit government to redistribute the proceeds to displaced workers in the form of cash or social programs, such as skills training.[30]

Part IV concludes.

I. TECHNOLOGICAL UN/EMPLOYMENT EXPLAINED

The term technological un/employment refers to two sides of an economic phenomenon. On one side is technological *un*employment: job loss brought about by technological change.[31] Technological unemployment has a long pedigree[32] and has been widely studied in the fields of economics[33] and public policy.[34] But all sophisticated thinkers on this topic recognize that there is another side to the phenomenon,

27. *See infra* Part III.C.

28. *See infra* Part III.C; *see also, e.g.*, ERIK BRYNJOLFSSON & ANDREW MCAFEE, RACE AGAINST THE MACHINE: HOW THE DIGITAL REVOLUTION IS ACCELERATING INNOVATION, DRIVING PRODUCTIVITY, AND IRREVERSIBLY TRANSFORMING EMPLOYMENT AND THE ECONOMY 36–47 (2011) (discussing the various "winners" and "losers" of the new machine age).

29. *See infra* Part III.C.

30. For a similar conclusion about the need for intervention from the employment law perspective, see Estlund, *supra* note 22, at 301–21.

31. *See* Joel Mokyr et al., *The History of Technological Anxiety and the Future of Economic Growth: Is This Time Different?*, 29 J. ECON. PERSP. 31, 32 (2015); *see also* MARTIN FORD, RISE OF THE ROBOTS: TECHNOLOGY AND THE THREAT OF A JOBLESS FUTURE 29–34 (2015) (discussing concerns over job loss as a result of technology in the 1960s and '70s); JEREMY RIFKIN, THE END OF WORK: THE DECLINE OF THE GLOBAL LABOR FORCE AND THE DAWN OF THE POST-MARKET ERA 81–89 (1995) (discussing concerns over automaton in the 1960s and '70s).

32. *See generally* Mokyr et al., *supra* note 31, at 33–42 (highlighting the concern that technology would replace jobs since the Industrial Revolution).

33. *See, e.g.*, Carl Benedikt Frey & Michael A. Osborne, *The Future of Employment: How Susceptible Are Jobs To Computerisation?*, 114 TECH. FORECASTING & SOC. CHANGE 254, 255 (2016) (discussing a long line of economics research on technology's impact on jobs).

34. *See generally, e.g.*, DARRELL M. WEST, CTR. FOR TECH. INNOVATION AT BROOKINGS, WHAT HAPPENS IF ROBOTS TAKE JOBS? THE EMERGING IMPACT OF ROBOTS ON EMPLOYMENT AND PUBLIC POLICY (2015) (discussing public policy of technology and unemployment).

which this Article calls technological *employment*.[35] Technological employment refers to job creation brought about by technological change—the process by which new technologies, through a variety of mechanisms, generate new jobs for humans, even as they take away the old.[36] Technological un/employment is a term of art used throughout this Article to encapsulate both of these phenomena.

To get a simple preview of how technological un/employment works, do a Google search for the phrase "self-driving car jobs." This will likely provide results for job postings in the field of self-driving car technology[37] and articles with titles like "Who's hiring for self-driving car jobs."[38] Then do a Google search for the phrase "self-driving car kill jobs." This should provide a host of articles about the negative impact of autonomous vehicles on employment and ideas for how to save the jobs of human drivers.[39]

How is it that a single technology can have such a disparate impact on social welfare, leading to new jobs for some and job losses for others? This Part explains precisely how both sides of this process work. After reading this Part, the reader should understand precisely what is meant by the term "technological un/employment" in Part II, which explains intellectual property's role in this process.

A. *Labor-Displacing Innovations*

Innovation is the driving force behind technological un/employment. Innovation means a new idea or application of a new idea that generates

35. The phenomenon of "technological employment" is implicitly recognized in the vast literature on technological unemployment. *See, e.g.*, David H. Autor, *Why Are There Still So Many Jobs? The History and Future of Workplace Automation*, 29 J. ECON. PERSP. 3, 4–5 (2015) (discussing a variety of reasons why there are still jobs despite increasing improvements in automation); *see also* Lewis M. Andrews, *Robots Don't Mean the End of Human Labor*, WALL STREET J. (Aug. 23, 2015), https://www.wsj.com/articles/robots-dont-mean-the-end-of-human-labor-1440367275 [https://perma.cc/4M3N-7E43] ("The invention of, say, the internal-combustion engine put buggy-whip makers and carriage assemblers out of business, but it created many more jobs in the manufacture, advertising, sales and maintenance of automobiles.").

36. *See* discussion *infra* Part I.B.

37. *Google Self Driving Car Project Jobs*, INDEED, https://www.indeed.com/q-Google-Self-Driving-Car-Project-jobs.html [https://perma.cc/R53Q-K4QF].

38. Marco della Cava, *Who's Hiring for Self-Driving Car Jobs*, USA TODAY (Oct. 17, 2016), https://www.usatoday.com/story/tech/news/2016/10/17/google-ford-not-only-names-self-driving-car-jobs/92315206/ [https://perma.cc/CF2F-HXBV].

39. *See, e.g.*, Mark Fahey, *Driverless Cars Will Kill the Most Jobs in Select US States*, CNBC (Sept. 2, 2016) https://www.cnbc.com/2016/09/02/driverless-cars-will-kill-the-most-jobs-in-select-us-states.html [https://perma.cc/YA5H-PGHZ]; Jack Stewart, *Robot & Us: Self-Driving Trucks Are Coming to Save Lives and Kill Jobs*, WIRED (May 5, 2017), https://www.wired.com/2017/05/robot-us-self-driving-trucks-coming-save-lives-kill-jobs/ [https://perma.cc/KE9A-9NL4].

value. Value is usually measured in the form of higher profits.[40] These higher profits can be realized in one of two ways: either by generating some output (a new product or service) for which consumers are willing to pay, or by generating a new way to increase productivity within a business (that is, lower cost per output).[41] The first type of innovation is called a product innovation.[42] Birth control, the television, and optical lenses are examples of product innovations.[43] The second type is called a process innovation.[44] Using a printing press rather than human scribes and using robotic arms rather than human employees to manufacture furniture are both examples of process innovations. Process innovations drastically lower the cost of producing a certain output (writings and furniture, respectively) because they require less time, money, and human labor.[45]

1. Labor-Displacing Versus Labor-Saving Innovations

Not all innovations reduce the need for human labor. Innovations can possess advantages that have nothing to do with labor reduction. An important subset of innovations are labor-saving. Their primary purpose is to reduce the human labor required to complete a task.[46] Anesthesia,

40. As in prior work, this Article relies on economists' broader definition of innovation, rather than patent law's narrower concept of a patentable invention. *See* Camilla A. Hrdy, *Patent Nationally, Innovate Locally*, 31 BERKELEY TECH. L.J. 1301, 1310–11 (2016); *see also infra* note 42 (defining product innovation).

41. *See* Hrdy, *supra* note 40.

42. A product innovation means the introduction of a new product or service, or a significant improvement on an existing product or service, for which consumers are willing to pay. CHRISTINE GREENHALGH & MARK ROGERS, INNOVATION, INTELLECTUAL PROPERTY, AND ECONOMIC GROWTH 4 (2010).

43. James Fallows, *The 50 Greatest Breakthroughs Since the Wheel*, ATLANTIC (Nov. 2013) https://www.theatlantic.com/magazine/archive/2013/11/innovations-list/309536/ [https://perma.cc/P6XN-UWCR].

44. A process innovation means the introduction of a process or method of operation that increases productivity (reduces the cost per output). GREENHALGH & ROGERS, *supra* note 42, at 9. Note that a process innovation does not have to be a technique or series of steps. As the Supreme Court noted in *Diamond v. Diehr*, a process innovation can be made possible by a "labor-saving machine" that allows a business to save labor and lower costs. Diamond v. Diehr, 450 U.S. 175, 182–83 n.7 (1980) (quoting Corning v. Burden, 56 U.S. (15 How.) 252, 267–68 (1854)).

45. GREENHALGH & ROGERS, *supra* note 42, at 5, 16. Note that a process innovation can be tied up with a product innovation. For instance, using the printing press to facilitate copying of writings came hand in hand with a new product: printed books.

46. The Supreme Court has observed the existence and patentability of "labor-saving" inventions several times. *See, e.g.*, *Diamond*, 450 U.S. at 182 n.7 (1981) ("[A]nother may invent a labor-saving machine by which this operation or process . . . may be carried on with much saving of labor, and expense of fuel . . . ." (quoting *Corning*, 56 U.S. (15 How.) at 268)); *see also* H.J. HABAKKUK, AMERICAN AND BRITISH TECHNOLOGY IN THE NINETEENTH CENTURY: THE SEARCH FOR LABOUR-SAVING INVENTIONS 6 (1962) ("[I]t was scarcity of labour 'which laid the foundation

invented in 1846, allowed doctors to alleviate pain during surgery. Its purpose was not to reduce the amount of labor it took to perform the surgery.[47] Further, not all labor-saving innovations are *labor-displacing*. For instance, a chairlift, invented in 1936, carries skiers up a hill, saving them from having to climb up the hill on their own.[48] Unless skiers were previously paying other humans to carry them up the hill, the invention of the chairlift is labor-saving without being labor-displacing. It does not adversely affect the employment prospects of others. However, if the labor saved by the innovation would otherwise be performed by a paid human worker, then the innovation can be classified as labor-displacing. It causes a significant reduction in the amount of paid human labor required to complete a task, and thus may lead to significant job displacement.[49]

2. The Role of Automation

Many labor-displacing innovations involve a particular type of technological development: automation.[50] Automation, which is sometimes used interchangeably with "mechanization" or "computerisation," refers generally to using machines to accomplish tasks that are, or otherwise would be, performed by humans.[51] The agent of automation need not be a robot that looks or functions like a human. It

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for the future continuous progress of American industry, by obliging manufacturers to take every opportunity of installing new types of labour-saving machinery.'" (quoting BRITISH ESSAYS IN AMERICAN HISTORY 264 (H. C. Allen & C. P. Hill eds., 1957))).

47. Fallows, *supra* note 43.

48. Daniel Engber, *Who Made That Ski Lift?*, N.Y. TIMES (Feb. 21, 2014) https://www.nytimes.com/2014/02/23/magazine/who-made-that-ski-lift.html [https://perma.cc/ZSM4-N79H].

49. For a discussion on how courts and regulators might determine what is "labor-displacing," see *infra* Part III.C.1.

50. *See* James Bessen, *How Computer Automation Affects Occupations: Technology, Jobs, and Skills* 7 (Bos. Univ. Sch. of Law, Law & Econ. Working Paper No. 15-49, 2016) ("Automation is not the only way that technology affects occupations . . . [but] automation might lead to job losses because it reduces the labor needed to perform tasks.").

51. *See, e.g.*, *id.* at 3 ("Automation of an occupation happens when machines take over one or more tasks, either completely performing those tasks or reducing the human labor time needed to perform them."); *see also* Raja Parasuraman et al., *A Model for Types and Levels of Human Interaction with Automation*, 30 IEEE TRANSACTIONS ON SYSTEMS, MAN & CYBERNETICS 286, 287 (2000) ("We . . . define automation as a device or system that accomplishes (partially or fully) a function that was previously, or conceivably could be, carried out (partially or fully) by a human operator."); *see also* Frey & Osborne, *supra* note 33, at 254 n.1 ("We refer to computerisation as job automation by means of computer-controlled equipment.").

simply must, in an economic sense, "substitute" for a human in performing the task.[52]

Automation is typically motivated by two interrelated factors: the desire to reduce the amount of human labor required to complete a task and thus to lower costs, and the desire to achieve performance benefits, such as superior speed, accuracy, or quality, that may or may not be within the capacity of human beings.[53] For example, Oracle[54] is currently marketing what it calls an "Autonomous" or "Self-Driving" Database. This is essentially a software program that permits collecting, managing, and updating a set of information without human involvement.[55] As of this writing, the advertisement is currently running on the front page of the print edition of *The Wall Street Journal*.[56]

The express purpose of the Self-Driving Database is both to drastically lower the costs of human labor (by *half*, to be precise), and to obtain performance benefits such as greater reliability and improved security.[57] This is a labor-displacing, not just a labor-saving, innovation, because it is performing work that would otherwise be done by paid human employees. If successful, this innovation will encroach on jobs that humans would otherwise have.

As discussed in the next Parts, the impact of automation on the human workforce is a subject of considerable debate. However, several recent empirical studies purport to find that many types of automation will negatively impact the jobs and wages of at least some people. Scholars at the Oxford Martin School at the University of Oxford estimate that forty-

52. Jack M. Balkin, *The Three Laws of Robotics in the Age of Big Data*, 78 OHIO ST. L.J. 1217, 1224 (2017) ("[R]obots, AI agents, and algorithms substitute for human beings, and operate as special purpose people.").

53. MCKINSEY GLOBAL INST., A FUTURE THAT WORKS: AUTOMATION, EMPLOYMENT, AND PRODUCTIVITY 11 (2017), https://www.mckinsey.com/~/media/McKinsey/Featured%20Insights/Digital%20Disruption/Harnessing%20automation%20for%20a%20future%20that%20works/MGI-A-future-that-works_Full-report.ashx [https://perma.cc/32E6-EVM2] ("The deployment of automation technologies [can] bring a range of performance benefits for companies. . . . They include, but are not limited to, greater throughput, higher quality, improved safety, reduced variability, a reduction of waste, and higher customer satisfaction.").

54. Oracle is one of the most profitable software companies in the world, based in Redwood Shores, California. *See generally Oracle Fact Sheet: Create Tomorrow, Today*, ORACLE (Oct. 2018), http://www.oracle.com/us/corporate/oracle-fact-sheet-079219.pdf [https://perma.cc/R9VL-LC9A] (explaining how Oracle has embedded innovative technologies into its cloud).

55. *See The World's #1 Database Is Now the World's First Self-Driving Database*, ORACLE, https://www.oracle.com/database/autonomous-database/feature.html [https://perma.cc/RG85-73SM] ("Oracle Autonomous Database Cloud offers total automation based on machine learning and eliminates human labor, human error, and manual tuning.").

56. *See, e.g.*, Oracle, Advertisement, *World's First "Self-Driving" Database*, WALL ST. J., Nov. 16, 2017, at A1.

57. *Id.*

seven percent of U.S. occupations "are potentially automatable over some unspecified number of years, perhaps a decade or two."[58] The Oxford Martin study finds that the jobs most likely to be automated include cashiers, order clerks, tellers, tax preparers, cargo and freight agents, watch repairers, title examiners, and telemarketers.[59] The safest jobs include (to name a sampling from the top twenty) recreational therapists, mental health and substance abuse workers, computer systems analysts, and anthropologists.[60]

A McKinsey Global Institute report provides a more conservative assessment, predicting that although few entire occupations will be replaced in the near future,[61] automation will "affect almost all occupations . . . to a greater or lesser degree."[62] The report concludes, strikingly, that "as a rule of thumb, about 60 percent of all occupations have at least 30 percent of activities that are technically automatable."[63] Obviously, "technically automatable" is not the same as "will be automated." The report states that a variety of factors go into a business's decision to automate a particular task: (1) technical feasibility; (2) commercial feasibility; (3) supply and cost of human labor alternatives;[64] (4) performance and cost benefits associated with using machines; and (5) regulatory hurdles or social inhibitions.[65] Thus, just because a labor-displacing solution is technically possible does not mean businesses will choose to adopt it. Countervailing considerations, including the

58. Frey & Osborne, *supra* note 33, at 265; *see also* CITI GPS, TECHNOLOGY AT WORK V2.0: THE FUTURE IS NOT WHAT IT USED TO BE 7 (2016) http://www.oxfordmartin.ox.ac.uk/downloads/reports/Citi_GPS_Technology_Work_2.pdf [https://perma.cc/F62W-FFFZ] ("47% of US jobs [are] at risk of computerization."); Sarah Nassauer, *Robots Are Replacing Workers Where You Shop*, WALL ST. J. (July 19, 2017), https://www.wsj.com/articles/robots-are-replacing-workers-where-you-shop-1500456602 [https://perma.cc/Z4LL-YSVN] (discussing results of Citi/Oxford study).

59. Frey & Osborne, *supra* note 33, at 278; *see also* Mark Whitehouse & Dorothy Gambrell, *How Screwed Is Your Job?*, BLOOMBERG BUSINESSWEEK, June 26, 2017, at 50, 52–53 (summarizing Frey and Osborne's data).

60. Frey & Osborne, *supra* note 33, at 269.

61. MCKINSEY GLOBAL INST., *supra* note 53, at 1 ("Given currently demonstrated technologies, very few occupations—less than 5 percent—are candidates for full automation today, meaning that every activity constituting these occupations is automated.").

62. *Id.* at 32.

63. *Id.*

64. *Id.* at 10 (noting that an important factor is "[t]he quality (for instance, skills), quantity, as well as supply, demand, and costs of human labor as an alternative affect which activities will be automated").

65. *Id.* at 10–12.

availability of cheap human labor, reluctance to fire people, and concerns about reputational harm, can sway businesses in the other direction.[66]

B. *Technological Employment*

In light of how much automation we see occurring around us, it is tempting to predict that technology will inevitably spell the "end of work."[67] Yet even notorious labor-displacing innovations, from the spinning loom to the computer, did not eliminate all or even most jobs.[68] To the contrary, numerous economists have documented that most labor-displacing innovations end up creating more work than they destroy.[69] The reason for this is the phenomenon of technological employment. A review of the economics literature reveals two main mechanisms by which technological employment is theorized to occur.

1. Job Generation

The first mechanism of technological employment is "job generation." Job generation refers to an innovation creating new jobs—or, to put it more technically, generating *new demand* for people with certain skills.[70] Pure job generation is like alchemy, creating jobs where there previously were none. The simplest example is the invention of a totally new product (say, a more effective means of anesthesia) for which people are willing to pay. This drives demand for workers with the skills necessary to make and distribute the product to consumers.[71] Job

66. *See id.* at 10. The farming industry provides a compelling example of this fact. For some crops, the availability of cheap labor, not technological feasibility, is the major determinant of whether growers use machines at harvest or people. *See, e.g.*, Binyamin Applebaum, *Fewer Immigrants Mean More Jobs? Not So, Economists Say*, N.Y. TIMES (Aug. 3, 2017), https://www.nytimes.com/2017/08/03/us/politics/legal-immigration-jobs-economy.html [https://perma.cc/AL24-HF8R].

67. *See* RIFKIN, *supra* note 31, at 8–9 (predicting the end or near-end of manual labor in factories within the "next twenty to thirty years").

68. Autor, *supra* note 35, at 4 ("Clearly, the past two centuries of automation and technological progress have not made human labor obsolete . . . .").

