

HOW INNOVATION MAKES US MORE EQUAL

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Inequality is said by many of our leading thinkers to be the defining issue of our time. Often, the reason given for the increase in inequality is located in innovation itself. Under this view, technology disproportionately increases the incomes of those who can take advantage of it, helping the one percent more than anyone else.¹ It also threatens the jobs of the less skilled. In my view, however, modern innovation ultimately helps reduce real inequality, certainly globally, and even within the United States. And it does so for fundamental, not contingent, reasons.

Information technology changes the world by using information to better deploy material resources. Because of the nature of our accelerating technology, that information rapidly becomes common property, benefiting everyone. Modern information technology dematerializes the world and thus democratizes it. Material resources are ultimately finite, but functionality of technology is not. The move from “its” to “bits” is thus a move to equality, and so is the acceleration of change because that acceleration rapidly pushes down the cost of previous innovations. Economic value is increasingly created not by material things but by the information from our accelerating

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1. See, e.g., David Rothman, *Technology and Inequality*, MIT TECH. REV. (Oct. 2, 2014), <http://www.technologyreview.com/featuredstory/531726/technology-and-inequality/> [<http://perma.cc/99CR-DEBD>] (noting some professors' views that technology is a key driver of income inequality); Jason Russell, *Innovation Increases Income Inequality, Economic Opportunity*, WASH. EXAMINER (June 8, 2015), <http://www.washingtonexaminer.com/innovation-increases-inequality-economic-opportunity/article/2565818> [<http://perma.cc/94NM-LRP8>] (describing a recent study by the National Bureau of Economic Research that supports the idea that innovation leads to income inequality).

technology that arranges the material. Information can be shared equally in ways that material goods cannot.

This means that our circumstances are more equal than conventional income measures would suggest.² To the extent that inequality should be addressed by policy, acknowledging these observations will help us draft more promising solutions, policies designed to increase innovation, and improvements to education rather than simply transfer resources from one group to another.

I. OUR DEMATERIALIZING, ACCELERATING TECHNOLOGY

Thomas Jefferson once said, “He who receives an idea from me receives instruction himself without lessening mine; as he who lights his taper at mine receives light without darkening me.”³ In the Information Age, we enjoy an ever-greater access to an ever-brighter light that generates more value and consumption for all—substantially tempering the effect of technology’s differential boost on incomes.⁴ The accelerating pace of technological change drives down the cost of these information-based products, sometimes so far that they decrease to zero.⁵

What is the driving force of technology and its acceleration today? It is largely information technology and computation.⁶

2. See Drew DeSilver, *The Many Ways to Measure Economic Inequality*, PEW RESEARCH CTR. (Dec. 18, 2013), <http://www.pewresearch.org/fact-tank/2013/12/18/the-many-ways-to-measure-economic-inequality/> [http://perma.cc/UHJ8-29YB] (describing traditional methods of measuring income inequality).

3. Letter from Thomas Jefferson to Isaac McPherson (Aug. 13, 1813), in THOMAS JEFFERSON, *POLITICAL WRITINGS* 575, 580 (Joyce Appleby & Terence Ball eds., 1999).

4. See, e.g., John P. Holdren, *Science and Technology for Sustainable Well-Being*, 319 *SCIENCE* 424, 425–26 (2008) (discussing how science and technology can help meet the most basic needs of the poor); Lucy Westcott, *Binary Code: Can Technological Innovations Improve Children’s Lives?*, *NEWSWEEK* (Nov. 20, 2014, 9:44 AM) <http://www.newsweek.com/binary-code-can-technological-innovations-improve-childrens-lives-285654> [http://perma.cc/TQF9-H4ZF] (describing a UNICEF study about the positive effect innovation is having on the lives of children in developing countries, including improving access to education).

5. See RAY KURZWEIL, *THE SINGULARITY IS NEAR: WHEN HUMANS TRANSCEND BIOLOGY* 338 (2005) [hereinafter KURZWEIL].

6. See Ray Kurzweil, *The Law of Accelerating Returns*, KURZWEIL ACCELERATING INTELLIGENCE (Mar. 7, 2001), <http://www.kurzweilai.net/the-law-of-accelerating-returns> [http://perma.cc/YG99-4LFN].

