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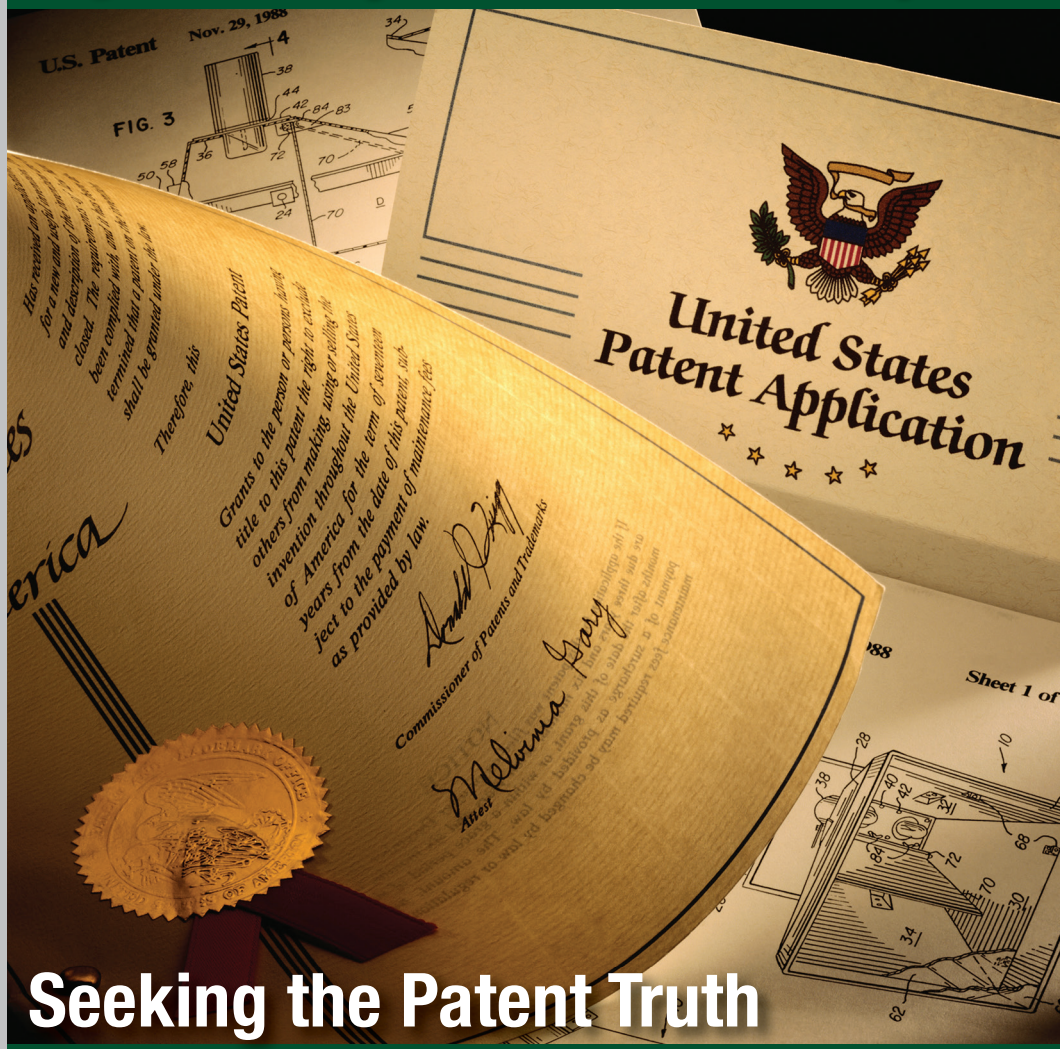

Seeking the Patent Truth

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FRONT COVER:
Seeking the Patent Truth: Patents Can Provide Justice and Funding for Inventors (See article on page 325)

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Seeking the Patent Truth

Patents Can Provide Justice and Funding for Inventors

ARTHUR M. DIAMOND, JR.

The quality and length of human life have enormously increased since roughly 1800, especially in the West. Deirdre McCloskey has called this enrichment "the great fact" of economic history (2010, 48–49), and Joseph Schumpeter claimed that the creative destruction that caused the enrichment was "the essential fact" of capitalism (1950, 83). Invention and innovation are key components of creative destruction, and for many decades most economists who studied patents believed that patents encouraged invention and innovation (e.g., Stigler 1968; Nordhaus 1969). More recently, however, many distinguished and thoughtful scholars and policy analysts (Cole 2001a, 2001b; Bessen and Meurer 2008; Boldrin and Levine 2008, 2013; Johnson 2010; McCloskey 2010; Ridley 2010) have doubted that patents encourage invention and innovation.