69. *See id.* ("[T]he employment-to-population ratio rose during the 20th century even as women moved from home to market; and although the unemployment rate fluctuates cyclically, there is no apparent long-run increase.").

70. "Job" refers to a bundle of tasks performed by people with similar sets of skills. Bessen, *supra* note 50, at 9–10 (defining an occupation as a bundle of tasks that can be performed by people with similar skills and observing that tasks can be transferred from one occupation to another); *see also* CLAUDIA GOLDIN & LAWRENCE KATZ, THE RACE BETWEEN EDUCATION AND TECHNOLOGY 176–79 (2008) (discussing availability of new jobs as a result of inventions that permitted automation of some types of work like cash registers and tractors).

71. *See* Vincent Van Roy et al., Unit of Econometrics & Applied Statistics, Joint Research Centre, Eur. Comm'n, *JRC Technical Report: Innovation and Employment in Patenting Firms:*

generation is also thought to have what economist Enrico Moretti calls a "multiplier effect."[72] When people have jobs, they spend more money elsewhere in the economy, such as in the services sector—which in turn drives demand and job generation in businesses like hair salons and restaurants.[73]

Things get more complicated when the innovation itself is labor-displacing (say, a robot that administers anesthesia more efficiently than humans).[74] But even here there can still be job generation due to the fact that innovations tend to create "substitute" jobs to replace those they eliminate.[75] For example, the invention of the tractor reduced the need for people to manually plow fields, but tractors also generated new demand for people with the skills necessary to manufacture, maintain, and operate tractors.[76] As explained in the next Part, the job generation argument becomes more tenuous the better machines become at performing human tasks without assistance. For instance, Oracle founder Larry Ellison claims that Oracle's Automated Database can "automatically provision, patch, tune and back-up itself, *with no human intervention*."[77] But in theory, any new invention creates at least the possibility for new human tasks.

Empirical Evidence from Europe, Rep. EUR 27377, at 3 (2015) ("[T]here is less debate about the positive employment effect of product innovations.").

72. ENRICO MORETTI, THE NEW GEOGRAPHY OF JOBS 55–63 (2012) (discussing the "multiplier effect" associated with technology sector jobs).

73. *See, e.g.*, David Autor & Anna Salomons, *Robocalypse Now—Does Productivity Growth Threaten Employment?*, 2017 ECB F. ON CENT. BANKING 45, 50, https://docplayer.net/56822268-Investment-and-growth-in-advanced-economies.html [https://perma.cc/3LSH-X3HT] ("These spillovers are sufficiently large that they more than offset employment losses in industries making rapid productivity gains.").

74. *See, e.g.*, BESSEN, *supra* note 24, at 107–09 (discussing anticipated impact of ATM machines on bank tellers).

75. *See, e.g.*, James Bessen, *Don't Blame Technology for Persistent Unemployment*, SLATE (Sept. 30, 2013, 3:31 PM), https://slate.com/technology/2013/09/technology-isn-t-taking-all-of-our-jobs.html [https://perma.cc/L6YB-765Y] (arguing that even if an innovation reduces jobs in one industry, it can offset these losses by generating "job growth in different occupations or industry segments"); Claire Cain Miller, *The Long-Term Jobs Killer Is Not China. It's Automation*, N.Y. TIMES (Dec. 21, 2016), https://www.nytimes.com/2016/12/21/upshot/the-long-term-jobs-killer-is-not-china-its-automation.html [https://perma.cc/6PCV-VG6J] ("Over time, automation has generally had a happy ending: As it has displaced jobs, it has created new ones.").

76. *See* Derek Thompson, *How the Tractor (Yes, the Tractor) Explains the Middle Class Crisis*, ATLANTIC (Mar. 13, 2012), https://www.theatlantic.com/business/archive/2012/03/how-the-tractor-yes-the-tractor-explains-the-middle-class-crisis/254270/ [https://perma.cc/ET38-DXHS].

77. Rebecca Hill, *Oracle Promises 'Highly Automated' Security in Self-Driving Database*, REGISTER (Oct. 2, 2017, 3:53 AM), https://www.theregister.co.uk/2017/10/02/oracle_openworld_2017_larry_ellison_keynote_day_one/ [https://perma.cc/8NHU-4S5Z] (emphasis added).

2. Demand-Boosting

The second mechanism of technological employment is what this Article calls "demand-boosting."[78] Demand-boosting predicts that hiring within a given occupation or industry will *increase* as a result of labor-saving innovations that increase productivity (that is, permit more output at lower cost).[79] As prices fall, consumption and demand for the products increase, and demand for workers rises accordingly.[80] For example, if tractors lower the price of food like tomatoes and wheat, this means consumers will buy more of that food. This increases demand for food and for any people whose skills are necessary to plant, grow, harvest, and distribute the food.[81]

Several commentators cite to demand-boosting in order to overcome fears that automation threatens the future of human work.[82] But does demand-boosting really work? To test the theory, economist James Bessen performed a case study of the automated teller machine (ATM).[83] One might think ATMs would have eliminated the jobs of bank tellers.[84] But Bessen found that, even though the ATM "took over cash handling tasks" and reduced work for human tellers, "the number of fulltime equivalent bank tellers has *grown* since ATMs were widely deployed during the late 1990s and early 2000s."[85] Bessen's explanation is that "the ATM allowed banks to operate branch offices at lower cost," which

78. GREENHALGH & ROGERS, *supra* note 42, at 268–69. Another term sometimes used is the "compensation theory." Van Roy et al., *supra* note 71, at 2 ("[T]he so-called 'compensation theory'. . . puts forward the view that process innovations lead to more efficient production and thus, assuming competitive markets, increasing demand and hence employment.").

79. GREENHALGH & ROGERS, *supra* note 42, at 268–69.

80. James Bessen, *AI and Jobs: The Role of Demand* 3 (Boston Univ. Sch. of Law & Econ., Research Paper No. 17-46, 2017), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3078715 [https://perma.cc/XTB3-XWZY] ("If demand increases sufficiently, employment will grow even though the labor required per unit of output declines.").

81. Demand-boosting usually occurs in conjunction with job generation. Demand for a company's output rises in response to increasing productivity and falling prices, *and* new or substitute jobs then emerge that need to be filled in order to meet that new demand. See the discussion in Bessen, *supra* note 50, at 2–3.

82. *See, e.g.*, Michael Jones, *Yes, the Robots Will Steal Our Jobs. And That's Fine. Those Jobs Will Be Replaced with New Ones*, WASH. POST (Feb. 17, 2016), https://www.washingtonpost.com/posteverything/wp/2016/02/17/yes-the-robots-will-steal-our-jobs-and-thats-fine/?noredirect=on&utm_term=.68d28e52a89c [https://perma.cc/C2FX-S8R8]; Jerry Kaplan, *Don't Fear the Robots*, WALL ST. J. (July 21, 2017, 10:17 AM), https://www.wsj.com/articles/dont-fear-the-robots-1500646623 [https://perma.cc/KS5Y-XPB2].

83. Bessen, *supra* note 50, at 5.

84. BESSEN, *supra* note 24, at 105.

85. Bessen, *supra* note 50, at 5 ("Indeed, since 2000, the number of fulltime equivalent bank tellers has increased . . . substantially faster than the entire labor force.").

lowered the prices of, and increased demand for, banking services.[86] This in turn "prompted [banks] to open many more branches" to meet the new demand, and led to hiring of bank tellers along with other related professionals, such as people who were needed to install and fix ATM machines.[87] This demand-boosting effect, Bessen concludes, "offset[] the erstwhile loss in teller jobs."[88]

C. *Technological Unemployment*

In light of the theories presented in the last Part, why would anyone worry about technological unemployment? As explained, technological unemployment is defined as job loss brought about by technological change.[89] But as is clear by now, technological change also creates new jobs. If economic historians like Bessen and David Autor are right, in the past, innovation has created more jobs than it has destroyed.[90]

And yet, some people are worried about technological unemployment. Respected public commentators, such as former Treasury Secretary Lawrence Summers,[91] have begun to cast doubt on whether what happened in the past will hold true in the future.[92] Based on a

86. *Id.*

87. *Id.*

88. *Id.*; *see also* BESSEN, *supra* note 24, at 105–09 (illustrating how the current narrative that machines replace labor and reduce employment and wages is "too simplistic").

89. See the definition in Mokyr et al., *supra* note 31.

90. *See, e.g.*, Autor & Salomons, *supra* note 73, at 49 ("Over the 35+ years of data explored here, we find that productivity growth has been employment-augmenting rather than employment-reducing; that is, it has *not* threatened employment.").

91. Lawrence H. Summers, Harvard Univ., Keynote Address at Conference: Making Sense of the Productivity Slowdown: Reflections on the Productivity Slowdown 16–17 (Nov. 16, 2015), https://piie.com/sites/default/files/publications/papers/transcript-20151116keynote.pdf [https://perma.cc/BP4J-FBUR]; *see also* Eduardo Porter, *Jobs Threatened by Machines: A Once 'Stupid' Concern Gains Respect*, N.Y. TIMES (June 7, 2016), https://www.nytimes.com/2016/06/08/business/economy/threatened-by-machines-a-once-stupid-concern-gains-respect.html [https://perma.cc/5VGX-XGND] (discussing current debates among economists regarding "end of work").

92. For just a sampling of recent media articles expressing anxiety about technological unemployment, see, for example, Robert C. Allen, *Lessons from History for the Future of Work*, 550 NATURE 321, 321–24 (2017), https://www.nature.com/polopoly_fs/1.22825!/menu/main/topColumns/topLeftColumn/pdf/550321a.pdf [https://perma.cc/QMV4-D9T2]; Rachel Abrams & Robert Gebeloff, *Another Blow for a Battered Work Force: E-Commerce Causes Retail Jobs to Dry Up in Old Steel Towns*, N.Y. TIMES, June 26, 2017, at A1; Special Report, *The Impact on Jobs: Automation and Anxiety: Will Smarter Machines Cause Mass Unemployment?*, ECONOMIST (June 25, 2016), http://www.economist.com/news/special-report/21700758-will-smarter-machines-cause-mass-unemployment-automation-and-anxiety [https://perma.cc/CL3S-3ZXQ]; Nida Najar, *Indian Technology Workers Worry About a Job Threat: Technology*, N.Y. TIMES (June 25, 2017), https://www.nytimes.com/2017/06/25/business/india-outsourcing-layoffs-automation-artificial-intelligence.html [https://perma.cc/B247-EFYQ]; *see also, e.g.*,

comprehensive review of this literature, this Part identifies five distinct reasons people like Summers are worried. These are, in a sense, five distinct attributes of modern technological unemployment that may differentiate today's results from what happened in the past.

1. Increasing Quality and Pace of Automation

First, commentators in the fields of economics, public policy, and journalism opine that machine capabilities are increasingly encroaching on the whole gamut of human skills.[93] For technological employment via job generation and demand-boosting to work, there must be tasks left for humans to do. But if machines can do everything, it does not matter how many new tasks are generated or how much demand rises. Machines, not humans, would be the workforce of the future.

Robots (machines that resemble humans) are now capable of performing a range of classic human functions, from driving vehicles,[94] to preparing food,[95] to milling steel,[96] to testing electronic devices.[97]

BRYNJOLFSSON & MCAFEE, *supra* note 28, at 2–9 (discussing this phenomenon); FORD, *supra* note 31, at xii ("[M]achines themselves are turning into workers, and the line between the capability of labor and capital is blurring as never before.").

93. *See* BRYNJOLFSSON & MCAFEE, *supra* note 28, at 9 ("The pace and scale of this encroachment into human skills is relatively recent and has profound economic implications."); ERIK BRYNJOLFSSON & ANDREW MCAFEE, THE SECOND MACHINE AGE: WORK, PROGRESS, AND PROSPERITY IN A TIME OF BRILLIANT TECHNOLOGIES 11 (2014) ("[C]omputers, robots, and other digital technologies are acquiring [ordinary human] skills and abilities at an extraordinary rate."); *see also* ALEC ROSS, THE INDUSTRIES OF THE FUTURE 27 (2016) ("[T]he current moment in the field of robotics is very much like where the world stood with the Internet 20 years ago."); Steve Lohr, *A.I. Will Transform the Economy. But How Much, and How Soon?*, N.Y. TIMES (Nov. 30, 2017), https://www.nytimes.com/2017/11/30/technology/ai-will-transform-the-economy-but-how-much-and-how-soon.html [https://perma.cc/5P35-NC8L] ("[AI] can probably do less right now than you think. But it will eventually do more than you probably think, in more places than you probably think, and will probably evolve faster than powerful technologies have in the past."); WEST, *supra* note 34, at 2 (discussing technology's growing capabilities in various fields).

94. *See infra* Part II.C.4

95. *See* Melia Robinson, *This Robot-Powered Restaurant Could Put Fast Food Workers out of a Job*, BUS. INSIDER (June 30, 2016, 5:17 PM), http://www.businessinsider.com/momentum-machines-is-hiring-2016-6 [https://perma.cc/M62V-R6TM].

96. *See* Thomas Biesheuvel, *How Just 14 People Make 500,000 Tons of Steel a Year in Austria*, BLOOMBERG BUSINESSWEEK (June 21, 2017, 12:01 AM), https://www.bloomberg.com/news/articles/2017-06-21/how-just-14-people-make-500-000-tons-of-steel-a-year-in-austria (describing a nearly deserted steel mill except for "three technicians who sit high above the line, monitoring output on a bank of flatscreens").

97. *See, e.g.*, Complaint for Violation of Uniform Trade Secrets Act, Breach of Contract, Interference with Business Expectancy, and Violation of Washington Consumer Act at 1–3, T-Mobile USA, Inc. v. Huawei Device USA, Inc., 115 F. Supp. 3d 1184 (W.D. Wash. 2014) (No. 2:14-cv-01351) (asserting T-Mobile's custom-built phone-testing robot, "Tappy," was part of a trade secret dispute after workers at Huawei stole Tappy's mechanical finger).

Drones—or "unmanned aerial vehicles"[98]—can perform a wide range of jobs formerly or still performed by humans: package delivery,[99] going to war,[100] crop-dusting,[101] disaster aide,[102] and insurance claims inspection.[103] The most influential form of automation consists simply of implementing algorithms on general purpose computers.[104] Quantifying algorithms' use in the economy is virtually impossible because algorithms are used in secret, with little transparency as to their function and capabilities.[105] Computer algorithms permit near-total automation of a variety of tasks, such as internet searching,[106] data collection and analysis,[107] stock picking,[108] and designing investment strategies.[109] One

98. *See generally* Margot E. Kaminski, *Drone Federalism: Civilian Drones and the Things They Carry*, 4 CALIF. L. REV. CIR. 57, 57 (2013) (discussing drones and their related privacy issues).

99. Elizabeth Weise, *Amazon Delivered Its First Customer Package by Drone*, USA TODAY (Dec. 14, 2016, 9:37 AM), https://www.usatoday.com/story/tech/news/2016/12/14/amazon-delivered-its-first-customer-package-drone/95401366/ [https://perma.cc/H8R3-T5EN].

100. *But see* Rebecca Crootof, *The Killer Robots Are Here: Legal and Policy Implications*, 36 CARDOZO L. REV. 1837, 1842 (2015) (exploring legal implications of autonomous weapons systems, including unclear liability). *See generally* John Yoo, *Embracing the Machines: Rationalist War and New Weapons Technologies*, 105 CALIF. L. REV. 443 (2017) (describing modern applications for robotics in warfare).

101. *See* SPRAYING DRONE, http://sprayingdrone.com [https://perma.cc/NM34-GVYM] (marketing "Spraying Drone" brand crop dusters).

102. *See, e.g.*, Associated Press, *Drones to the Rescue*, N.Y. TIMES (June 19, 2017), https://www.nytimes.com/2017/06/19/health/drones-by-air.html [https://perma.cc/QY98-UAUG] (reporting ambulance drones are used to rapidly deliver defibrillators to people in cardiac arrest).

103. Nicole Friedman, *That Drone Hovering Over Your Home? It's the Insurance Inspector*, WALL ST. J. (Aug. 4, 2017, 5:30 AM), https://www.wsj.com/articles/that-drone-hovering-over-your-home-its-the-insurance-inspector-1501839002 [https://perma.cc/T73W-4Y73].

104. *See, e.g.*, WEST, *supra* note 34, at 4.

105. *See* FRANK PASQUALE, THE BLACK BOX SOCIETY: THE SECRET ALGORITHMS THAT CONTROL MONEY AND INFORMATION 6 (2015).

106. Barry Schwartz, *How Google Uses Machine Learning in its Search Algorithms*, SEARCH ENGINE LAND (Oct. 18, 2016, 10:40 AM), https://searchengineland.com/google-uses-machine-learning-search-algorithms-261158 [https://perma.cc/VQA6-L9AL] (discussing Google's use of search algorithms to improve internet searching, both with and without human assistance).

107. *Oracle Autonomous Database: Think Autonomous*, ORACLE, https://www.oracle.com/database/autonomous-database/feature.htmland [https://perma.cc/Q5HR-2W9Q] (explaining the aforementioned Oracle Autonomous Database, claiming superiority over human-based alternatives).

108. Bailey McCann, *The Artificial-Intelligent Investor: AI Funds Beckon*, WALL ST. J. (Nov. 5, 2017, 10:07 PM), https://www.wsj.com/articles/the-artificial-intelligent-investor-ai-funds-beckon-1509937622 [https://perma.cc/8MUL-5JCU].

109. Hugh Son, *Your Robo-Advisor May Have a Conflict of Interest*, BLOOMBERG BUSINESSWEEK (July 27, 2017, 6:00 AM), https://www.bloomberg.com/news/articles/2017-07-27/your-robo-adviser-may-have-a-conflict-of-interest [https://perma.cc/Q2CT-T2RM].

program, called "Woebot" even provides mental therapy (albeit probably not very well).[110]

The more disturbing piece of this story is the accelerating pace of these improvements. For example, commentators are not alarmed by the simple fact that self-driving cars are being developed and commercialized, but that this is happening so quickly.[111] A major potential driver of this uptick in pace is "machine learning."[112] Machine learning outsources the process of automation to machines, putting machines in charge of automating complex, labor-intensive processes without significant human involvement, and with greater speed and accuracy than humans could ever achieve.[113] As Professors Erik Brynjolfsson and Tom Mitchell put it, machine learning permits "automating automation."[114]

Besides contributing to the increasing pace of improvements in automation, machine learning may alter the landscape of invention itself. If machines are now capable of generating patentable inventions, this means inventors are no longer always human.[115] This, too, has the potential to exacerbate technological unemployment. As explained further in Part II, intellectual property-generating companies like Google and Tesla are a big part of today's technological employment story. They are responsible for creating jobs with comparatively high wages for engineers and scientists capable of obtaining patents and copyrights.[116]

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110. Megan Molteni, *The Chatbot Therapist Will See You Now*, WIRED (June 7, 2017, 7:00 AM), https://www.wired.com/2017/06/facebook-messenger-woebot-chatbot-therapist/ [https://perma.cc/TU57-QA5K].