Moore's Law is part of a long-term growth in computation.⁷ Electromechanical methods began the push for enhanced computation more than a century ago.⁸ They were replaced by vacuum tubes, which were surpassed by transistors, which gave way to today's integrated circuit.⁹ Other methods under research today, from optical computing to nanotubes, are likely to be responsible for continued growth.¹⁰ This dramatic increase in hardware capacity is only part of the story. Software has been improving apace as well.¹¹ This interconnectivity by the Internet brings machines closer together, and this accelerating power in hardware, software, and connectivity relentlessly transforms economic sectors.¹²

In artificial intelligence's most recent trial, Watson, the IBM machine, beat the best *Jeopardy!* players in the world.¹³ This reflects advances in all those areas. The computer disentangled humor, recognized puns, and resolved ambiguity. Unlike its predecessor, Big Blue, which defeated the world chess champion fifteen years earlier, Watson succeeded in a less-precisely rule-driven game—one much more like the chaotic world we inhabit.¹⁴ This fluidity enables computing applications in an increasing number of areas. Watson is going into medical diagnostics,¹⁵ and these diagnostic programs will level the standard

7. See MOORE'S LAW, <http://www.moorelaw.org/> [<http://perma.cc/X2Y9-2ESJ>] (last visited Oct. 1, 2015).

8. See KURZWEIL, *supra* note 5, at 67 (providing a graphic timeline that shows electromechanical methods in existence in the 1910s).

9. See *id.* (providing a graphic timeline of the exponential growth from the electromechanical method through the integrated circuit).

10. See *id.* at 112–13.

11. See *id.* at 428.

12. See, e.g., *id.* at 336–37 (describing the way in which interconnectivity is impacting the education market).

13. John Markoff, *Computer Wins on 'Jeopardy!': Trivial, It's Not*, N.Y. TIMES (Feb. 16, 2011), http://www.nytimes.com/2011/02/17/science/17jeopardy-watson.html?pagewanted=all&_r=0 [<http://perma.cc/4NFW-N4JU>].

14. Dylan Loeb McClain, *First Came The Machine That Defeated a Chess Champion*, N.Y. TIMES (Feb. 16, 2011), <http://www.nytimes.com/2011/02/17/us/17deepblue.html?ref=chess> [<http://perma.cc/XBY9-FXLJ>].

15. See Lauren F. Friedman, *IBM's Watson Supercomputer May Soon Be the Best Doctor in the World*, BUSINESS INSIDER (Apr. 22, 2014, 10:14 AM), <http://www.businessinsider.com/ibms-watson-may-soon-be-the-best-doctor-in-the-world-2014-4> [<http://perma.cc/22TG-ZTF9>].

of health care, making the rich's access to the best doctors relatively less valuable than it was before.¹⁶ The story of machine intelligence and its ability to level up is always the same: once it gains a foothold, it improves until it dominates.¹⁷

If lawyers or law students think that they are immune to the leveling of the computational revolution, they are very mistaken. The work that junior associates once did—sorting documents for instance—is now going to machines.¹⁸ Computers can sort better than people because fatigue, boredom, and distraction reduce human accuracy. Machine intelligence, in contrast, works nonstop without caffeine or sleep. For many lawyers this may not be such a good result, but for legal consumers it is a tremendously equalizing force.¹⁹

II. EXPONENTIAL COMPUTATIONAL CHANGE'S BOOST TO EQUALITY

This exponential nature of computational change is more generally a powerful force for equality. It means that innovations become more rapidly and broadly available. It took hundreds of years after the clock was invented for timekeeping pieces to trickle down to the middle class.²⁰ Even in the last century, only the relatively well-off had refrigerators and tele-

16. *See id.*

17. *See, e.g., Has The Ideas Machine Broken Down?*, THE ECONOMIST (Jan. 12, 2013), <http://www.economist.com/news/briefing/21569381-idea-innovation-and-new-technology-have-stopped-driving-growth-getting-increasing> [<http://perma.cc/P4X2-RBFQ>] (describing the way in which technological innovation develops).