111. *See, e.g.*, Tim Higgins, *Driverless-Car Companies Try to Rev Their Engines on Commercial Prospects*, WALL ST. J. (Jan. 8, 2018, 3:55 PM), https://www.wsj.com/articles/driverless-car-companies-try-to-rev-their-engines-on-commercial-prospects-1515416403 [https://perma.cc/HQ6X-PXL8].

112. Erik Brynjolfsson & Tom Mitchell, *What Can Machine Learning Do? Workforce Implications*, 358 SCIENCE 1530, 1530 (2017).

113. *Id.* at 1531.

114. *See id.*; *see also* Byron Spice, *Machine Learning Will Change Jobs*, CARNEGIE MELLON UNIV. (Dec. 21, 2017), https://www.cmu.edu/news/stories/archives/2017/december/machine-learning-study.html [https://perma.cc/8SSW-3KEE] (providing commentary by the source's author about effects of automation in future job markets and examples of what job types would not be a good fit for automation).

115. *See generally* Ryan Abbott, *I Think, Therefore I Invent: Creative Computers and the Future of Patent Law*, 57 B.C. L. REV., 1079, 1079–80, 1083–84 (2016) (recounting the emergence of creative AI's relationship with the Patent Office and AI's proven abilities to independently create new, innovative works).

116. Google is considered one of the top places to work in the country. Rachel Gillett, *The 50 Best Places to Work in 2018, According to Employees*, BUS. INSIDER (Dec. 6, 2017, 8:51 AM), https://www.businessinsider.com/best-places-to-work-2018-2017-12#5-google-46 [https://perma.cc/695A-892D]. It employs around 88,110 employees. *Number of Full-Time Alphabet Employees from 2007 to 2017*, STATISTA, https://www.statista.com/statistics/273744/ number-of-full-time-

But, if machines are the inventors of the future, then these drivers of high-wage employment would go away too.

2. Limits to Demand as a Driver of Technological Employment

Demand-boosting relies on the idea that more productivity leads to lower prices, which leads to more consumption, which leads to more hiring. But the demand-boosting mechanism has inherent limits—which some worry may be reached in the not too distant future.[117]

First, consumers' demand for products and services itself has limits. As Professor Bessen has discussed, the degree to which automation will boost employment depends on how much a decrease in price actually enhances consumers' demand for an output.[118] Although this mechanism works when consumers respond to decreases in price by buying more of the output (that is, prices for the output are elastic), it does not work as well in more satiated markets like food or clothing, where decreasing the price does not lead people to buy more because they already have enough (that is, prices are inelastic).[119] In some industries, there could be a point at which demand and hiring begin to flatten out, despite falling prices due to automation.[120]

A second, related downward push on demand-boosting comes from the fact that "robots don't consume."[121] Demand-boosting implicitly relies on human consumers to drive demand outputs. But, if more human jobs become automated, workers will be robots, not humans, and there will be fewer and fewer humans earning disposable income to spend and drive demand and further hiring.[122]

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google-employees/ [https://perma.cc/KE2Z-5WKJ]. For more details on the prospects of IP-generators, see Part III.C.

117. Rifkin explains that adherence to the "trickle down technology argument" (what this Article refers to as "demand-boosting") has revealed the theory does not hold up when put to the test. RIFKIN, *supra* note 31, at 15. "[T]he conventional economic wisdom has been that new technologies boost productivity, lower the costs of production, and increase the supply of cheap goods, which, in turn, stimulates purchasing power, expands markets, and generates more jobs. . . . Its logic is now leading to unprecedented levels of . . . unemployment, a precipitous decline in consumer purchasing power, and the specter of a worldwide depression of incalculable magnitude and duration." *Id.*

118. Bessen, *supra* note 50, at 2–3

119. *Id.* at 5–6.

120. *Id.* at 15; *see also* RIFKIN, *supra* note 31, at 7 (describing how certain industries and position types are particularly vulnerable to employment loss); Autor, *supra* note 35, at 7 (discussing the limits to demand as the driver of employment); Brynjolfsson & Mitchell, *supra* note 112, at 1533 (noting that automation's impact on employment depends in part on the "price elasticity" of demand).

121. *See, e.g.*, FORD, *supra* note 31, at 196–97.

122. *See, e.g.*, *id.* at 197; *see also* Brynjolfsson & Mitchell, *supra* note 112, at 1534 ("Automation may change the total income for some individuals or the broader population . . .

A final barrier to demand-boosting is that not all markets will see a decrease in prices just because costs go down. As Bessen notes, a crucial assumption behind demand-boosting is that markets are competitive, not monopolistic.[123] If barriers to entry—for example, intellectual property—prevent competition from driving down prices, this would hinder demand-boosting still further.[124] Imagine that the use of intellectual property had permitted companies to keep prices high and to restrict output during the Industrial Revolution, when automated looms lowered costs and increased demand for items like clothing. Maybe the clothing industry would not have expanded as much and hiring would not have risen.[125]

3. Decreasing Quality of Remaining Human Work

Some commentators are skeptical of these fears. They contend that we should have faith that innovation will create new jobs we cannot yet imagine.[126] But modern technological unemployment is not just about technology's impact on the overall quantity of jobs. It's about technology's impact on the *quality* of jobs.

Technological change can either augment or diminish human work.[127] Augmentation, on its own, is a very good thing. Workers become more productive and their performance is enhanced, sometimes to superhuman

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[and thus] change demand for some types of goods and the derived demand for the tasks needed to produce those goods.").

123. *See, e.g.*, Bessen, *supra* note 50 ("If we assume that rapid productivity growth generated rapid price declines *in competitive product markets*, then these price declines would be a major source of demand growth." (emphasis added)).

124. *See* Lemley, *supra* note 14, at 497–99 (arguing intellectual property may be used to artificially preserve monopolies as the costs of production fall).

125. For what actually happened, see BESSEN, *supra* note 24, at 97 ("With progressively lower costs, prices fell, consumers demanded more cotton cloth per capita, and there was more demand for weavers.").

126. *See* Lemley, *supra* note 14, at 512–15 (opining that, even in a world where people are no longer needed to produce goods and services, people will have new jobs to do); Daniel Hemel, *Bringing the Basic Income Back to Earth*, NEW RAMBLER REV. (Sept. 19, 2016), http://newramblerreview.com/book-reviews/economics/bringing-the-basic-income-back-to-earth#.V-RzhtMTcdc.twitter [https://perma.cc/GC4B-3M84] (reviewing ANDY STERN & LEE KRAVITZ, RAISING THE FLOOR: HOW A UNIVERSAL BASIC INCOME CAN RENEW OUR ECONOMY AND REBUILD THE AMERICAN DREAM (2016) and CHARLES MURRAY, IN OUR HANDS: A PLAN TO REPLACE THE WELFARE STATE (Revised & Updated ed., 2016)) ("[A]dvances in artificial intelligence will lead to some job losses in the coming years. But these advances will also lead to new jobs . . . ."); *see also* Kaplan, *supra* note 82 (casting doubt on the ability of machines to perform many essential tasks in today's economy).

127. *See, e.g.*, Brynjolfsson & Mitchell, *supra* note 112, at 1531 (explaining that machine learning can make certain jobs less valuable and others more valuable as it "augment[s] human capabilities").

levels.[128] Several major professions are augmented by machines. Affected professionals include, to name a few, mechanical engineers, chief executive officers, and microbiologists—all of whom stand to benefit from technologies that complement, rather than replace, their skill sets.[129] One extreme example is the "quants" who manipulate electronic trading algorithms to achieve much higher returns than ordinary traders and analysts.[130] Another example is certain doctors, who use artificial intelligence to make more accurate diagnoses or perform surgery.[131] Some lawyers, too, benefit immensely from technology that facilitates case law research.[132]

Diminution, on the other hand, occurs when technology substantially reduces demand for workers' skills, and reduces their wages accordingly.[133] Even when technology does not wipe out someone's profession, it can turn them into, basically, an automaton, there mainly to "fill in gaps" left over by machines.[134] The manufacturing sector provides some depressing examples. A recent *New Yorker* article, for instance, describes the workplace of a large manufacturer of office furniture that

128. The notion that technology will augment some professions, but not others, is the thesis of several recent books. *See, e.g.*, THOMAS DAVENPORT & JULIA KIRBY, ONLY HUMANS NEED APPLY: WINNERS AND LOSERS IN THE AGE OF SMART MACHINES 65–66 (2016); *see also* Jeanne Meister, *Future of Work: Three Ways to Prepare for the Impact of Intelligent Technologies in Your Workplace*, FORBES (July 6, 2016), https://www.forbes.com/sites/jeannemeister/2016/07/06/future-of-work-three-ways-to-prepare-for-the-impact-of-intelligent-technologies-in-your-workplace/ [https://perma.cc/E3TJ-3M9V] (discussing how "intelligent technologies" will enhance workplace productivity).

129. Frey & Osborne, *supra* note 33, app. A tbl. at 270.

130. Gregory Zuckerman & Bradley Hope, *The Quants Run Wall Street Now*, WALL ST. J. (May 21, 2017), https://www.wsj.com/articles/the-quants-run-wall-street-now-1495389108 [https://perma.cc/4JTM-6TGA].

131. Tom Sullivan, *Cognitive Computing Will Democratize Medicine, IBM Watson Officials Say*, HEALTHCARE IT NEWS (Apr. 27, 2017, 4:20 PM), https://www.healthcareitnews.com/news/cognitive-computing-will-democratize-medicine-ibm-watson-officials-say [https://perma.cc/RQH2-KKFJ] ("Artificial intelligence tools will augment physicians' jobs . . . ."); *see also* Tim O'Reilly, *Don't Replace People. Augment Them*, MEDIUM (July 17, 2016), https://www.oreilly.com/ideas/dont-replace-people-augment-them [https://perma.cc/5A5B-XXZE] ("My eyes were fixed by an augmented surgeon able to do something that had been previously impossible.").

132. *See* Karen Turner, *Meet 'Ross,' the Newly Hired Legal Robot*, WASH. POST (May 16, 2016), https://www.washingtonpost.com/news/innovations/wp/2016/05/16/meet-ross-the-newly-hired-legal-robot/ [https://perma.cc/8SZQ-V8VA]; *see also* ROSS INTELLIGENCE, http://www.rossintelligence.com [https://perma.cc/HJR2-PZRN] (providing an example of legal research technological advancements).

133. *See e.g.*, FORD, *supra* note 31, at 3.

134. *See, e.g.*, Brynjolfsson & Mitchell, *supra* note 112, at 1531; *see also* FORD, *supra* note 31, at 3 (concluding that human job quality is decreasing due to such technology).

introduced computerized work stations and computer-assisted arms.[135] Sometimes called "meat robots" by their own peers, employees now "follow a strict automated protocol," for which they "need little training."[136] "Even the drill [used to affix parts of furniture being assembled] [is] attached to a computer-assisted arm; the worker just [has] to move it to the right position and let the machine do its magic."[137] A decade ago, the article concludes, "industrial robots assisted workers in their tasks. Now workers—those who remain—assist the robots in theirs."[138]

Diminution can happen to high-skill as well as low-skill jobs. For example, translating languages was once the sole domain of skilled human translators.[139] But thanks to improving translation technologies, "[i]t is much easier for machines (and humans) to translate between closely related languages."[140] Humans are not fully replaced because some translations are too complex or context-specific for machines to do alone.[141] However, for many purposes, "Google Translate is faster, cheaper, and often as good as a human interpreter."[142] Human translators are used merely to "clean up" the work of automated translation tools.[143]

4. Rising Inequality in Who Has What Jobs

One of the most disturbing pieces of modern technological un/employment is that the impact of technology differs drastically for different members of society.[144] The result is that even if technology

135. Sheelah Kolhatkar, *Welcoming Our New Robot Overlords*, NEW YORKER (Oct. 23, 2017), https://www.newyorker.com/magazine/2017/10/23/welcoming-our-new-robot-overlords [https://perma.cc/ZWB5-84NQ].

136. *Id.*

137. *Id.*

138. *Id.*

139. *Translation Platforms Cannot Replace Humans: But They are Still Astonishingly Useful*, ECONOMIST (Apr. 29, 2017), https://www.economist.com/news/books-and-arts/21721357-they-are-still-astonishingly-useful-translation-platforms-cannot-replace-humans [https://perma.cc/FJ9P-Z5RD].

140. *Id.*

141. *Id.* ("Literature requires far too supple an understanding of the author's intentions and culture for machines to do the job. And for critical work—technical, financial or legal, say—small mistakes (of which even the best systems still produce plenty) are unacceptable . . . .").

142. Greg Ip, *We Survived Spreadsheets, and We'll Survive AI*, WALL ST. J. (Aug. 2, 2017, 11:47 AM), https://www.wsj.com/articles/wesurvived-spreadsheets-and-well-survive-ai-1501688765 [https://perma.cc/7KYP-4CCU].

143. *Why Translators Have the Blues: A Profession Under Pressure*, ECONOMIST (May 27, 2017), https://www.economist.com/news/books-and-arts/21722609-profession-under-pressure-why-translators-have-blues [https://perma.cc/YT66-D63P].

144. *See* BRYNJOLFSSON & MCAFEE, *supra* note 28, at 39 ("Even when technological progress increases productivity and overall wealth, it can also affect the division of rewards,

creates more new jobs than it destroys on net, these net gains are not equally distributed.[145]

The main disparity comes from the thesis that technological change is "skill-biased."[146] According to economics professors Claudia Goldin and Lawrence Katz "the central idea . . . is that certain technologies are difficult for workers and consumers to master, at least initially."[147] "[E]mployees who are slow to grasp new tools will not be promoted and might see their earnings reduced. Those who are quicker will be rewarded."[148] The upshot is that "low-skill" workers—generally, people with lower levels of formal education—are left behind or made obsolete by machines, but "high-skill" workers—people with higher levels of formal education—are rewarded.[149]

In their recent book, *Race Against the Machine*, economists Erik Brynjolfsson and Andrew McAfee show that this thesis is supported by historical data on the correlation between wages and education level.[150] "Over the past 40 years," they write, "weekly wages for those with a high school degree have fallen and wages for those with a high school degree and some college have stagnated. On the other hand, college-educated workers have seen significant gains, with the biggest gains going to those who have completed graduate training . . . ."[151] Brynjolfsson and McAfee link this unequal distribution of gains mainly to machines and automation, rather than to other trends such as globalization.[152]

5. Inability of Education to Keep Pace

The fact that technology favors higher-skilled workers would not in itself be a problem if everyone had the skills necessary to be a winner. However, according to Goldin and Katz, education in the United States has not kept pace with technological advancement, leaving a gap between

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potentially making some people worse off than they were before the innovation."). The book further explains this issue. *Id.* at 36–47 (discussing various "winners and losers" ushered in by advances in technology).

145. *See id.* at 39–40.

146. *Id.* at 39; *see also* Autor & Salomons, *supra* note 73, at 48 (discussing how wage loss for less educated workers is "typically attributed to skill-biased demand shifts"); GREENHALGH & ROGERS, *supra* note 42, at 268 ("[T]he predominant view is that high-skilled workers are complementary to high-technology capital and knowledge stocks, while those with lower skills are substitutes for capital.").

147. GOLDIN & KATZ, *supra* note 70, at 90.

148. *Id.* Frey and Osborne discuss Goldin and Katz's large body work in Frey & Osborne, *supra* note 33, at 257.

149. GOLDIN & KATZ, *supra* note 70, at 94–98.

150. *Id.* at 94–99.

151. BRYNJOLFSSON & MCAFEE, *supra* note 28, at 39–40.

152. *Id.* at 4–9, 39–42.

the demand for educated workers and the supply.[153] They call this the "race between technology and education."[154] The result of technology winning the race is a "skills gap": higher demand for people with a certain skill set than there is supply.[155]

In theory, education could resolve the skills gap and alleviate inequality by bringing the unskilled to the level of the skilled. However, under Goldin and Katz's framework, if improvements in automation continue at the same or an increasing rate, education may improve too slowly to help people gain the skills required to work with future technologies. Moreover—returning to the points made above about machines' increasingly impressive range of capabilities and the limits to demand as a driver of remaining human employment—even assuming perfect education, there simply may not be enough jobs to go around.[156] Martin Ford provides a compelling, albeit disturbing, visual depiction of this scenario. He depicts the historic job market like a pyramid, with many low-skill jobs at the bottom, and only a few high-skill jobs at the top.[157] "It's becoming increasingly clear," Ford writes, that "robots, machine learning algorithms, and other forms of automation are gradually going to consume much of the base of the jobs skills pyramid."[158] Even by investing in "still more education and training," Ford concludes, it is unlikely that we can "cram everyone into that shrinking region at the very top."[159] In other words, not only is education not keeping pace with technology, but doing so may one day be an impossibility.

II. INTELLECTUAL PROPERTY AS A DRIVER OF TECHNOLOGICAL UN/EMPLOYMENT

The consensus of the work discussed above is that innovation both eliminates *and* creates employment and, moreover, that innovation significantly affects the quality and distribution of jobs across the economy.[160] This Part shows that intellectual property plays a role in

153. GOLDIN & KATZ, *supra* note 70, at 7–8, 99–102.

154. *Id.* at 7, 298.

155. *See, e.g.*, Kristin Majcher, *The Hunt for Qualified Workers*, MIT TECH. REV. (Sept. 16, 2014), https://www.technologyreview.com/s/530701/the-hunt-for-qualified-workers/ [https://perma.cc/VNU2-PCVN]. *But see* Andrew Weaver, *The Myth of the Skills Gaps*, MIT TECH. REV. (Aug. 25, 2017), https://www.technologyreview.com/s/608707/the-myth-of-the-skills-gap/ [https://perma.cc/7936-KEMM] ("[P]ersistent hiring problems are less widespread than many pundits and industry representatives claim.").

156. FORD, *supra* note 31, at 252–53 ("The numbers simply don't work.").

157. *Id.* at 252.

158. *Id.*

159. *Id.* at 252–53.

160. *See supra* Part I.

generating technological un/employment, and it may contribute to these trends.

The reader might initially think the presence or absence of intellectual property makes no difference for employment at all. This is because modern intellectual property rights only provide a right to exclude others from using the covered innovation.[161] Intellectual property covering a particular technology does not give a company the right to use it, let alone guarantee they will be successful.[162] On the flip side, absent intellectual property, companies are free to adopt innovations like drones and self-driving cars, so long as they do not run afoul of health and safety or other regulations.[163]

This intuition is wrong. The easiest way to see why is to go back in time.