18. *See, e.g., Blair Janis, How Technology is Replacing the Practice of Law*, GPSOLO, May/June 2014, at 10, 12 (describing how coding technology is being used in e-discovery); John Markoff, *Armies of Expensive Lawyers, Replaced By Cheaper Software*, N.Y. TIMES (Mar. 4, 2011), http://www.nytimes.com/2011/03/05/science/05legal.html?_r=0 [<http://perma.cc/L542-P2KJ>] (describing how artificial intelligence is replacing lawyers in document review).

19. *See Bellas & Wachowski, Artificial Intelligence: The Law Machine in Your Future*, ATTORNEYS CREATIVE ROUNDTABLE (June 20, 2015), <http://www.attorneyscreativeroundtable.com/2015/06/20/artificial-intelligence-the-law-machine-in-your-future/> [<http://perma.cc/4Z9F-KCLG>].

20. *See id.*; *see also History of Timekeeping*, TOURNEAU, https://www.tourneau.com/catalog/editorial_onecolumn.jsp?pageName=HistoryOfTimeKeepingTimeline [<https://perma.cc/5VVB-4QVX>] (last visited July 18, 2015). The mechanical clock was invented in England in 1275, but it was not until 1700 that clock ownership became widespread.

visions.²¹ Today, new technology circulates through the population far more quickly.²² Five years after the introduction of multi-touch smartphones, about half of America's population had one.²³ Today it is sixty-four percent and still growing.²⁴ The basic reason is that new innovations make the last innovations less expensive as the value of even slightly less good intellectual property is pushed toward zero.²⁵ Outside the United States, smartphones have been a source of a substantial income equalization with those in developing nations using them to interconnect and make money. Similarly, innovations in health care spread more rapidly. The improvements in health care do not even show up in the income statistics. As health care is put into the vessel of computation—for example, low-cost monitoring and detection of disease—improvements will also become more universally available.²⁶

More generally, the question of whether we have growing inequality is related to the question of whether we are living in a period of great stagnation, with low economic growth.²⁷ Some in Silicon Valley have pushed back against this claim by suggesting that GDP numbers do not capture all the free and near to free goods that software is creating, like apps and ever faster to access to information, as on Twitter and Facebook.²⁸ Conservatives and libertarians should be very aware that the GDP is a government-

21. See, e.g., STEPHEN MOORE & JULIAN L. SIMON, *THE GREATEST CENTURY THAT EVER WAS: 25 MIRACULOUS TRENDS OF THE PAST 100 YEARS 18–19* (1999), available at <http://object.cato.org/sites/cato.org/files/pubs/pdf/pa364.pdf> [<http://perma.cc/T62K-SE3B>] (showing the rapid increase in refrigerator and television ownership during the twentieth century).

22. See KURZWEIL, *supra* note 5, at 50.

23. See *Device Ownership Over Time*, PEW RES. CTR., <http://www.pewinternet.org/data-trend/mobile/device-ownership/> [<http://perma.cc/224T-WSDS>] (last visited July 18, 2015).

24. *Id.*

25. See KURZWEIL, *supra* note 5, at 338–39.

26. See Gillian Davies & Robin Lee, *Technology: The Cure for Rising Healthcare Costs?*, MIT TECH. REV. (Sept. 3, 2013), <http://www.technologyreview.com/view/518946/technology-the-cure-for-rising-healthcare-costs/> [<http://perma.cc/F6LS-A8B5>].

27. See, e.g., TYLER COWEN, *AVERAGE IS OVER: POWERING AMERICA BEYOND THE AGE OF GREAT STAGNATION* (2013).

28. See Timothy Aepfel, *Silicon Valley Doesn't Believe U.S. Productivity Is Down*, WALL ST. J. (July 15, 2015), <http://www.wsj.com/articles/silicon-valley-doesnt-believe-u-s-productivity-is-down-1437100700> [<http://perma.cc/Q4MG-3KDL>].

imposed statistic, and that it thus may not capture all the increases in human welfare.²⁹ And, of course, if it is ignoring the increasing availability of free goods, that fact provides evidence for the claim made here that innovation is tempering inequality by creating goods that all enjoy in common.