A. *Privilege Regimes*

Unlike today, historically, there was no question intellectual property rights could influence employment. The U.S. patent regime has its origins in sixteenth century Great Britain, and before that, fifteenth century Venice.[164] Back then, patents conferred the "privilege" to practice an invention in the jurisdiction, without which the inventor could not use his invention in the realm.[165] Privilege-granting regimes made the decision whether to confer a privilege based on a variety of factors besides an invention's novelty—including the invention's likely "impact on local labor, commerce, and prices."[166] Like early corporate charters, "patents

161. 35 U.S.C. § 154(a)(1) (2012) ("Every patent shall contain . . . a grant to the patentee, his heirs or assigns, of the right to exclude others from making, using, offering for sale, or selling the invention throughout the United States or importing the invention into the United States . . . ."); *see also* 17 U.S.C. § 106 (2012) ("[T]he owner of copyright under this title has the exclusive rights to do and to authorize any of the following . . . .").

162. *See* Ted Sichelman, *Commercializing Patents*, 62 STAN. L. REV. 341, 343 (2010) (noting that few patents are ever commercialized).

163. Various regulations external to intellectual property regulate the use of emerging technologies. *See, e.g.*, Carla Reyes, *Moving Beyond Bitcoin to an Endogenous Theory of Decentralized Ledger Technology Regulation: An Initial Proposal*, 61 VILL. L. REV. 191, 201 (2016) (discussing ways to regulate Bitcoin and other payments systems that operate using "distributed ledger technology").

164. *See* ROBERT MERGES & JOHN DUFFY, PATENT LAW AND POLICY: CASES AND MATERIALS 3–5 (5th ed. 2011).

165. *See* Camilla A. Hrdy, *State Patent Laws in the Age of Laissez Faire*, 28 BERKELEY TECH. L.J. 45, 58 (2013); *cf.* Adam Mossoff, *Who Cares What Thomas Jefferson Thought About Patents? Reevaluating the Patent "Privilege" in Historical Context*, 92 CORNELL L. REV. 953, 957–58 (2007) (casting doubt on the notion that early American patent rights were seen as "privileges" in the modern sense of the term).

166. *See* Mario Biagioli, *Patent Republic: Representing Inventions, Constructing Rights and Authors*, 73 SOC. RES. 1129, 1134 (2006); *see also* Oren Bracha, *The Commodification of Patents*

were granted selectively to private developers who promised to furnish the state with something that would contribute to economic growth or infrastructure."[167]

Therefore, if an inventor came to the sovereign seeking a patent to use the technology in the region, and that technology was likely to have a negative impact on the work force, it was far less likely the sovereign would grant that patent. For example, Professor Mario Biagioli has recounted the famous inventor Galileo's efforts to obtain a "privilege" to operate his new water pump—in Venice in 1594—based on his assessment of the pump's utility in providing an efficient way to pump water in "[t]erminally swampy" Venice.[168] One wonders whether Venetian officials would have granted Galileo the privilege to operate his water pump if Galileo had instead insisted his water pump's main advantage would be to reduce employment for Venetian farmers.

There are indeed documented instances of privilege granting regimes denying patents for labor-displacing inventions. The Introduction mentioned William Lee's unsuccessful attempt to achieve a patent for his knitting machine in England and France, which the Queen of England predicted would bring her subjects to "ruin by depriving them of employment."[169] Another example comes from Venice, courtesy of Professor Stefania Fusco. The petitioner, Maria Bessea Brancaleoni, sought a patent for "a machine that could be used to either to spin and [sic] wind several kinds of materials." The officials reviewing her petition stated that the invention was "ingenious and beautiful and could easily accomplish" what Brancaleoni had promised. However, they warned the Signoria (the issuing authority) to be careful, because "if the device proved to be effective (as was likely to be the case) it would be to the detriment of the poor, because this machine would cause unemployment among poor [women]."[170]

These examples demonstrate that in both England and Venice, at least some patents were reviewed specifically for their predicted impact on labor and were sometimes denied if found to be to detrimental to workers.

This changed in early American patent law. As Professor Biagioli and others have observed, the U.S. Patent Act of 1790 shifted the focus of

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1600–1836: How Patents Became Rights and Why We Should Care, 38 LOY. L.A. L. REV. 177, 186–87 (2004) (describing the functionality of tangible benefits offered in patent petitions).

167. Herbert Hovenkamp, *The Emergence of Classical American Patent Law*, 58 ARIZ. L. REV. 263, 267 (2016); *see also* Hrdy, *supra* note 165, at 60–64, 95–96, 100–04 (discussing consideration of social utility in state patent laws and earlier privilege regimes).

168. Biagioli, *supra* note 166, at 1132–33.

169. *See* ACEMOGLU & ROBINSON, *supra* note 3.

170. This example is courtesy of Professor Stefania Fusco. Professor Fusco's original translation is on file with the author.

patents from generating local utility in the socioeconomic sense to disclosing new information.[171] Nonetheless, in the first few decades, employment remained a factor that was sometimes raised in discussions surrounding patentability—for instance in assessing whether a patent met the Patent Act's "utility" requirement.[172] Professor Oren Bracha gives the example of Eli Whitney's patent for his cotton gin, challenged in *Whitney v. Carter* (1810).[173] When the cotton gin's utility was questioned, Whitney's counsel responded by cataloguing the public benefits conferred by the cotton gin, including that the cotton gin provided "a lucrative employment" for "[i]ndividuals who were depressed with poverty" and "sunk in idleness."[174] This example shows not only that inventions' impact on employment was a valid consideration within the U.S. patent system, but also that inventions were perceived to lead to technological *em*ployment as well as unemployment.

B. *Modern Intellectual Property*

Modern intellectual property rights in the United States are not what they were in early privilege regimes. The Patent Act, which is in this respect representative of modern American intellectual property regimes, no longer supplies the right or permission to practice an invention in the jurisdiction. Instead, a patent supplies only the "*right to exclude others*" from making, using, selling, or importing the covered invention for the lifetime of the patent.[175] Thus, denying intellectual property rights for a labor-displacing innovation would not create a ban on using or adopting the technology; it would just mean the innovator does not get the benefit of exclusivity. What is more, today, neither the Patent Office nor courts scrutinize the moral or economic implications of inventions when deciding whether to grant or uphold intellectual property rights.[176]

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171. *See* Biagioli, *supra* note 166, at 1138; *see also* Camilla Hrdy, *State Patents As a Solution to Underinvestment in Innovation*, 62 U. KAN. L. REV. 487, 493–95 (2013) (discussing the four essential features that differentiated state patents from U.S. patents).

172. *See* Oren Bracha, Owning Ideas: A History of Anglo-American Intellectual Property 99–100 (June 2005) (unpublished S.J.D. thesis, Harvard Law School) (discussing assessment of social utility in early nineteenth century patent law).

173. 29 F. Cas. 1070, 1071 (C.C.D. Ga. 1810); *see* Bracha, *supra* note 172, at 418–19.

174. *See Whitney*, 29 F. Cas. at 1072; *see* Bracha, *supra* note 172.

175. 35 U.S.C. § 154(a) (2012); *see also* Kewanee v. Bicron, 416 U.S 470, 480 (1974) ("The patent laws promote [the Progress of Science and useful arts] by offering a right of exclusion for a limited period as an incentive to inventors to risk the often enormous costs in terms of time, research, and development.").

176. An exception is Justice Joseph Story's so-called "moral utility" requirement, under which an invention cannot be "injurious to the morals, the health, or the good order of society." Bedford v. Hunt, 3 F. Cas. 37, 37 (C.C.D. Mass. 1817). However, the moral utility doctrine has

However, standard intellectual property theory suggests intellectual property rights still have an impact on both the magnitude and the pace of technology's replacement of human labor. There are four major intellectual property regimes: patents,[177] copyrights,[178] trade secrets,[179] and trademarks.[180] A primary reason government creates intellectual property rights is to help innovators internalize the uncompensated benefits their innovations generate for others (called positive externalities or spillovers), so that innovators will innovate more than they otherwise would and get society closer to the optimal level of innovation.[181] More specifically, intellectual property is thought to affect incentives to innovate in two key ways. First, the right to exclude acts as an incentive to invent and commercialize a given innovation by making it easier for companies to appropriate returns by restricting copying and competition.[182] Second, the race for priority over a legal right to exclude—particularly in patent law where one inventor achieves universal priority—is believed to accelerate the pace at which invention and commercialization occurs.[183]

To be clear, few would argue that intellectual property is a "but for" determinant of whether, or when, an innovation is invented and adopted. Rather, intellectual property is viewed as one of several factors that affect companies' decisions, and the extent to which intellectual property does so will depend on the form of intellectual property and the context.[184] When it comes to the incentive to innovate, the four intellectual property regimes operate distinctly; but each is perceived to have an effect. Most scholarship focuses specifically on patents' effects on incentives to invent

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been largely rejected by modern courts. *See* Sean B. Seymore, *Making Patents Useful*, 98 MINN. L. REV. 1046, 1057–59 (2014).

177. 35 U.S.C. §§ 101–103, 112 (2012).

178. 17 U.S.C. §§ 101–102, 106 (2012).

179. 18 U.S.C. §§ 1831–1839 (2012).

180. 15 U.S.C. §§ 1127, 1114, 1125 (2012).

181. R. Polk Wagner, *Information Wants to Be Free: Intellectual Property and the Mythologies of Control*, 103 COLUM. L. REV. 995, 1005, 1009 (2003) (asserting that intellectual property serves to preserve incentives to generate new information in the face of inevitable spillovers).

182. *See* GREENHALGH & ROGERS, *supra* note 42, at 272 (observing that intellectual property rights allow firms to achieve "excess profits that cannot be easily competed away by other firms in the short run").

183. *See, e.g.*, Michael Abramowicz & John F. Duffy, *The Inducement Standard of Patentability*, 120 YALE L.J. 1590, 1599 (2011); *see also* Hrdy, *infra* note 185, at 32–33 (discussing theories under which patents accelerate the pace of innovation).

184. *See, e.g.*, Stuart J.H. Graham et al., *High Technology Entrepreneurs and the Patent System: Results of the 2008 Berkeley Patent Survey*, 24 BERKELEY TECH. L.J. 1255, 1255 (2009) (surveying entrepreneurs to learn how they perceive patents in various industries).

and commercialize.[185] With respect to copyrights, although most copyright subject matter seems divorced from the types of labor-saving innovation under discussion, an important subset of copyright subject matter has been integral to automation: software.[186] Trade secret law only provides a right to exclude others who obtain the innovation by improper means or in breach of a duty of confidentiality,[187] but the principle by which trade secrets operate is the same: the right to exclude is presumed to provide, among other things, an incentive to innovate.[188] Trademark's status as an innovation incentive is the most controversial of the four, since trademark law's primary goal is said to be to protect consumers from confusion as to the source of goods and services, and only secondarily to give sellers an incentive to invest in product "quality."[189] However, some contend trademarks provide an incentive to innovate because trademarks help innovators prevent others from passing off their own offerings as those of the true innovator, and in this way retain a first-mover advantage for their innovations as against potential competitors.[190]

With respect to each of these intellectual property regimes, the upshot is that, when presented with the decision of whether to innovate or not innovate, the potential innovator is at least theoretically more likely to

185. *See, e.g.*, Camilla A. Hrdy, *Commercialization Awards*, 2015 WIS. L. REV. 13, 27–39; Robert P. Merges, *Uncertainty and the Standard of Patentability*, 7 HIGH TECH. L.J. 1, 2–3 (1992); Ouellette, *supra* note 11, at 75–87.

186. Despite early objections, copyright law protects computer code as "literary works" and also protects some functional aspects of software. *See generally* Pamela Samuelson, *The Uneasy Case for Software Copyrights Revisited*, 79 GEO. WASH. L. REV. 1746, 1782 (2011) (discussing that copyright protection is deeply entrenched in software protection).

187. *See* Kewanee Oil Co. v. Bicron Corp., 416 U.S. 470, 490 (1974).

188. *Id.* at 493 ("Trade secret law encourages the development and exploitation of those items of lesser or different invention than might be accorded protection under the patent laws . . . [and] promotes the sharing of knowledge . . . ."); *see also* Richard C. Levin et al., *Appropriating the Returns from Industrial Research and Development*, 3 BROOKINGS PAPERS ON ECON. ACTIVITY 783, 783–831 (1987) (providing survey evidence regarding the perceived importance of patents and trade secrets as innovation incentives).

189. Robert Bone, *Hunting Goodwill: A History of the Concept of Goodwill in Trademark Law*, 86 B.U. L. REV. 547, 558 (2006); *see also* Mark McKenna, *The Normative Foundations of Trademark Law*, 82 NOTRE DAME L. REV. 1839, 1844–49 (2007) (providing that the goal of trademark law is to improve the quality of information in the marketplace and reduce consumer search costs).

190. *See, e.g.*, GREENHALGH & ROGERS, *supra* note 42, at 40 ("The signaling argument for trademarks is linked to the basic justification for IPRs: firms would be reluctant to invest in new product innovation if the new product could not be distinguished from imitations."); *see also* William M. Landes & Richard A. Posner, *Trademark Law: An Economic Perspective*, 30 J.L. & ECON. 265, 266 (1987) (discussing trademarks as an incentive to invest in product quality). I am also indebted to ideas presented by Jason S. George & Lisa Larrimore Ouellette in their working paper, entitled *Trademarks as Innovation Incentives*, which they presented at the Intellectual Property Scholars Conference at Berkeley Law on August 9, 2018.

choose to innovate due to the option for intellectual property protection, and is likely to do so faster than in a world without intellectual property protection.

C. *Intellectual Property's Impact on Technological Un/employment*

For various reasons, economists have not studied the impact of modern intellectual property rights on employment as widely as one might think.[191] However, pursuant to standard intellectual property theory, intellectual property rights should be expected to have two major effects on the process of technological un/employment[192]: what this Article calls the Incentive Effect and the Distribution Effect.

1. The Incentive Effect

The Incentive Effect predicts that the incentives generated by intellectual property laws magnify and accelerate the pace of technological un/employment. The chance to obtain an exclusive right increases the incentive to invent and commercialize any given innovation at any given point in time. Within the entire universe of innovation, at least some will be labor-saving innovations. At least some of these labor-saving innovations will end up being labor-*displacing*.[193] Therefore, the existence of intellectual property laws should make it more likely that any given labor-displacing innovation will be invented, commercialized, and adopted in industry, and increase the pace at which this occurs.[194]

The Incentive Effect generates a testable hypothesis. Call the entire universe of innovation I, and call the labor-saving subset of all innovation, I_L. The Incentive Effect predicts that intellectual property rights should, in the aggregate, increase the overall size of I_L by providing the opportunity to exclude others from using the protected innovation. Thus, the size of I_L in the presence of intellectual property rights, call it I_L^{IP}, should be greater than the size of I_L in the absence of IP, call it I_L^0. If the Incentive Effect holds true, intellectual property rights increase the size of the universe of innovations that are labor-displacing.

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191. Economists' work usually seeks to answer a different question: *innovation's* impact on employment. They view intellectual property as mere proxies for innovation itself. *See, e.g.*, Van Roy et al., *supra* note 71, at 3–4 (finding that higher levels of innovation, as measured by forward-weighted patent citations, had a positive impact on employment at firms in high-tech manufacturing sectors).

192. Again, technological un/employment means the simultaneous creation and elimination of jobs due to advances in technology via the mechanisms discussed in Part II.

193. See Part II.A for an explanation of labor-displacing.

194. Obviously, intellectual property is not the only factor influencing invention and adoption of labor-saving developments. *See supra* Part I.A.2 (discussing five factors that go into the decision of whether to automate).

$$I_L^{IP} > I_L^0$$

Proving the Incentive Effect is not as difficult as it might at first appear, *if* readers are willing to assume that intellectual property has a positive net impact on the total universe of innovation in the long run.[195] If the whole universe of innovation gets bigger, then the subset of innovation that is labor-saving also gets much bigger, so long as there is nothing about intellectual property that leads inventors to favor investment in labor-creating innovations. This caveat is discussed in greater detail below.[196]

One way to disprove the Incentive Effect would be if there were zero or very few intellectual property rights obtained for labor-saving inventions. This would suggest that intellectual property is insignificant in the mix of factors affecting the decision to invent labor-saving solutions to problems. However, the patent record reveals that companies regularly seek to protect labor-saving innovations through the patent system. There are many famous labor-saving patents from the Industrial Revolution, such as several early patents on the steamboat, famous for outpacing boats operated "by any other power,"[197] and the cotton harvester, advertised as "having a large capacity for work."[198] The automated teller machine (ATM), discussed in Part II, was covered by patents lauding its cost cutting potential.[199] A search for the term "labor-saving" in Google Patents reveals over 80,000 results, such as labor-saving long arm gardening shears,[200] a labor-saving materials dispenser,[201] and a labor-saving consolidated checkout system.[202] The

195. In the short run, intellectual property rights would actually do the opposite: slow down adoption of labor-saving technologies for as long as they are protected by an exclusive right. *See* Robert Merges & Richard Nelson, *On the Complex Economics of Patent Scope*, 90 COLUM. L. REV. 839, 868 (1990) (discussing classic studies showing a "tradeoff between increased inventive effort resulting from longer anticipated patent life and greater deadweight costs associated with longer monopoly"). This conclusion assumes that intellectual property scopes and term lengths are appropriately tailored so as to limit needless monopoly costs as well as negative impacts on cumulative innovation. *Cf. id.* at 873–74 (observing difficulties of tailoring to limit costs).

196. *See infra* Part II.C.2.

197. *See* Hrdy, *supra* note 165, at 78, 105 (discussing John Fitch's 1791 patent).

198. U.S. Patent No. 526,209 (filed June 17, 1893) (issued Sept. 18, 1894). The Cotton-Harvester's stated objective was to produce a "simple and durable apparatus" for harvesting cotton, "capable of operation by unskilled labor," and "having a large capacity for work." *Id.*

199. For instance, the objective of U.S. Patent No. 3,761,682, for a "Credit Card Automatic Currency Dispenser," was "[t]o provide the consumer with a source of ready cash without the expense of branch banking" and to "make cash available to bank customers on a 24 hour basis." U.S. Patent No. 3,761,682 (filed Oct. 7, 1971).