It is of course true that people have been coming up with ideas for thousands of years, but the exponential increases in computational power and connectivity have accelerated this process.³⁰ And while it is true that most ideas must take material form in order in order to be converted into usable products, the lower costs of manufacturing—also made possible by computation—mean that innovative ideas come across at much lower prices.

One possible objection to this argument is that many innovations are not free.³¹ In our society, some expressions of ideas are considered intellectual property, protected by patents and copyrights, and the inventors and authors do charge for the use of that property. But our laws also happily limit protections even for expressions of ideas, requiring that patents describe new ideas in detail to be fully public in return for their patent protection.³² Thus, they provide inspiration for even more ideas. Perhaps even more importantly, technological acceleration limits the duration of the effective monopoly of patents, often because the next thing is already around the corner, which makes the last great new thing less valuable.³³

29. See FED. RESERVE BANK OF BOSTON, *How Do We Measure "Standard of Living"?*, THE LEDGER, Winter 2003, at 4, 5, 8, available at <http://www.bostonfed.org/education/ledger/ledger03/winter/win03.pdf> [<http://perma.cc/3JSF-E23G>] (explaining that GDP does not capture important metrics such as access to health care).

30. See Kurzweil, *supra* note 6 (explaining how computation and information based technologies are a player in modern technological advancements).

31. See Bright B. Simmons, *Is the Cost of Innovation Falling?*, HARV. BUS. REV. (Oct. 29, 2012), <https://hbr.org/2012/10/is-the-cost-of-innovation-falling> [<https://perma.cc/S4Y9-K822>].

32. See also, *e.g.*, 35 U.S.C. § 273 (2012) (proving defense to patent infringement based on prior commercial use).

33. See Greg Satell, *What Can We Expect From The Next Decade of Technology?*, FORBES (June 29, 2013), <http://www.forbes.com/sites/gregsatell/2013/06/29/what-can-we-expect-from-the-next-decade-of-technology> [<http://perma.cc/55KD-T8Q4>].

III. SPEEDING UP INNOVATION THROUGH POLICY

This understanding of how technological progress reduces inequality of consumption can help us redirect government policy to reduce inequality further still. Public policy aimed at reducing inequality should thus focus not on direct transfers of wealth, but rather on improving education and increasing innovation.³⁴ Better and more flexible education helps address the greatest possible downside to innovation—the disruption to employment—because better-educated individuals are much more able to transition to new jobs.³⁵ And more innovation has the benefit of creating more ideas from which all can benefit.

One of the real barriers to improving education and entrepreneurialism is the structure of the public schools. These institutions are unlikely to prepare people well for entrepreneurialism simply because their curriculum is decided from the top down by bureaucrats, who will just try to reproduce the conventional wisdom.³⁶ They do not find out what is good for people to know at a particular place and time. Given that public schools are bureaucratic and often union-dominated, they are unlikely to be entrepreneurial themselves or sympathetic to focusing on the skills needed to prosper in the market.³⁷ If we had a structure in which we had a more competitive education system where the leaders are more sympathetic to competition, rather than a system run largely by government bureaucrats, we would naturally see a better ecosystem emerge for encouraging the acquisition of the kinds of flexible skills needed to thrive in our rapidly changing world.³⁸

34. See SANDY BAUM ET AL., COLLEGE BD., EDUCATION PAYS 2013: THE BENEFITS OF HIGHER EDUCATION FOR INDIVIDUALS AND SOCIETY, <https://trends.collegeboard.org/sites/default/files/education-pays-2013-full-report-140108.pdf> [<https://perma.cc/LJ27-LHKM>] (last visited July 21, 2015).

35. See *id.*

36. See Philip K. Howard, *To Fix America's Education Bureaucracy, We Need to Destroy It*, THE ATLANTIC (Apr. 2, 2012), <http://www.theatlantic.com/national/archive/2012/04/to-fix-americas-education-bureaucracy-we-need-to-destroy-it/255173/> [<http://perma.cc/36RQ-8HM6>].

37. See *id.*

38. J.D. Harrison, *Can You Really Teach Entrepreneurship?*, WASH. POST (Mar. 23, 2014), http://www.washingtonpost.com/business/on-small-business/can-you-really-teach-entrepreneurship/2014/03/21/51426de8-a545-11e3-84d4-e59b1709222c_story.html [<http://perma.cc/LC6H-KFME>].

The premise that schools do not have enough time to teach things such as entrepreneurship is false.³⁹ They are often poorly managed and the teachers who are good are not properly incentivized.⁴⁰ This structure needs to be changed and then there will be time to teach skills useful for competing in the modern world. It is not inconsistent, for instance, to teach skills of accounting and mathematics simultaneously. It is striking, for instance, that many people do not come out of high school even knowing what a balance sheet is. That lesson can be built into understanding something about the manipulation of numbers.

The other critically important step for increasing innovation is to get government out of the way. Most obviously, the government should systematically eliminate regulations that help incumbents block the entry of new firms offering disruptive technologies that could transform the marketplace. At the local level, for instance, low-income urban residents, like those in Chicago and New York City, would benefit from the introduction of big-box stores that are often thwarted by big-city labor unions.⁴¹ Those stores are an example of why prices for baskets of goods consumed by people of modest means have actually been decreasing far more than the basket of goods for people who are wealthy.⁴²

Happily, technological acceleration may also help us constrain bad government regulations, because it interferes with both the demand and supply of such regulations. It makes it less likely that the government will be used to perpetuate corporate interests. Public choice theory recognizes that companies attempt to use the government in furtherance of their goals.⁴³ Given the

39. *See id.*

40. *See id.*

41. *See* Nancy Cleeland & Abigail Goldman, *Grocery Unions Battle to Stop Invasion of the Giant Stores*, L.A. TIMES (Nov. 25, 2003), <http://articles.latimes.com/2003/nov/25/business/ft-walmart25> [<http://perma.cc/BNK7-LAH5>].

42. *See* Max Borders, *The Big Box Effect*, FOUND. FOR ECON. EDUC.: THE FREEMAN (May 14, 2014), <http://fee.org/freeman/detail/the-big-box-effect> [<http://perma.cc/46FT-796X>].

43. *See* Louise Story, *As Companies Seek Tax Deals, Governments Pay High Price*, N.Y. TIMES (Dec. 1, 2012), http://www.nytimes.com/2012/12/02/us/how-local-taxpayers-bankroll-corporations.html?pagewanted=print&_r=0 [<http://perma.cc/4D3F-WFAW>].

speed and unpredictability of changing technologies, companies will have more difficulty using regulation to prevent beneficial competition. In a world of technological acceleration, it is very hard to foresee all of the threats to a company, and that makes it very hard for them to use the government as a shield.

Technological acceleration also tends to deliver technological shocks that make it very difficult for government to continue with suboptimal regulation. We see examples of that dynamic in the taxi industry.⁴⁴ The benefits of having Uber and Lyft have become obvious, and that clarity makes it hard for politicians and bureaucrats to sustain special-interest regulations that help incumbents in the transportation industry.⁴⁵ Another problem that regulators face today is that the regulations may become so obsolescent that people may be able to move around them.⁴⁶ One might say that technological shock is the equivalent of war in its capacity to disorient and confound the power of interest groups.

Freer trade and more open world markets will also benefit innovation. On a global scale, international trade creates a larger, more integrated market that comes with greater incentives for innovation.⁴⁷ Liberal immigration policies, particularly for the more talented, would also increase innovation.⁴⁸ The free movement of people allows those with talent to collaborate where they can gain the most. Even in our era of digital communication, innovators in places such as Silicon Valley or New York's Silicon Alley improve their output by working closely together.⁴⁹

44. See Kate Rogers, *Uber, Lyft make moves to benefit drivers*, CNBC (Mar. 3, 2015, 2:25 PM), <http://www.cnbc.com/2015/03/03/uber-lyft-make-moves-to-benefit-drivers.html> [<http://perma.cc/A3ZM-8ZS3>].