200. U.S. Patent No. 7,530,172 B1 (filed May 30, 2007).

201. U.S. Patent No. 5,592,760 (filed July 25,1995).

202. U.S. Patent No. 5,497,853 (filed June 5, 1992).

term "automation" yields over 300,000 results, including several recent patents involving "sales force automation"[203] and "home automation system[s]."[204] The term "autonomous vehicle" alone yields over 40,000 results, several of which are owned by Uber Technologies.[205]

To illustrate how labor-saving patents are presented, take NCR Corp's patent for a labor-saving consolidated checkout system—the self-service checkout terminals we can now use at the grocery store and the pharmacy.[206] Observing that "the largest expenditures" in the retail industry besides "the cost of the goods sold" are "the cost of labor expended," the patent then discusses at length the invention's goal to "reduce labor costs" associated with grocery and supermarket transactions.[207] The patent aims to reduce labor costs by "reduc[ing] the number of occasions in which an employee of the retailer must intervene in the customer's transaction relative to self-service checkout terminals which have heretofore been designed."[208] In other words, the invention's primary objective is to reduce the amount of labor required to perform the task to as close to zero as possible.

The fact that a large number of labor-saving inventions have been patented does not indicate any influence on innovation stemming from the ease of obtaining a patent. If, instead, there were few labor-saving inventions in the patent record, this would potentially indicate that increased difficulty of obtaining a patent does influence innovation. However, if these patents are having their desired effect on the amount and pace of innovation, they also must be having a magnifying effect on labor-saving innovation and thus on technological un/employment.

2. Caveats

It is important to emphasize that the Incentive Effect does not hypothesize that intellectual property rights enlarge only the size of I_L. Rather, intellectual property rights enlarge the size of the entire universe of innovation, including I_L. In other words, this Article does not necessarily claim that intellectual property's incentive mechanism—for

203. U.S. Patent No. 7,340,410 B1 (filed June 13, 2002).

204. U.S. Patent No. 6,473,661 B1 (filed Mar. 15, 2000).

205. *E.g.*, U.S. Patent Nos. 9,557,183 B1, 9,603,158 B1, 9,616,896 B1, 9,672,446 B1, 9,432,929 B1.

206. U.S. Patent No. 6,522,772 B1 (filed Sept. 30, 1998). The National Cash Register Company was founded in 1884 by John H. Patterson. *Company*, NCR, https://www.ncr.com/company [https://perma.cc/F8SG-GGM4]. NCR Corp. has since developed many machines to facilitate consumer transactions, including cash registers, ATMs, and self-service kiosks. *See id.* Patterson's first patent for a cash register has a grant date of 1889. *See* U.S. Patent No. 414,440 (issued Nov. 5, 1889).

207. U.S. Patent No. 6,522,772 B1 col. 1 ll. 14–20.

208. *Id.* col. 3 ll. 31–35.

instance, the fact that intellectual property relies on a right to exclude[209]—leads businesses to prefer labor-saving innovations over labor-creating innovations.[210]

To illustrate the point by way of example, the presence of intellectual property does not necessarily mean Google is more likely to invent a new kind of automated car as opposed to a new kind of human-operated car. But the presence of intellectual property does mean Google is more likely to invent all types of new cars, including fully automated cars, and to do so faster than it otherwise would. Note that, on the flip side, there is no evidence to suggest that intellectual property encourages investing in labor-creating innovations. To the contrary, as discussed in Part II.A, market forces already encourage investing in automation, and it seems reasonable to assume that intellectual property would magnify those incentives. Thus, all else being equal, in this example Google would be more likely to invent the automated car than the new kind of human-operated one.

There is another crucial caveat. There is no guarantee that any given labor-saving innovation will end up being labor-displacing. In the past, new technologies from the cotton gin to the ATM ended up creating more jobs than they destroyed, at least in net terms. Even inventions that permit total automation of tasks, such as a fully automated vehicle, can end up generating new tasks that people can be paid to perform. This is what technological un/employment is all about. Again, for all the reasons discussed in Part II.C, this does not completely solve the problem. The long-term concern is that in the future machines will take over all conceivable tasks—the job of the engineer who makes the vehicle as well as the job of the driver. The more realistic, present-day concern is that the gains from technological advances are not equally distributed. A driver cannot become an engineer overnight; becoming an engineer takes a lifetime of comparative privilege and resources that most people do not have. This second point becomes very important in light of the next Part's argument: that intellectual property tends to exacerbate the division of returns between technological un/employment's winners and losers.

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209. Some have argued, for instance, that patents, which provide a right to exclude in exchange for disclosure, may lead innovators to prefer certain types of inventions that are easier to exclude and more difficult to keep secret. *See, e.g.*, Amy Kapczynski & Talha Syed, *The Continuum of Excludability and the Limits of Patents*, 122 YALE L.J. 1900, 1905 (2013).

210. That said, when assessing damages in patent cases, courts have held damages may include the profits the infringer would have expected to obtain from savings on labor. This could mean patentees have an incentive, beyond the strong incentives they already have, to invest specifically in inventions that save on labor costs, knowing they can recover damages based on future infringers' savings on labor. *See, e.g.*, Trio Process Corp. v. L. Goldstein's Sons, Inc., 612 F.2d 1353, 1355–57 (3d Cir. 1980); Doten v. City of Boston, 138 F. 406, 406–07 (1st Cir. 1905).

3. The Distribution Effect

The Distribution Effect is an outgrowth of the Incentive Effect. The Distribution Effect has two parts. First, intellectual property increases returns for intellectual property owners by giving them a right to exclude, thereby increasing demand and wages for people who possess the skills necessary to generate intellectual property ("IP-generators"). Second, because at least some of this same intellectual property involves labor-displacing innovations, this contributes to lower demand and wages for people whose core skills are more easily replaced by machines and who are not capable of generating intellectual property ("non-IP-generators").[211] The upshot is that intellectual property magnifies the division of rewards between generators of intellectual property and the workers whom their innovations replace.

The Distribution Effect generates at least one core hypothesis: that demand and wages for IP-generators should be exponentially higher than for non-IP-generators. Proving the Distribution Effect is difficult, in large part because it is difficult to isolate intellectual property's impact on employment and wages as opposed to *innovation's* impact.[212] But several pieces of evidence suggest that intellectual property, in specific, may contribute to comparatively higher wages for IP-generators.

First, as already mentioned, data from the last several decades shows a correlation between technological advances and increased wages for "high-skill" as compared to "low-skill" workers.[213] Second, evidence shows that wages in geographic regions with high levels of innovation and higher levels of patenting per entity—"brain hubs" like Silicon Valley, California—tend to be higher than wages in other regions.[214]

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211. For purposes of simplicity, workers are divided into two groups: "IP-generators," who generate valuable intellectual property and are not easily replaced by machines, and "non-IP-generators," who do not generate valuable intellectual property and whose skills are more easily replaced by machines. This assumes IP-generators are less likely to be replaced by machines than non-IP-generators, which is not necessarily true. It also assumes that returns from intellectual property trickle down to IP-generators, which is also not necessarily true, since IP-generators do not always own the intellectual property that they generate. This complexity is discussed further below. This simplicity obviously does not map precisely onto reality; but other commentators on this topic make similarly simplistic distinctions between "high-skill" and "low-skill" workers all the time. *See, e.g.*, GOLDIN & KATZ, *supra* note 70, at 94–96.

212. The recent USPTO report stresses that this connection is tenuous. U.S. PATENT & TRADEMARK OFFICE, *supra* note 1, at i ("[O]ur methodology does not permit us to attribute [differences in economic indicators such as employment, wages, and value added] to IP alone . . . .").

213. *See, e.g.*, BRYNJOLFSSON & MCAFEE, *supra* note 28, at 39–40.

214. I review the connection between innovation, patenting, and wages in Hrdy, *supra* note 40, at 1317–22; *see also* MORETTI, *supra* note 72, at 72–97 (observing that innovation hubs have a higher concentration of skilled workers and arguing that this leads to higher wages for the entire community).

Lastly and most compellingly, several studies purport to find employees in IP-intensive industries—in which companies own more intellectual property per size—have comparatively higher wages than workers in other industries.[215] To give just one example, the recent USPTO report, mentioned in the Introduction, found that wages in "IP-intensive" industries are forty-six percent higher than in other industries that are not classified as IP-intensive.[216]

These correlations between prevalence of intellectual property and wages are particularly interesting because they suggest that returns from intellectual property—which go principally to the companies that own the intellectual property, such as Alphabet—are shared with the people who actually generate that intellectual property, such as, say, engineers who work for Alphabet. In other words, intellectual property does not just increase returns for owners, but also increases wages for IP-generators in cases where ownership is divided between employer and employee. There are several mechanisms by which intellectual property might have this effect on wages. First, firms may "share" some of the rents from intellectual property with employees whose skills are necessary to obtain those rents.[217] Second, firms may pay IP-generating employees more in order to keep them from working for competitors and from sharing their secrets.[218] Third, employees may be able to more easily signal their abilities to the job market if they can obtain intellectual property.[219]

Again, there is no airtight proof that intellectual property rights, in specific, cause these higher wages. It could be that people who are IP-generators have more education and skill than other people and are in higher demand because they are scarcer. This Article merely suggests the

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215. *See* GREENHALGH & ROGERS, *supra* note 42, at 277 (discussing studies finding the innovation rents variable is "a significant determinant of higher wages," with as much as 20–30% of rents generated through innovation going to workers).

216. U.S. PATENT & TRADEMARK OFFICE, *supra* note 1 ("Private wage and salary workers in IP-intensive industries continue to earn significantly more than those in non-IP-intensive industries. In 2014, workers in IP-intensive industries earned an average weekly wage of $1,312, 46 percent higher than the $896 average weekly wages in non-IP-intensive industries in the private sector. This wage premium has largely grown over time from 22 percent in 1990 to 42 percent in 2010 and 46 percent in 2014.").

217. *See* GREENHALGH & ROGERS, *supra* note 42, at 277.

218. *See* Andrea Contigiani et al., *Trade Secrets and Innovation: Evidence from the "Inevitable Disclosure" Doctrine*, 39 STRAT. MGMT. J. 2921, 2925 (2018); Jonathan M. Barnett & Ted Sichelman, *Revisiting Labor Mobility in Innovation Markets* 30 (Univ. of S. Cal. Law Sch., Working Paper No. 207, 2016), https://core.ac.uk/download/pdf/76907918.pdf [https://perma.cc/TQE2-LGDL].

219. For instance, it is theorized that inventors of high-quality patents can obtain higher wages when they are able to signal their skills to other firms. *See* Contigiani et al., *supra* note 218, at 2925–26 n.6 (assuming that "high-skill inventors" with the ability to produce "high-quality patents" receive a wage premium).

possibility that one reason these people are paid so well is that they are capable of generating intellectual property that will give their employers a legal right to exclude others.

4. The Case of Self-Driving Cars

Leaving aside aggregate data, the most compelling evidence for the impact of intellectual property on technological un/employment may be a contemporary case study: self-driving cars.[220] Corporations are pouring billions of dollars into self-driving car research, and the U.S. government is contemplating following suit.[221] Start-ups can raise millions to develop self-driving vehicle technology.[222] Salaries for experts in this field, such as roboticists and engineers, are startlingly high.[223]

Why is there so much money pouring into self-driving cars? The fundamental reason is presumably that self-driving cars can bring tremendous value to businesses, which can use them to reduce costs and improve speed, safety, and accuracy.[224] Companies cannot develop the product or compete with others in the industry unless they have top talent,

220. *See generally* Samuel D. Adkisson, *System-Level Standards: Driverless Cars and the Future of Regulatory Design*, 40 U. HAW. L. REV. 1, 3–5 (2018) (discussing the future of self-driving cars).

221. *See* Bill Vlasic, *U.S. Proposes Spending $4 Billion on Self-Driving Cars*, N.Y. TIMES (Jan. 14, 2016), https://www.nytimes.com/2016/01/15/business/us-proposes-spending-4-billion-on-self-driving-cars.html [https://perma.cc/KF8T-EMXG]; *Toyota Spending $1B on Self-Driving Car Research*, REUTERS (Nov. 6, 2015), https://www.cnbc.com/2015/11/06/toyota-spending-1b-on-self-driving-car-research.html [https://perma.cc/2BHD-PZHA].

222. *See* Max Chafkin & Josh Eidelson, *These Truckers Work Alongside the Coders Trying to Eliminate Their Jobs*, BLOOMBERG BUSINESSWEEK (June 22, 2017), https://www.bloomberg.com/news/features/2017-06-22/these-truckers-work-alongside-the-coders-trying-to-eliminate-their-jobs [https://perma.cc/2Q2A-SY4S]; Liza Lin, *Daimler Gets a Foothold in China's Self-Driving Car Market*, WALL ST. J. (July 24, 2017), https://www.wsj.com/articles/daimler-invests-in-beijing-based-self-driving-startup-momenta-1500930180 [https://perma.cc/C94N-C3TP].

223. *See* Johana Buiyan, *Ex-Googler Sebastian Thrun says the Going Rate for Self-Driving Talent is $10 Million per Person*, RECODE (Sept. 17, 2016, 11:30 AM), https://www.recode.net/2016/9/17/12943214/sebastian-thrun-self-driving-talent-pool [https://perma.cc/N62K-6R97]; Cade Metz, *Tech Giants are Paying Huge Salaries for Scarce A.I. Talent*, N.Y. TIMES (Oct. 22, 2017), https://www.nytimes.com/2017/10/22/technology/artificial-intelligence-experts-salaries.html [https://perma.cc/996E-QGJ2].

224. *See, e.g.*, Rogers, *supra* note 22, at 100–01 (discussing the temptation for Uber to switch to autonomous vehicles); Laura Stevens & Tim Higgins, *Amazon Forms Team to Focus on Driverless Technology*, WALL ST. J. (Apr. 24, 2017, 8:03 AM), https://www.wsj.com/articles/amazon-team-focuses-on-exploiting-driverless-technology-1493035203 [https://perma.cc/CW2G-XQGP] (discussing ways Amazon may incorporate self-driving cars into its package delivery in order to cut costs and improve delivery service).

so they lure workers with the prospect of huge salaries.[225] But another reason could be the expectation that, at the end of the road, these workers will generate valuable intellectual property, including trade secrets as well as patents, that can be used to exclude competitors or licensed to others for high fees.[226] The ability to generate intellectual property is obviously not the only reason companies are investing in self-driving cars or in IP-generating workers.[227] But absent the chance for exclusive rights, self-driving cars might not be quite such a profitable industry, and these people might not be quite so well paid.

Meanwhile, the very same intellectual property that allows IP owners to achieve higher profits, and thus IP-generators to achieve higher wages, simultaneously threatens the jobs and earning power of truck drivers and other people who drive for a living—non-IP generators.[228] Even now, the wage differential is striking. While base pay for engineers in the self-driving vehicle field is well over $200,000 per year, truck drivers' median pay is around $40,000 per year and will presumably fall as use of autonomous trucks is increasingly adopted.[229]

This difference might not be problematic if the numbers were different—if there were more jobs available for people to be engineers working on autonomous vehicles than there were for people to be truck drivers. But at least currently, companies developing autonomous vehicles hire comparatively few human workers in relation to the companies' net worth.[230] The American Trucking Association reports that "there are approximately 3.5 million professional truck drivers in the

225. For instance, Anthony Levandowski sold Otto to Uber for $700 million. Robotocists from Carnegie Mellon came on board, lured away from academia with huge salaries. *See* Johana Bhuiyan, *Inside Uber's Self-Driving Car Mess*, RECODE (Mar. 24, 2017, 4:35 PM), http://www.recode.net/2017/3/24/14737438/uber-self-driving-turmoil-otto-travis-kalanick-civil-war [https://perma.cc/FM4X-SD94].

226. *See* Waymo LLC v. Uber Techs., Inc., No. C 17-00939 WHA, 2017 WL 2123560, at *1–2, *7 (N.D. Cal. May 15, 2017) (bringing claims against Uber for theft of trade secrets under state and federal law); *cf.* John R. Allison et al., *Valuable Patents*, 92 GEO. L.J. 435, 439 (2004) (noting that the decision to litigate patents may be representative of their perceived value).

227. *See supra* Part I.C.1 (discussing the fundamentals affecting the decision to automate); *supra* Part I.C.5 (discussing the skills gap).

228. *See* Chafkin & Eidelson, *supra* note 222.

229. *Id.*; *see also* Alan Ohnsman, *Autonomous Car Race Creates $400k Engineering Jobs for Top Silicon Valley Talent*, FORBES (Mar. 27, 2017, 12:33 PM), http://www.forbes.com/sites/alanohnsman/2017/03/27/autonomous-car-race-creates-400k-engineering-jobs-for-top-silicon-valley-talent/#5fe9355814a3 [https://perma.cc/ACP5-5D3W] (discussing salaries of self-driving car engineers).

230. *See* WEST, *supra* note 34, at 6 ("Many of the large tech firms have achieved broad economic scale without a large number of employees."); *see also* Chafkin & Eidelson, *supra* note 222 ("[Otto] had fewer than 100 employees when Uber Technologies Inc. acquired it for $700 million.").

United States."[231] Even if the United States could successfully retrain former drivers to be engineers, there would not be enough jobs to go around.[232]

III. THE CASE FOR A PRO-EMPLOYMENT INNOVATION POLICY

Part II argued that intellectual property facilitates and accelerates the pace of technological un/employment and exacerbates inequality between developers of labor-displacing innovations and others who are displaced by them. If accurate, this thesis complicates the conventional view that intellectual property rights "create jobs."[233] It is more accurate to say that intellectual property rights spur innovation, and that this innovation both creates and destroys jobs.

This raises a normative issue. Should the government adopt policies to alleviate unemployment and inequality brought about by technological change? For instance, should the government do anything about the truck drivers who lose their jobs when self-driving cars become the norm?

Some might say "do nothing." Innovation increases productivity, provides consumers a better lifestyle, and is good for the economy in the long run.[234] The fact that innovation has negative as well as positive effects on society is the price of progress. However, that response is unlikely to satisfy the many commentators mentioned in Part I who believe technological change is having an increasingly negative impact on the quality and distribution of work.[235] Moreover, as revealed in Part II, government-granted intellectual property rights actually exacerbate these problems by increasing the returns from innovation. It is therefore conceivable that in the near future, some legislators will seek to use intellectual property as a policy tool to address concerns surrounding technological un/employment. As this Part shows, the main way the

231. *Truck Drivers in the USA*, ALLTRUCKING.COM, http://www.alltrucking.com/faq/truck-drivers-in-the-usa/ [https://perma.cc/LL8D-V49H]. The total number of people employed in the industry, including those in positions that do not entail driving, "exceeds 8.7 million." *Id.*; *see also* Ben Leubsdorf, *Self-Driving Cars Could Transform Jobs Held by 1 in 9 U.S. Workers*, WALL ST. J. (Aug. 14, 2017, 10:18 AM), https://blogs.wsj.com/economics/2017/08/14/self-driving-cars-could-transform-jobs-held-by-1-in-9-u-s-workers/ [https://perma.cc/3Z4K-LGAE] (noting Commerce Department economists predict the approximately 3.8 million people who drive taxis, trucks, and other vehicles for a living may either be displaced or see their wages fall drastically).

232. *See supra* Part I.C.5.

233. *See* Leahy, *supra* note 12.

234. *See, e.g.*, JOSH LERNER, THE ARCHITECTURE OF INNOVATION: THE ECONOMICS OF CREATIVE ORGANIZATIONS 16 (2012) ("Innumerable studies have documented the strong connection between new discoveries and economic prosperity across nations and over time.").

235. *See, e.g.*, Estlund, *supra* note 22, at 309–12 (concluding that employment law should intervene to alleviate the plight of workers in a world of increasing automation); *see also* discussion *supra* Part I.C (discussing these commentators and their perspectives).

government could do so is by using the intellectual property regime, likely in combination with the tax system, to reduce the amount of labor-displacing innovations in the economy and mitigate the impacts of those innovations on workers.[236]

Anticipating this development, this Part assesses the main policy mechanisms by which the government could, if it chooses, intervene to alleviate the effects of technological un/employment.

But first, this Article must address certain threshold objections.

A. *Threshold Objections*

1. The "Productivity is Everything" Objection

The first objection—the "productivity is everything" objection—is that any policy with the goal of increasing, rather than reducing, the amount of human labor required to complete a task must by definition make companies and individuals less productive, and therefore retard economic growth.[237] As Professor Daniel Hemel puts this argument,

> the ratio of economic outputs (in dollars) to human labor inputs (in hours) is the very definition of labor productivity. And gross domestic product is simply hours worked times labor productivity. . . . If we want GDP growth, then we either have to work longer hours (which doesn't sound fun) or raise labor productivity.
>
> . . . .
>
> . . . [S]o if a "robot" is simply an innovation that reduces the ratio of human labor inputs to economic outputs significantly, then what we need is robots galore.[238]

In other words, argues Professor Hemel, the government should not be using policy to reduce the amount of labor-saving innovation in the economy, but to increase it. Doing the opposite—say, taxing businesses that employ robots—would be grave error. Not only would it become generally more difficult to start a business,[239] but companies, and innovators, would be forced to direct resources towards solutions that are

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236. *See infra* Part III.C.3.a.

237. *See* Daniel Hemel, *Should Robots Be Subsidized? Probably*, MEDIUM (Aug. 17, 2017), https://medium.com/whatever-source-derived/should-robots-be-subsidized-18909e1fdb64 [https://perma.cc/YT43-NZG4].

238. *Id.* ("As Paul Krugman puts it: 'Productivity isn't everything, but in the long run it is almost everything.'").

239. Professor Cooter, for instance, argues that one reason for the comparative poverty of certain nations is that the state places a "heavy regulatory burden" on entrepreneurs seeking to create new companies and therefore hinders economic growth. Robert Cooter, *Innovation, Information, and the Poverty of Nations*, 33 FLA. ST. U. L. REV. 373, 387–88 (2005).

less efficient, costing more per unit of output. For example, businesses might use humans instead of robots even when robots are far cheaper or better suited to the task. Research firms might invest in comparatively inefficient technological solutions like multi-human-driven motor vehicles in order to obtain some government subsidy or avoid running afoul of some new tax or regulation.

And this is not all. Professor Bessen, whose work was discussed in Part I.B, might add that if government guides investment away from labor-saving solutions, then workers would no longer have incentives to educate themselves appropriately for the technologies of the future.[240] Secure in the sense that the government will not let them be automated out of work, workers might not work as hard to train themselves and become more productive. Why bother training for a future job maintaining or interfacing with robots when you can just keep driving for a living?[241] In short, markets would no longer deliver accurate signals to people about what occupations to train for.[242]

This might not be so terrible if the government actually succeeds in halting automation in its tracks. Businesses in the jurisdiction would be less efficient, but so would everyone else. Yet, economic growth is not determined in a vacuum. Assuming significant levels of global competition are permitted—a certainty in today's world of increasing globalization[243]—any nation that adopts policies to discourage labor-displacing innovations, like self-driving cars, would face competition from neighbors that *do not* invoke such a policy. That country would fall behind others and see its economy falter in comparison.[244]

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240. *See* BESSEN, *supra* note 24, at 102–04 (discussing importance and difficulty of learning skills needed to operate labor-reducing innovations such as power looms).

241. *See* Daniela Hernandez, *Seven Jobs Robots Will Create—or Expand*, WALL ST. J. (Apr. 29, 2018, 10:07 PM), http://www.wsj.com/articles/seven-jobs-robots-will-createor-expand-1525054021 [http://perma.cc/VH3T-SFG2].

242. *See* Weaver, *supra* note 155 (arguing that, when it comes to predicting which skills will be needed in the economy, "there is no substitute for coordination between the supply side of the labor market (workers and their skill investments) and the demand side (employers and their skill requirements)").

243. SUZANNE BERGER & MIT INDUS. PERFORMANCE CTR., HOW WE COMPETE: WHAT COMPANIES AROUND THE WORLD ARE DOING TO MAKE IT IN TODAY'S GLOBAL ECONOMY 9 (2005) (defining "globalization" as "changes in the international economy and in domestic economies" in the direction of a "single global market," in which wages, prices, and interest rates are the same around the world).

244. A historic analogy is France's agenda to create jobs in the 1970s, including subsidizing industries "most likely to hire large numbers of workers"—all of which left France unable "to adapt to a world of rapid technological change and intense global competition." MARC LEVINSON, AN EXTRAORDINARY TIME: THE END OF THE POSTWAR BOOM AND THE RETURN OF THE ORDINARY ECONOMY 204 (2016); *see also* Liz Alderman, *French Companies Have Newfound Freedom . . . to Fire*, N.Y. TIMES (Jan. 23, 2018), https://www.nytimes.com/2018/01/23/

2. The Hayekian Objection

The second objection—the "Hayekian objection"—is that even if reducing or slowing the pace of labor-displacing innovation were desirable, the government lacks the capacity to do so.[245] As Professor Amy Kapczynski has observed, intellectual property scholarship is deeply influenced by the Hayekian view that, all else being equal, free markets should be preferred over the government for allocating resources because the government lacks knowledge of what types of goods are needed and how much of them to supply.[246] If the government were to begin dictating which types of innovations to pursue—telling businesses to invest in human-operated machines, for instance—this would amount to precisely the sort of "industrial policy"[247] that governments seek to avoid by adopting technology-neutral intellectual property systems in lieu of direct government financing for innovation.[248] On this view, if the government were to restructure innovation policy to alleviate the effects of technological un/employment, this would reverse a major benefit of using intellectual property in the first place by exposing the incentive system to government influence.

B. *Justifications for Intervention*

Given these concerns, we might think no country should or would adopt a policy that seeks to reduce, rather than to increase, the amount of labor-displacing innovations in the marketplace. Yet there are several

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business/france-labor-jobs.html [https://perma.cc/6S8Q-GLPF] (discussing recent regulatory changes in France making it easier to hire and fire workers in France in order to revive growth).

245. Friedrich Hayek was an Austrian economist famous for objecting to John Maynard Keynes' view that government should subsidize demand in order to stimulate spending and employment. *See, e.g.*, F.A. Hayek, *The Use of Knowledge in Society*, 35 AM. ECON. REV. 519, 519, 524, 530 (1945) (arguing a "single mind" cannot produce a solution to economic problems the same way interactions between all people in the market can); *see also* NICHOLAS WAPSHOTT, KEYNES HAYEK: THE CLASH THAT DEFINED MODERN ECONOMICS 43–44 (2011) (discussing the fundamental differences in Hayek and Keynes beliefs).

246. Amy Kapczynski, *Intellectual Property's Leviathan*, 77 LAW & CONTEMP. PROBS. 131, 134 (2014) ("[T]he conventional theory [of IP law] . . . implicitly invokes a Hayekian hypothesis about information asymmetries.").

247. *See, e.g.*, Cooter, *supra* note 239, at 378–79 (arguing that government "manipulations" of the market in the form of taxes, subsidies, and regulations amount to "industrial policy" or "technology policy," in which government unwisely seeks to guide market decisions).

248. *See* Hrdy, *supra* note 40, at 1303–04; *see also* Kapczynski, *supra* note 246 (discussing the government creates intellectual property rights and is "incapable of effectively engaging more directly in the organization of information production"); Daniel Hemel & Lisa Ouellette, *Beyond the Patents–Prizes Debate*, 92 TEX. L. REV. 303, 327 (2013) (discussing the distinction between "market-set" and "government-set" innovation incentives).

justifications for intervention. These justifications may give pause to even the fiercest skeptics of government intervention in markets.[249]

1. Correcting Externalities

The first justification is that labor-displacing innovations generate negative externalities. A negative externality is a cost conveyed to others that is not represented in a market transaction.[250] Pollution is a classic example. Imagine a factory that emits pollution into the environment when it manufactures its products. The true costs of the factory's activity—to the earth or to people who live close to the factory—are "external" to the market in the sense that they are not taken into account in the factory's decision to engage in the polluting activity.[251] Taxation is often posited as a way to force companies to "internalize" these negative externalities.[252] The factory in this example would likely pollute less if it were subject to a pollution tax.

Some commentators have asserted that technologies that permit automation, such as factory robots, impose negative externalities on others—not unlike pollution. As two well-known economists put the argument, "automating tasks reduces employment . . . and this has a first-order effect on workers . . . . [I]innovators do not internalize this externality."[253]

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249. *Cf.* Miranda Perry Fleischer & Daniel Hemel, *Atlas Nods: The Libertarian Case for a Basic Income*, 2017 WIS. L. REV. 1189, 1189 (defending a "universal basic income" against objections from libertarians); *see also* N. GREGORY MANKIW, PRINCIPLES OF MICROECONOMICS 11–13 (6th ed. 2012) (discussing common "market failures" that might warrant government intervention in markets).

250. *See* Robert Cooter & Ariel Porat, *Liability Externalities and Mandatory Choices: Should Doctors Pay Less?*, 1 J. TORT L. 1, 7 (2006); Brett M. Frischmann & Mark A. Lemley, *Spillovers*, 107 COLUM. L. REV. 257, 262 (2007) ("[P]ositive (or negative) externalities are benefits (costs) realized by one person as a result of another person's activity without payment (compensation). Externalities generally are not fully factored into a person's decision to engage in the activity."); *see also* MANKIW, *supra* note 249, at 12 ("[A]n externality . . . is the impact of one person's actions on the well-being of a bystander.").

251. Frischmann & Lemley, *supra* note 250, at 300.

252. *E.g.*, Cooter & Porat, *supra* note 250, at 1, 24; Fleischer & Hemel, *supra* note 249, at 1232.

253. Daron Acemoglu & Pascual Restrepo, *The Race Between Machine and Man: Implications of Technology for Growth, Factor Shares and Employment* 30 (NBER, Working Paper No. 22,252, 2016), http://cdi.mecon.gov.ar/bases/doc/nber/w22252.pdf [https://perma.cc/YGJ4-XNQY]. For other examples, see Loren Nerhus, *Automation and the Labor Force*, 16 MAJOR THEMES ECON. 65, 66 (2014) ("Even though everyone in society benefits from improvements in technology, it does create negative externalities for some segments in the short run."); Ernest Chi-Hin Ng, *Taxing the Robots and Other Externalities*, BUDDHISTDOOR GLOBAL (Mar. 17, 2017), https://www.buddhistdoor.net/features/taxing-the-robots-and-other-externalities [https://perma.cc/4S64-HJMR] ("[T]echnology is creating new jobs but it is also destroying some old ones even faster. . . . In economics, negative consequences not directly

This assertion at first appears counterintuitive. After all, innovation is the opposite of pollution, generating positive rather than negative externalities in the form of new ideas that benefit others. According to the theoretical framework associated with Harold Demsetz, the primary purpose of patent and copyright laws is to permit companies to internalize the benefits of their creations in order to encourage them to innovate, notwithstanding the fact that others will benefit from their ideas.[254] Yet, as Demsetz himself observed, these very same ideas can also create negative externalities for those whose livelihoods are tied up in ideas that are now obsolete.[255] Technological un/employment is merely a species of this general problem. New inventions that permit increased automation may destroy the jobs of human workers who were previously needed to perform those tasks.

Importantly, the company generating the externality here is not typically the employer that chooses to adopt a new machine in lieu of workers in order to reduce its costs—for instance, the lettuce farmer who decides to use a machine to harvest crops instead of humans in order to avoid paying their wages.[256] A true externality, like pollution, is a negative effect on bystanders "who are not participating in the relevant market and thus have not transacted with the provider of the benefits or costs."[257] In this case, the lettuce farmer imposes no externalities on others who are not already taken into account in the transaction. The workers the farmer lets go *do* participate in the transaction to the extent they control the wages they demand for their labor. At least theoretically, they can demand lower wages in order to avoid being displaced by the machine, assuming the transaction costs involved in negotiating this outcome are not too high.[258]

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accounted for in a transaction, but borne by other third parties (society, future generations, the ecology, and so forth), are known as negative externalities.").

254. *See* Harold Demsetz, *Toward a Theory of Property Rights*, 57 AM. ECON. REV. 347, 359 (1967) ("If we extend some degree of private rights to the originators, these ideas will come forth at a more rapid pace."); *see also* Mark Lemley, *Property, Intellectual Property, and Free Riding*, 83 TEX. L. REV. 1031, 1031 (2005) (discussing how externalities in intellectual property are positive not negative).

255. Demsetz, *supra* note 254 ("[T]he existence of the private rights [for the originators of ideas] does not mean that their effects on the property of others will be directly taken into account. A new idea makes an old one obsolete and another old one more valuable.").

256. William M. Blair, *Farms Reaping a Harvest with Automation*, N.Y. TIMES (Apr. 10, 1964), https://www.nytimes.com/1964/04/10/farms-reaping-a-harvest-with-automation.html [https://perma.cc/G5PK-Y5DA].

257. *See* Frischmann & Lemley, *supra* note 250.

258. R. H. Coase, *The Problem of Social Cost*, 3 J.L. & ECON. 1, 15 (1960); *see also* MANKIW, *supra* note 249, at 210–12 (illustrating this concept).

This is sometimes referred to as a "pecuniary externality" versus a "technological externality."[259] A technological externality, such as pollution imposed on the inanimate environment, occurs outside the market; a pecuniary externality is a wealth transfer between private parties that occurs *within* the market.[260] As Professors Brett Frischmann and Mark Lemley explain, "economists don't much care about pecuniary externalities, reasoning that wealth transfers 'within' the market—that is, externalities mediated by the price mechanism—result in offsetting private costs and benefits."[261]

But there are arguably more than pecuniary externalities at work in the process of technological un/employment. There are technological externalities as well.[262] The pollution-spewing factory in this scenario is not the employer who merely adopts new machinery to save on costs. It is the innovator who develops the labor-displacing invention. The driving force behind this technological externality is the same as the driving force that motivates government to create intellectual property rights: the fact that the innovation can eventually be copied and used by other businesses across the economy.[263] Thanks in part to intellectual property rights, innovators can now be compensated through the sale and licensing of their inventions.[264] As discussed above in Part II.C, the owners of this intellectual property, such as Eli Whitney, NCR Corp., Google, and Uber, profit. But they do not internalize the full costs that those same inventions impose on workers across the economy—workers whose skills are now made obsolete by the advancement of technology.[265]

If it is true that labor-displacing innovations create negative externalities for workers, then policymakers might be justified in imposing measures to force innovators to internalize the externalities. The economists quoted above, for instance, theorize that "the social planner will need to impose a tax on automation . . . in order to combat the tendency of the decentralized equilibrium to automate

259. *See* Frischmann & Lemley, *supra* note 250, at 262–63.

260. *Id.*

261. *Id.* at 263.

262. *Id.* at 262 ("Technological externalities are direct benefits (or costs) realized by third parties—agents who are not participating in the relevant market and thus have not transacted with the provider of the benefits or costs.").

263. *Id.* at 272–73 ("Ideas can be freely copied by others in the absence of a legal rule restricting that copying without depriving their creators of the use of the ideas.").

264. *See id.* at 273 ("A patent licensee . . . is buying the right not to be sued for using the knowledge she did have, whether because she developed it independently or because she learned it from the inventor's use.").

265. Demsetz, *supra* note 254; *see also* BESSEN, *supra* note 24, at 19–20 (suggesting that technology generates market failures in education).

excessively."[266] The result of such a tax should be that innovators will generate fewer labor-displacing innovations in order to avoid incurring the tax. If they choose to innovate anyway, they would have to pay a tax that could go towards helping displaced workers or other social programs such as education. The precise policy levers available to government are discussed at length in Part III.C.[267]

2. Effectuating Redistribution

Some may be more moved by appeals to distributive justice than by discussion of externalities.[268] As discussed in Part I.C.4, the impact of innovation on employment is highly uneven across society, disproportionately harming some people and helping others.[269] It is perhaps not surprising, then, that several commentators, including famous company executives, have suggested turning to "Keynesian policies" of government spending supported by taxation in order to help those whose jobs are displaced by automation.[270] For instance, Tesla's CEO, Elon Musk, has stated his view that "[artificial intelligence] is the biggest risk that we face as a civilization," and speculated that policymakers should try to slow down development and potentially even give people a "universal basic income" (UBI) to help them get along without paid work.[271] The primary motivation behind these views is

266. Acemoglu & Restrepo, *supra* note 253; *see also* Ng, *supra* note 253 ("Some of these negative externalities can be addressed through taxation and/or surcharges."). Note that Acemoglu and Restrepo do not specify whether the tax would be imposed on businesses that adopt robots or the owners of the underlying intellectual property.

267. Another policy option would be to impose liability through the tort system. *See* Cooter & Porat, *supra* note 250 ("When markets fail, liability law often improves the situation by making injurers compensate victims.").

268. *See, e.g.*, Justin Hughes & Robert P. Merges, *Copyright and Distributive Justice*, 92 NOTRE DAME L. REV. 513, 518 (2016); *see also* MANKIW, *supra* note 249, at 13 (listing alleviating inequality as a potential basis for government intervention in the free market).

269. BRYNJOLFSSON & MCAFEE, *supra* note 28, at 39 ("Even when technological progress increases productivity and overall wealth, it can also affect the division of rewards, potentially making some people worse off than they were before the innovation.").

270. *See, e.g.*, Jonathan Taplin, *Can the Tech Giants Be Stopped?*, WALL ST. J. (July 14, 2017, 2:34 PM), https://www.wsj.com/articles/can-the-tech-giants-be-stopped-1500057243 [https://perma.cc/P6ER-JLBB].