45. See *id.*

46. See Julian Sanchez, *How Tech Can Render Regulations Uber Obsolete*, CATO INST. (Apr. 17, 2012), <http://www.cato.org/blog/how-tech-can-render-regulations-uber-obsolete> [<http://perma.cc/SR3W-VSZJ>].

47. See Daniel Spulber, *The Global "Idea" Market*, KELLOGG INSIGHT (Apr. 1, 2009), http://insight.kellogg.northwestern.edu/article/the_global_idea_market [<http://perma.cc/9CT5-QKP2>].

48. See Charles Kenny, *To Remain Tops in Innovation, the U.S. Needs Immigration Reform*, BLOOMBERG (July 22, 2013), <http://www.bloomberg.com/bw/articles/2013-07-22/to-remain-tops-in-innovation-the-u-dot-s-dot-needs-immigration-reform> [<http://perma.cc/5FPN-7V6Z>].

49. See Christina Hernandez Sherwood, *Why Proximity Matters for Innovation*, ZDNET (Feb. 13, 2012), <http://www.zdnet.com/article/why-proximity-matters-for-innovation/> [<http://perma.cc/CU79-WV6J>].

More generally, a concern with inequality should lead to policies that decrease social rent-seeking, which directs people away from productive innovation and allows the wealthy to gain unearned rents from government. For instance, the artificial wealth from the too-big-to-fail financial regime has sometimes lured people into finance and away from other parts of the economy.⁵⁰ There is a large difference between the social benefits of entrepreneurship and the social costs of government guarantees. Steve Jobs and Bill Gates, for example, are not resented for their massive wealth because it is well understood that they have helped everyone through their innovations. On the other hand, the bailout of big banks generated hostility toward the institutions that lived high on the taxpayer guarantee.⁵¹

Yet, I do not want to suggest that there are no downsides to innovation for equality. It is true that innovation also may create dislocations to employment, as new forms of technology make old jobs obsolete. But there are not a fixed set of jobs so that the technology disruption leads to permanent job loss. The idea that there are a fixed number of jobs is so wrong that economics has name for it—the lump-sum fallacy.⁵² Technology creates new jobs as well and so long as there is an infinite range of human desires there will be new job opportunities. Although machines are very good at analytics, they are not very good at personal skills. So our future may see more people investing in those kinds of things.

To be sure, technological acceleration can happen so quickly that people may need help to transition to new jobs. But that issue emphasizes the importance of more flexible and efficient education, which I have discussed.

Moreover, government can take advantage of the same technology that is disrupting jobs to improve policymaking to help

50. See Sydney Ember, *In Recruiting Game, Wall Street Still Competes*, N.Y. TIMES (Jan. 27, 2014), <http://dealbook.nytimes.com/2014/01/27/in-recruiting-game-wall-street-still-competes/> [http://perma.cc/4FPV-UFW8].

51. *The Unwinnable War: Tim Geithner and the Politics of Bailouts*, THE ECONOMIST (May 16, 2014, 7:56 PM), <http://www.economist.com/blogs/freeexchange/2014/05/tim-geithner-and-politics-bailouts> [http://perma.cc/2DN8-T578].

52. See *Lump of Labor Fallacy*, INVESTOPEDIA, <http://www.investopedia.com/terms/l/lump-of-labour-fallacy.asp> [http://perma.cc/87TJ-2J75] (last visited July 22, 2015).

people find new jobs. As I discuss at length in my book, *Accelerating Democracy*, the government also needs to innovate and utilize evidence-based knowledge, taking advantage of the prediction markets and empiricism made possible by technology. That kind of government would be in a better position to assess programs that may lead people to new kinds of employment.

In conclusion, what we really need are politics that accelerate innovation. It will continue to temper inequality by creating an even greater common pool of ideas that we can all enjoy. A politics of innovation is also a politics of unity where different economic groups all gain, rather than a politics of division where some use government to their advantage at the expense of others. While politicians are forever talking about transcending divisions, the actual fostering of innovation is the best way to bring us together. More than ever before, our economy can be a positive-sum game in which the gains for some rapidly redound to the benefit of all.