271. *See, e.g.*, Catherine Clifford, *Elon Musk: Robots Will Take Your Jobs, Government Will Have to Pay Your Wage*, CNBC (Nov. 4, 2016, 2:19 PM) https://www.cnbc.com/2016/11/04/elon-musk-robots-will-take-your-jobs-government-will-have-to-pay-your-wage.html [https://perma.cc/87ZH-M6FK]; Tim Higgins, *Elon Musk Lays out Worst-Case Scenario for AI Threat*, WALL ST. J. (July 15, 2017, 5:32 PM), https://www.wsj.com/articles/elon-musk-warns-nations-governors-of-looming-ai-threat-calls-for-regulations-1500154345 [https://perma.cc/Z7WW-W5E7].

clearly a desire to correct the injustice of intense inequality—not a concern about correcting inefficient market externalities.[272]

Of course, not everyone will agree that inequality alone is a solid basis for adopting a policy that risks slowing down innovation and hindering overall productivity. Anti-state libertarians, in particular, may chafe at this idea.[273] That said, Professor Miranda Fleischer and Professor Hemel have argued that even libertarians might agree with some amount of redistribution.[274] One justification they give is that redistribution itself may be akin to a "public good"—a non-rival, non-excludable resource like a bridge or a road—that benefits many, yet is hard to exclude, and so will not be generated without some government action.[275] They observe that, along with inequality, pervasive poverty and unemployment among a large portion of the population can contribute to social ills, such as increased crime.[276] (Notably, utilizing automation in lieu of human employees may exacerbate this connection between unemployment and crime because fewer human employees typically means less security and fewer "eyes on the street."[277]) Therefore, when government adopts policies to limit the number of people who are unemployed and who turn to crime, this permits everyone to benefit from the luxury of being safe. When viewed in this light, redistribution is not the end in itself, but simply a means to achieving the end of a safer world for all.

In sum, whether it is conceptualized as a policy to alleviate inequality, or as a policy to alleviate the societal ills that accompany unemployment,

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272. Robert Reich, *What if the Government Gave Everyone a Paycheck?*, N.Y. TIMES: BOOK REV. (July 9, 2018), https://www.nytimes.com/2018/07/09/books/review/annie-lowrey-give-people-money-andrew-yang-war-on-normal-people.html [https://perma.cc/LU3V-WXGV] (reviewing ANNIE LOWREY, GIVE PEOPLE MONEY (2018) and ANDREW YANG, THE WAR ON NORMAL PEOPLE (2018)) ("A core challenge in the future will be how to redistribute money from the ever richer owners of the robots and related technologies to the rest of us, who are otherwise likely to become poorer and less secure.").

273. Fleischer & Hemel, *supra* note 249, at 1193 ("[L]ibertarianism is—or at least is generally thought to be—inhospitable to redistribution.").

274. *Id.* at 1194–95.

275. *Id.* at 1227.

276. *Id.* at 1224–25. There are various mechanisms through which unemployment may contribute to crime, though the precise relationship is a subject of debate. *See* Matthew D. Melick, *The Relationship Between Crime and Unemployment*, 11 PARK PLACE ECONOMIST 30, 30–31 (2003) (identifying "two major schools of thought regarding the unemployment-crime relationship," one focusing on the "supply of offenders," which may rise as employment opportunities decrease, the other focusing on the "supply of victims," which may actually fall since people have less to steal).

277. *See* Shannon Pettypiece & David Voreacos, *Walmart's Out-of-Control Crime Problem Is Driving Police Crazy*, BLOOMBERG BUSINESSWEEK (Aug. 17, 2016), https://www.bloomberg.com/features/2016-walmart-crime/ [https://perma.cc/7365-HRBX] (discussing increased crime around Walmart stores since the company began reducing the number of human employees).

government intervention in the face of increasing automation can theoretically be justified—despite the risk of a slight fall in productivity.

3. A Correction to State Intervention

A final justification for intervention is that intellectual property itself can be seen as a form of prior government interference in the free market—as simply another form of regulation.[278] On this view, intellectual property's negative impacts on some forms of employment are similar to other constraints imposed by the state that arguably lead companies to shed jobs, such as minimum wage laws that make labor more expensive for hiring firms or subsidies embedded into the tax code that induce firms to invest in automation rather than labor.[279]

When government-created intellectual property rights are revealed as a driver of technological un/employment, policies to alleviate negative effects of the phenomenon on the workforce can be seen simply as corrections to guide markets back to where they would be without the incentive effects of intellectual property.[280] For example, if government creates intellectual property, and intellectual property is one reason that millions of drivers lose their jobs upon adoption of self-driving cars, then perhaps government is justified in taking action to help those drivers.

Crucially, as explored further below, any policies to alleviate social ills produced by government action in creating intellectual property must be moderated to avoid undermining the reason government creates intellectual property in the first place.

C. *Crafting a Policy to Address Technological Un/employment*

If policymakers are swayed by one or more of these justifications, they will need to carefully consider how best to regulate technological un/employment. This Part identifies five threshold determinations that must be considered in crafting a policy and assesses the various policy

278. *See* Mark Lemley, *The Regulatory Turn in IP*, 36 HARV. J.L. & PUB. POL'Y 109, 115 (2013) (suggesting that intellectual property law has come more and more to resemble government-directed regulation); *cf.* Mossoff, *supra* note 165, at 1009 ("[N]atural rights philosophy played an important role, albeit hardly single-handedly, in defining and protecting patents as privileges in the early American republic.").

279. *Cf.* Hemel & Fleischer, *supra* note 249, at 1213 ("Some individuals might be unable to access the labor market *due to constraints imposed by the state*, such as the minimum wage or licensing laws." (emphasis added)). *See also* Abbott & Bogenschneider, *supra* note 22, at 150 (explaining various ways that the tax system "encourages automation by providing employers with preferential tax treatment for robot workers. . . . Tax policies may thus result in automation in some cases in which a firm would other- wise choose a human worker").

280. *But see* Hemel & Fleischer, *supra* note 249, at 1213 ("[T]he fact that the state itself stands in the way of full employment would likely not convince a minimal-state libertarian to expand the state further by taxing for redistributive purposes.").

options. Ultimately, this Article favors more moderate policy measures in lieu of blunt tools like bans.

1. Whether a Given Innovation Warrants Regulation

The threshold issue for regulators is how to identify an innovation that warrants regulation. Part I.A defined labor-displacing innovations as a subset of labor-saving innovations: innovations that eliminate or significantly reduce the labor required to complete a task that would otherwise be performed by paid human workers. Sometimes it is easy to identify labor-displacing innovations because the inventors advertise them that way. Oracle's "Self-Driving" Database, for instance, can easily be classified as a labor-displacing innovation, given that it is advertised as being designed to eliminate human labor.[281]

But most innovations would presumably have less obvious impacts on the workforce. Indeed, inventions can have a multitude of possible uses, only some of which may have negative impacts on employment. For example, Kraft Food's patented method for making Swiss cheese (the "Stine process") had a long list of benefits, mostly related to the shape and size of the cheese produced by the process.[282] But it also happened to fit more easily into "labor-saving trucks," permitting a reduction in labor costs.[283] It would have been difficult to predict this impact *ex ante*.

Regulators, and courts in individual cases, may be able to make these types of determinations, so long as they have sufficient data and a clear legal standard. Intellectual property doctrine provides a framework for classifying the impacts of "dual use" technologies. For example, the Supreme Court has considered the impact, for purposes of copyright infringement, of a video recording device that both permits unauthorized copying of copyrighted content (a bad thing, because it depletes creators' incentives to make content), and generates benefits like recording for purposes of "time-shifting" (a good thing, because now people can record content to view later). In these cases, the Supreme Court has directed courts to consider whether the technology is "capable of substantial noninfringing uses."[284]

In this context, regulators can ask whether an innovation that has some labor-displacing uses—such as an automated surgical tool with greater

281. *See supra* Part I.A.

282. Kraft Foods Co. v. Walther Dairy Prods., 118 F. Supp. 1, 20 (W.D. Wis. 1954), *aff'd*, 234 F.2d 279 (7th Cir. 1956).

283. *Id.* (noting that one benefit of the Stine process was that "[l]abor saving devices such as lift trucks [could] be used for handling the cheese made by the Stine process, which are not feasible with the large wheel Swiss").

284. Dotan Oliar, *The Copyright-Innovation Tradeoff: Property Rules, Liability Rules, and Intentional Infliction of Harm*, 64 STAN. L. REV. 951, 958 (2012) (quoting Sony Corp. of Am. v. Universal Studios Inc., 464 U.S. 417, 442 (1984)).

precision than a human surgeon could ever achieve—is also "capable of substantial non-labor-displacing uses" that outweigh adverse impacts on some peoples' jobs—such as saving lives that would otherwise be lost in surgery. At the least, this type of legal standard could serve as a starting point for making the difficult decision of whether to regulate.

2. Whether to Target the Point-of-Invention or the Point-of-Adoption

The second question to consider is when to regulate within the innovation lifecycle. As described by Professor Brett Frischmann, there are two temporal targets for innovation policy.[285] A policy can target *ex ante* investment decisions, which are made when inventors "decide how to allocate resources among prospective inventive prospects," or *ex post* investment decisions, which are made after the results of the invention have been developed.[286] Intellectual property rights, research grants, and R&D tax incentives, all target the *ex ante* decision point—whether and what to invent.[287] But many taxes and regulations target the *ex post* decision—whether and how to adopt an invention once it has been invented.[288]

In this context, government would have to decide whether to use policy to affect inventors' incentives or adopters' incentives. In some situations, this might mean regulating totally different entities. Inventors of improvements in automation are likely to be research firms, universities, or independent inventors, while adopters can be anything from large financial firms to pharmacy chains to mom-and-pop restaurants.[289] In other cases, the decision-maker may be the same entity. For instance, Uber is both an inventor of self-driving car improvements and has plans to adopt it in the Uber ride-sharing business.

In some ways, the distinction is very important. Regulating at the point of invention would presumably make it less likely that companies would invent labor-displacing innovations in the first place. In contrast, regulating at the point of adoption would permit invention, but it would put strings on whether those inventions can be adopted in the marketplace.

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285. *See* Brett Frischmann, *Innovation and Institutions: Rethinking the Economics of U.S. Science and Technology Policy*, 24 VT. L. REV. 347, 356–57 (2000).

286. *Id.* at 356.

287. *Id.* at 356–57.

288. *Id.* at 356.

289. In these situations, adopters would have to purchase particular embodiments of labor-displacing technologies through distributors, or they be asked to obtain a license to the underlying intellectual property. Either way, IP owners would be profiting due to possession of an exclusive right. *See* Robert Merges, *A Transactional View of Property Rights*, 20 BERKELEY TECH. L.J. 1477, 1500 (2005) (viewing a key function of patents as facilitating disclosure and transfer of information related to innovations from creators to the most effective developers).

However, the distinction may not make much difference. Most regulations would presumably end up affecting both decisions to invent and decisions to adopt. For example, banning drones that can deliver packages would deter their adoption in the marketplace, but it would also affect decisions to invent in this field.[290] Likewise, taxing patents on drones that can deliver packages would affect both the decision to invent such technology, and the decision of whether to adopt it, since the tax would likely be passed on to businesses to some degree. Because of the feedback loop between decisions to invent and decisions to adopt, whether government regulates at the point of invention or at the point of adoption should not strictly matter when it comes to affecting incentives.

There is, however, a very practical reason why the distinction does matter. As discussed above, deciding which innovations are "labor-displacing" is already a difficult task even with good information. The earlier the government attempts to interfere in a technology's lifecycle, the more difficult this classification will become. When regulating at the point-of-adoption rather than the point-of-invention, government should have a better idea about whether a labor-displacing device will lead to significant firing of workers. This weighs in favor of regulating after an invention has been put into use.

3. Which Type of Regulatory Mechanism to Use

This Part addresses the question of precisely which mechanism to use. There are a multitude of regulatory mechanisms available for alleviating technological un/employment.[291]

a. Bans

The simplest option is to adopt a total ban on a certain labor-displacing technologies.[292] Some polities might try this option in the coming

290. The market for the technology would exert a "pull" on the direction of invention. *Cf.* Peter Lee, *Interface: The Push and Pull of Patents*, 77 FORDHAM L. REV. 2225, 2226 (2009).

291. In general, government can use a "stick"—a negative incentive to deter people from acting in a certain way—or a "carrot"—a positive incentive to encourage people to act in a certain way. This Article mainly discusses sticks. *See* Ian Ayres & Amy Kapczynski, *Innovation Sticks: The Limited Case for Penalizing Failures to Innovate*, 82 U. CHI. L. REV. 1781, 1783 (2015).

292. A ban could be promulgated at the federal level by an agency within the Department of Labor (DOL), U.S. DEP'T LABOR, https://www.dol.gov [https://perma.cc/7JJQ-EYNW], or an agency within the Department of Transportation (DOT), such as the National Highway Traffic Safety Administration (NHTSA), which regulates vehicle design and manufacturing in order to improve motor vehicle safety. NAT'L HIGHWAY TRAFFIC ADMIN., https://www.nhtsa.gov [https://perma.cc/NB76-7QP8]. *But see* Adkisson, *supra* note 220, at 12–18 (noting that under its current statutory authority, NHTSA standards must, among other things, "meet the need for motor vehicle safety" and not be technologically or economically unfeasible).

years.[293] The effect of a ban is what it sounds like: no more of the banned technology within the jurisdiction. Advantages of a ban include that it is comparatively easy to administer and, on the surface, cheap. Government pays nothing directly, other than the cost of enforcement. Private actors also pay nothing directly—though their bottom line may suffer.[294]

Bans are highly vulnerable to the Hayekian objection.[295] With a regulatory ban, the government's lack of knowledge is front and center because the government must know at the outset which particular innovations to ban.[296] Bans are also vulnerable to the "productivity is everything" objection.[297] Because a ban halts the prohibited technology in its tracks, it is likely to negatively impact businesses' productivity and put the jurisdiction at an economic disadvantage.[298] In other words, the concerns highlighted in Part III.A are in full force. Bans are accordingly unlikely to be a wise policy.

b. Intellectual Property Law

Intellectual property law itself provides another avenue for effectuating some of the same goals as a ban. If intellectual property increases incentives to generate and commercialize labor-displacing innovations, then, by the same token, denying intellectual property for labor-displacing innovations would reduce those incentives.

The most feasible way to institute this mechanism is through the patent system, the only intellectual property regime in which prior application is required to receive protection.[299] Like Queen Elizabeth, the government, through the USPTO, could begin to deny patents for technologies that promise to eliminate significant numbers of jobs. For example, if NCR Corp. applies for a patent for a labor-saving consolidated checkout system, whose express goal is to reduce

293. For example, India's transportation minister, Nitin Gadkari, recently floated the idea of banning driverless cars in the country, stating, "We will not allow driverless cars in India. We don't need it . . . . Each car gives a job to a driver. Driverless cars will take away those jobs . . . ." *See* Rishi Iyengar, *India's Transport Chief: Driverless Cars Will Kill Transport Jobs*, CNN (July 25, 2017, 11:47 AM), http://money.cnn.com/2017/07/25/technology/india-driverless-cars-jobs/index.html [https://perma.cc/9QN6-H7KC].

294. *See* Ayres & Kapczynski, *supra* note 291, at 1786 ("[I]f a government has a choice between a threat or a payment to induce innovation, ceteris paribus, the threat will be cheaper.").

295. *See supra* Part III.A.2; *see also, e.g.*, Cooter, *supra* note 239, at 378–79 (discussing various types of "technology policy").

296. *See supra* Part III.A.1.

297. *See supra* Part III.A.1.

298. *See supra* Part III.A.1; *see also* Hemel, *supra* note 237 (discussing the possibility of a robot subsidy instead of a robot tax in order to avoid unemployment and economic inequality).

299. *See* 35 U.S.C. § 101 (2012); *cf.* 15 U.S.C. § 1125(a) (2012) (providing protection for unregistered trademarks).

labor costs associated with the retail grocery or supermarket industry,[300] this would be denied.

While a "job saving patent bar"—barring patents for specific inventions—could achieve the desired effect of dampening incentives to generate labor-displacing inventions, the idea faces significant challenges. The first problem is simply that the patent office lacks legal authority to conduct these denials. The obvious legal means to accomplish this type of subject matter bar would be the utility requirement of Section 101 of the Patent Act.[301] However, as presently interpreted by the USPTO and the courts, the utility requirement does not scrutinize the moral or economic implications of inventions.[302] Thus, in order to overcome long-accepted doctrine and case law from the Federal Circuit,[303] a statutory amendment from Congress would almost certainly be required.

A more fundamental problem is the USPTO's limited informational capacity. Patent examiners would need to be able to accurately discern which inventions will threaten the workforce in the future. But the patent office has limited information about issues external to patent law.[304] To mitigate this problem, examiners might only be charged with flagging potential labor-displacing inventions. They could then require patentees themselves to submit an impact statement delineating how the invention is likely to impact the labor market. This would at least permit examiners to draw on private knowledge in making its decisions. Alternatively, the examiner could put the patent prosecution on hold and forward the application and impact statement to a separate agency within the Department of Commerce, such as the Small Business Administration (SBA). Either way, a subject matter bar would seem to require significant information that government is unlikely to possess so early in an invention's lifecycle.[305]

A distinct objection is that an intellectual property subject matter bar seems a highly roundabout way to affect incentives. As explained, denying an intellectual property right does not deny the right to use the technology. It just denies the exclusive right to do so. Government might be better off just banning problem technologies outright. On the other

300. U.S. Patent No. 6,522,772 B1 col. 1 l. 14–23.

301. 35 U.S.C. § 101 (2012).

302. Seymore, *supra* note 176, at 1047–48.

303. *Id.* at 1059.

304. *See* Robert Merges, *Intellectual Property in Higher Life Forms: The Patent System and Controversial Technologies*, 47 MD. L. REV. 1051, 1067–68 (1988) (noting that the patent system is not seen as the proper governmental institution in which to make speculative judgments regarding the "potential negative consequences" of new technology).

305. *See supra* Part III.C.3.

hand, regulators might prefer the fact that a labor-displacing patent bar would merely blunt incentives, not ban innovations outright. Denying intellectual property rights could represent a compromise option in comparison to a total ban. That said, if the government is trying to dampen incentives to adopt labor-displacing innovations, it would probably be better off using the tax system.[306] This is especially true if the government wishes to provide aide to displaced workers. Along with the informational problem mentioned above, a major downside to the intellectual property bar, as compared to a tax, is that it would not directly provide aide for workers.[307] Workers might be left with the worst of both worlds: Subject-matter bars would not actually prevent companies from automating, and they would not require any redistribution to workers.

In sum, even if patent bars are somewhat effectual in deterring automation, they would probably be unworkable in practice and represent only a partial solution for displaced workers.

c. Tax

Tax represents a natural alternative to the above options, and it is likely to be the preferred mechanism of regulation, especially if the primary goal is redistribution.[308] The taxation mechanism would work as follows: Government would impose a tax (a required payment of cash into the public fisc) on companies that decide to invent or adopt technologies that have an adverse impact on jobs. The tax could be imposed on two discrete groups: businesses that adopt labor-displacing innovations to automate work, or the owners of the underlying intellectual property on labor-displacing innovations.

d. Taxing Businesses That Automate

The most often discussed tax proposal along these lines is the so-called "robot tax."[309] In an interview, Bill Gates discussed two versions

306. *Cf.* Hemel & Ouellette, *supra* note 248, at 303 (noting that tax incentives have many of the same advantages as intellectual property rights as innovation incentives).

307. A ban on IP for labor-displacing innovations might lower prices for downstream consumers, who might also be workers. *Id.* at 371 ("[P]atent rights operate as shadow taxes that enable patentees to charge prices above marginal cost.").

308. *See* Louis Kaplow & Steven Shavell, *Why the Legal System Is Less Efficient than the Income Tax in Redistributing Income*, 23 J. LEGAL STUD. 667, 667 (1994) ("[R]edistribution through legal rules offers no advantage over redistribution through the income tax system and typically is less efficient.").

309. For critique of a robot tax from the "productivity is everything" perspective, see Hemel, *supra* note 237 ("The concern that motivates most of these robot tax proposals . . . is that robots will replace human labor as an input into the production process, leading to higher unemployment and economic inequality.").

of this tax.[310] The first version would tax business profits derived from adopting robots, or other types of labor-displacing innovations, in lieu of humans.[311] The second version would tax the robots' owners at the same rate the robots would have been taxed if they were human workers.[312] Gates explained this version of the robot tax idea as follows:

> Right now, the human worker who does, say, $50,000 worth of work in a factory, that income is taxed and [society] get[s] income tax, social security tax, all those things. If a robot comes in to do the same thing, you'd think that we'd tax the robot at a similar level.[313]

Professors Ryan Abbott and Bret Bogenschneider explain how the Gates robot tax might actually be effectuated within the current tax system. For example, one seemingly simple option is to disallow corporate income tax deductions for capital investments in things like robots or automation software that give rise to the tax benefits achieved by not having to pay human workers.[314]

A tax on businesses that adopt labor-displacing innovations has several features that make it a potentially attractive solution. First, unlike a ban, a tax does not stop companies from automating, but instead forces companies to internalize the costs of doing so. While a tax would, to some degree, discourage companies from replacing humans with technology, it would not totally halt companies' impulses to adopt productivity-enhancing innovations or interfere with market forces.[315] This helps respond to both the Hayekian objection and the "productivity is everything" objection, mentioned above.[316] Second, because a tax is imposed relatively late in a technology's lifecycle—at the point-of-adoption rather than the point-of-invention—this alleviates the challenge

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310. *See* Kevin J. Delaney, *The Robot that Takes Your Job Should Pay Taxes, Says Bill Gates*, QUARTZ (Feb. 17, 2017), https://qz.com/911968/bill-gates-the-robot-that-takes-your-job-should-pay-taxes/ [https://perma.cc/AU3V-4SPN].

311. "Certainly there will be taxes that relate to automation," Gates predicted. *Id.* "Some of it can come on the profits that are generated by the labor-saving efficiency there." *Id.*

312. *See id.*

313. *Id.*; *see also* Abbott & Bogenschneider, *supra* note 22, at 149.

314. Abbott & Bogenschneider, *supra* note 22, at 169; *see also id.* at 170–73 (discussing several distinct options).

315. *See* Frischmann, *supra* note 285, at 382 ("[T]ax incentives have the potential to improve market-based efficiency by providing indirect subsidies that align private firms' incentives in a socially desirable fashion."); *see also* Hemel & Ouellette, *supra* note 248, at 328 ("[T]ax incentives, like patents, rely on potential innovators—rather than government officials—to decide (1) which inventions are worth pursuing and (2) which R&D projects are most likely to yield the inventions in question. Like patents, tax incentives cause innovators to pursue inventions that will succeed in the market . . . .").

316. *Cf.* Hemel, *supra* note 237 (arguing for a robot subsidy, instead of a robot tax).

of predicting a technology's future impact on workers. Third, a tax would permit government to collect tax revenues that can be redistributed via the tax system to those who are harmed by labor-displacing innovation. This is quite significant if a primary reason for regulating is concern over unequal distribution of resources in the wake of technological innovation.

e. Taxing Intellectual Property Owners

One alternative is to tax the owners of intellectual property covering labor-displacing innovations. For example, Professor Robert Reich speculates a universal basic income (UBI) might be "financed out of the profits going to . . . labor replacing innovations, or perhaps even a revenue stream off of the underlying intellectual property."[317] One version of this is a "job displacing intellectual property tax." This would be similar to the job-displacing patent bar described above, except the penalty would be a tax on profits, not a denial of the patent. The amount of the tax would be proportionate to the profits made from sales or licenses of the underlying technology. For instance, if Google owned intellectual property covering its computer chips used in artificial intelligence systems (called TPU chips), and the government classified these chips as labor-displacing innovations, then Google would have to pay a small tax on those profits.[318] The assumed effect would be a marginal reduction in patenting of labor-displacing inventions, and a new stream of revenues from companies that choose to patent labor-displacing inventions anyway.[319]

The labor-displacing intellectual property tax has a few obvious advantages over the labor-displacing patent bar. First, the labor-displacing intellectual property tax would be implemented at the point-

317. Robert Reich, *Why We'll Need a Universal Basic Income*, ROBERT REICH (Sept. 29, 2016), http://robertreich.org/post/151111696805 [https://perma.cc/5NQK-KWYS]; *see also* Reich, *supra* note 272 (discussing the concept of UBI); ROBERT MERGES, JUSTIFYING INTELLECTUAL PROPERTY 132–33 (2011) (discussing limited taxation of IP owners as a way to force innovators who benefit from IP to give back to society).

318. *See* Cade Metz, *Google Makes Its Special A.I. Chips Available to Others*, N.Y. TIMES (Feb. 12, 2018), https://www.nytimes.com/2018/02/12/technology/google-artificial-intelligence-chips.html [https://perma.cc/6DGS-VNMM] (discussing Google's plan to allow other companies to buy access to its chips for use in A.I.); *see also* Reinhardt Krause, *In AI Technology Race, U.S. Chips May Be Ace-In-The-Hole Vs. China*, INV. BUS. DAILY (Nov. 27, 2017), https://www.investors.com/news/technology/ai-technology-u-s-chip-stocks-vs-china/ [https://perma.cc/8AEF-7TXZ] ("The race is on to build AI chips for data centers, self-driving cars, robotics, smartphones, drones and other devices. . . . Google's TensorFlow data-center software runs on its own 'TPU' chips.").

319. *See supra* Part II.C.1. One complication is that some inventors might choose secrecy, rather than patenting, to avoid incurring the tax. A way to prevent this type of distortion would be to tax income from licensing of intellectual property, including trade secrets, rather than patents themselves.

of-adoption rather than during the patent application stage. This would allow time to see whether the invention is actually adopted in the workforce and used to eliminate large numbers of workers, alleviating the administrative difficulty in point-of-invention regulation. Second, the main agency responsible would be the Internal Revenue Service (IRS), not the USPTO. This would assuage some of the concerns discussed above about the USPTO's limited capacity. Third, it would generate tax revenues to go towards workers or towards social measures to curb automation's effects, such as education. Thus, even if the reader is not convinced that automation generates negative externalities for workers,[320] she might see significant merit in the idea of a labor-displacing intellectual property tax from a fairness perspective.

The labor-displacing intellectual property tax also has some advantages over a tax imposed on businesses that automate. First, this option may resonate with policymakers interested in helping small businesses.[321] Businesses that adopt labor-displacing inventions include farmers, restaurants, clothing makers, and mom-and-pop establishments operating with small profit margins. In contrast, intellectual property owners are likely to be larger firms like Uber, Alphabet, and Tesla. Second, as discussed in Part I.B, from an economic standpoint, the negative externality that gives rise to technological unemployment is generated by the new ideas that permit reduction of labor. As explained, the "pollution-spewing factory" in this scenario is not the farmer who adopts the lettuce harvesting machine; it is the originator of the ideas that goes on to experience increased profits due to an exclusive right. Thus, even if the tax is ultimately passed on to businesses and consumers, it makes greater economic sense to tax the externality at its point of origin.[322]

4. What to Do with the Proceeds

Once the policymaker decides to pursue a tax and redistribution strategy, a separate question is what to do with the proceeds. One possibility is to institute a "universal basic income" (UBI). A UBI is a guaranteed minimum income in the form of cash paid out to everyone on a periodic basis, irrespective of whether they are employed or what their income is.[323] Several influential thinkers have spoken of a UBI as a

320. *See supra* Part III.B.1.

321. *See, e.g.*, 15 U.S.C. § 638 (2012).

322. Acemoglu & Restrepo, *supra* note 253 ("[T]he social planner will need to impose a tax on automation . . . in order to combat the tendency of the decentralized equilibrium to automate excessively."); *see supra* Part III.B.1.

323. *See* Fleischer & Hemel, *supra* note 249, at 1196.

potential panacea for a jobless future.[324] The UBI has usually been proposed as a traditional progressive tax, transferring wealth from rich to poor.[325] But a UBI could also be used in association with a tax on innovators. For example, both the robot tax and the job-displacing patent tax could be used to fund a UBI.[326]

Commentators have identified several problems with a UBI. Some argue guaranteed subsistence payments may have perverse effects on peoples' incentives to work, and would exacerbate rather than help the underemployment problem.[327] Others see this as a positive. It could be good, Professor Reich suggests, if people could have "more free time to do what they want to do instead of what they have to do to earn a living."[328]

A solution built on guaranteed cash payments is attractive for various reasons,[329] but of course is not the only option. Another commonly discussed option is to use tax proceeds for education and skills training in order to help prepare workers to take on new jobs in the wake of rapid technological shifts.[330] Several commentators believe that improving the education system is the key to helping people be able to participate in a workforce dominated by computers and AI.[331] Education and targeted

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324. Examples include Elon Musk and Robert Reich, discussed herein. *See id.* at 1199 n.32 (noting fears about automation are a reason for more attention to adopting a UBI).

325. As Professors Fleischer and Hemel explain, a UBI would presumably be drawn from richer people, who would pay more in taxes, and then 'redistributed' to the less wealthy, who would pay less in taxes but receive the same UBI. *Id.* at 1192 ("[The] UBI is, at its core, a program of income redistribution.").

326. *See* Reich, *supra* note 317 (discussing the possibility of a UBI).

327. Dan Nidess, *Why a Universal Basic Income Would be a Calamity*, WALL ST. J. (Aug. 10, 2017, 6:19 PM), https://www.wsj.com/articles/why-a-universal-basic-income-would-be-a-calamity-1502403580 [https://perma.cc/9ACB-6PA2] ("[M]illions of Americans [would] become dependent on the government and the taxpaying elite."); *see also* Fleischer & Hemel, *supra* note 249, at 1248 ("[An] objection to a UBI is that recipients will reduce work effort or drop out of the labor force altogether.").

328. Reich, *supra* note 317.

329. Some prefer the cash option as supporting both autonomy and efficiency: Recipients can spend the cash in ways that work best for them, rather than having to rely on the allocation decisions of others with less information. They could, for example, invest it in skills training if they wish. *See* Fleischer & Hemel, *supra* note 249, at 1234.

330. *See generally* CITI GPS, *supra* note 58, at 115–24 (discussing how the education sector can respond to the challenge of skills training).

331. *See, e.g.*, JOSEPH E. AOUN, ROBOT-PROOF: HIGHER EDUCATION IN THE AGE OF ARTIFICIAL INTELLIGENCE 6–17 (2017) (arguing education needs to adapt to teach people to work with AI); BESSEN, *supra* note 24, at 19–20 (arguing technology policy should include more focus on skills training to help workers adapt to new technologies); *see also* Cade Metz, *As China Marches Forward on A.I., the White House is Silent*., N.Y. TIMES (Feb. 12, 2018), https://www.nytimes.com/2018/02/12/technology/china-trump-artificial-intelligence.html

skills training would not ensure anyone who wants a job can get one. But they would at least give people a better opportunity to work if they wish to do so,[332] and aid companies that are having trouble filling their current needs for skilled talent.[333]

Yet of course there are several challenges here too—the most significant being that education and skills training are not a solution to unemployment caused by complete automation. If that occurs, society may have no other option besides a UBI.

5. Which Level of Government Should be Responsible

A final issue to consider is the question of governmental allocation: Which part of the United States government should be responsible for crafting and administering a policy to address technological un/employment? The author has previously argued that certain kinds of innovation policy are better effectuated at the state and local level.[334] Local governments may have superior incentives to act on behalf of constituents, and superior information about local conditions, such as availability and makeup of the workforce.[335] Localizing regulation would also permit tailoring of policies to different regions. For example, a state robot tax could be instituted in Alabama, but not in California. Proceeds could be used to train workers in the region.[336]

On the other hand, a better option might be to institute such taxes at the federal level, because this would permit a geographic redistribution.[337] For example, under a job-displacing patent tax, innovators in Silicon Valley, who own more patents than anywhere else in the country, would pay taxes; the proceeds would be used to train workers in other parts of the country, who are being displaced by those

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[https://perma.cc/72JN-PKSC] (noting that the Obama administration saw educating students in AI technologies as a key to improving the U.S.'s global competitiveness).

332. *See, e.g.*, Claire Cain Miller & Jess Bidgood, *How to Prepare Preschoolers for an Automated Economy*, N.Y. TIMES (July 31, 2017), https://www.nytimes.com/2017/07/31/upshot/how-to-prepare-preschoolers-for-an-automated-economy.html [https://perma.cc/G9JF-CTYR].

333. *See* supra Part I.C.5 (discussing skills gaps).

334. Hrdy, *supra* note 40, at 1334.

335. *Id.*

336. If states decide to tax intellectual property rights, there could be some interesting preemption issues. For instance, if a state imposed an 80% tax on certain patents, this would likely be preempted by the Intellectual Property Clause and the Patent Act. Camilla A. Hrdy, *The Reemergence of State Anti-Patent Law*, 89 U. COLO. L. REV. 133, 154–55 (2018); *see also* MERGES, *supra* note 317, at 133 ("[A]t some point, tax rates climb so high that, in principle anyway, the state may be seen to overstep the proper bounds of its authority.").

337. *See* Camilla A. Hrdy, *Cluster Competition*, 20 LEWIS & CLARK L. REV. 981, 989 (2016) (arguing that the federal government can use federal funding for emerging innovation clusters to "effectuate a geographic redistribution of resources from richer to poorer states").

inventions at higher rates. Even if the tax is instituted at the federal level, administration of benefits programs should arguably be done at the local level, especially if the proceeds are used for education and skills training. Indeed, state and local governments already administer a wide range of job creation programs, including skills training, many of them specifically directed at developing a suitable workforce for companies in the technology sector.[338]

CONCLUSION

The major focus of IP scholarship has been on whether intellectual property promotes innovation.[339] But this Article shows that if intellectual property is successful in promoting innovation, then by necessity intellectual property also facilitates and accelerates the pace of technological un/employment: the simultaneous elimination and creation of jobs brought about by technological change.

This Article generates two testable hypotheses regarding intellectual property's role. First, the Incentive Effect theorizes that intellectual property protection magnifies incentives to generate labor-displacing innovations, and thus marginally increases the size of the universe of labor-displacing innovations in the economy, and the pace at which they come into existence.[340] Second, the Distribution Effect theorizes that intellectual property, by design, increases returns for intellectual property owners and, accordingly, increases demand and wages for those employees whose skills are necessary to generate this intellectual property; yet at the same time, intellectual property makes it marginally more likely that other workers will be replaced by some of those same innovations.[341] The upshot is that intellectual property exacerbates the unequal division of rewards between owners and generators of intellectual property, and others whom those inventions replace. [342]

To be clear, innovation is generally a very good thing, and has been shown to be essential to the economic prosperity of nations.[343] The entire point of this Article's use of the term "technological un/employment" is that even labor-displacing innovation tends to create new jobs, sometimes very good ones, just as it destroys or diminishes old ones.[344] But many commentators (including the author) are not certain innovation is on net

338. Hrdy, *supra* note 40, at 1362–74.

339. *See, e.g.*, MERGES, *supra* note 317, at 1–11.

340. *See supra* Part II.C.1.

341. *See supra* Part II.C.3.

342. *See supra* Part II.C.3.

343. LERNER, *supra* note 234; *see also* Hemel, *supra* note 237 ("To make America economically great again, we need a productivity boost.").

344. *See supra* Part I.B.

going to create more jobs than it displaces in the near future. Moreover, commentators are disturbed by the declining quality and distribution of available jobs, and the failure of education and skills training opportunities to keep pace.[345] Some form of policy may be necessary to address this situation for purposes of distributive justice if not necessarily efficiency.[346]

Intellectual property represents an underexplored avenue for such a policy. As explained, this Article does not support denials of intellectual property for labor-displacing inventions. While this strategy (might have) made sense in Queen Elizabeth's time, today's government has far more effective tools. This Article also opposes fully banning labor-displacing inventions like autonomous vehicles because this risks unduly hindering innovation and exceeds government's predictive capacities. Instead, this Article urges more moderate measures. For example, the government might impose a small tax on profits from certain intellectual property rights covering labor-displacing innovations.[347] This tax should have a twofold effect: to slow down the pace at which companies pursue labor-displacing solutions and to permit giving back to workers at least some of what they lose through the tax system. The proceeds could be distributed in the form of cash or in the form of social programs designed to alleviate the negative impacts of job displacement. The government cannot and should not stop the tide of market inclinations to innovate, even when this leads to more automation of work. At most, the government should try to marginally alter incentives and focus on alleviating the negative impacts on some members of society in the here and now. Indeed, slowing things down is arguably the government's very role in this type of circumstance.[348]

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345. *See supra* Part I.C.

346. *See supra* Part III.B.

347. As discussed, there are several reasons to prefer a tax on intellectual property owners rather than a tax on companies that choose to adopt labor-displacing innovations. *See supra* Part III.C.3.c.

348. KARL POLANYI, THE GREAT TRANSFORMATION: THE POLITICAL AND ECONOMIC ORIGINS OF OUR TIME 39 (2d ed. 2001) ("Why should the ultimate victory of a trend be taken as a proof of the ineffectiveness of the [government's] efforts to slow down its progress? And why should the purpose of [government's] measures not be seen precisely in that which they achieved, i.e., in the slowing down of the rate of change?").