The great fact is not just a historical curiosity because most of us would like to see it continue and accelerate, so it is important to seek out the patent truth. Do patents work well? Should they be maintained, abolished, or reformed? To answer these questions, I begin by examining arguments from ethics and economics, evaluated in the light of historical and contemporary evidence. Next I provide historical narratives of how patent systems have worked well in the past and have stopped working well in the United States in recent decades. Finally, I discuss possible

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government policy reforms and private entrepreneurial institutional innovations that may create a better patent system in the future.

The Moral Case: Justice and Opportunity

The basic moral argument for patents is akin to the basic moral argument for property rights more generally. John Locke ([1689] 1967) observed that if you mix your labor with land, you have a right to the land. The fundamental moral intuition behind Locke's observation can be given the biblical expression that you should only reap what you sow. Ayn Rand observed that "patents and copyrights are the legal implementation of the base of all property rights: a man's right to the product of his mind" (1966, 125).[1]

Locke also observed that the property right in land was not absolute—it was limited by what Robert Nozick called "the Lockean proviso" (1974, 175–82) that there be as much and as good land left for others to likewise mix their labor with. So Locke's defense of property rights in land comes with a practical qualification. If even the property right in land is subject to practical qualification, so, even more strongly, we would also expect the more obscure case of intellectual property to be subject to practical qualification.

To further understand the roots of the moral intuition behind intellectual-property rights, consider the photos in figure 1 illustrating an experiment with dogs (Range et al. 2009; see also Associated Press 2008).[2] Two dogs who have been trained to shake hands are placed next to each other. I do not know the dogs' names, but I like to call the one on the left "Galt." In the first photo, the experimenter shakes hands with Galt. She then rewards him with a piece of dry brown bread. The experimenter then shakes hands with the second dog, and in the second photo we see her giving him a piece of juicy prime sausage, as Galt watches. In the third photo, the experimenter then extends her hand again to Galt, who turns away without extending a paw (though you can see the sausage-rewarded dog starting to lift a paw to indicate willingness to shake hands again). The moral intuition behind property rights is not just human; it is apparently mammalian! Maybe it goes deeper: Claudia Wascher and Thomas Bugnyar (2013) have replicated the experiment with birds, and McCloskey summarizes research suggesting that even butterflies act as though they share the moral intuition behind property rights (2010, 332–33).

How do the animal experiments apply to patents? Most of us grant that if a farmer mixes her labor with previously unowned land, it is fair that she own the

1. For another careful analysis of the similarities in the moral and legal foundations of tangible and intellectual-property rights, see Epstein 2006.

2. Friederike Range and her colleagues' experiment with dogs was basically a replication of an earlier experiment with capuchin monkeys (Brosnan and de Waal 2003). A TED Talk by Frans de Waal in November 2011 includes a wonderful video clip of the experiment (de Waal 2011, also posted on YouTube).

Figure 1
The Moral Intuition behind Property Rights

Note: Dog on left (Galt) shakes hand and then gets brown bread; dog on right gets sausage after shaking hand; Galt refuses to shake hands after having seen that the other dog gets a better reward for the same action.

Source: Associated Press 2008 (reproduced by arrangement with Associated Press).

land. So if an inventor likewise mixes her labor with material objects to create an invention, it is also fair that she own the invention. To do otherwise would be to give the inventor the dry brown bread, while we give the farmer the juicy, prime sausage. To do otherwise, according to John Stuart Mill in his *Principles of Political Economy,* would be "stealing" and "a gross immorality" ([1848] 1909, 933).

During the last year of his life, Steve Jobs spoke of Apple's patent-violation lawsuit against Google: "Our lawsuit is saying, 'Google, you f***ing ripped off the iPhone, wholesale ripped us off.' Grand theft. I will spend my last dying breath if I need to, and I will spend every penny of Apple's $40 billion in the bank, to right this wrong. I'm going to destroy Android, because it's a stolen product" (quoted in Isaacson 2011, 512, asterisks added by Diamond).[3] For Jobs, money was not the issue (whether as incentive or enabler). He believed that Google had stolen what was his and that theft was wrong. By the way, those who accuse Jobs of hypocrisy on this issue are wrong: he did not steal the mouse from Xerox PARC (Hiltzik 2000, 329–45), as was suggested, for example, in the television movie *Pirates of Silicon Valley* (Burke 1999). The inventors and executives at Xerox PARC consciously gave Jobs access to their intellectual property—the inventors in part because they wanted their inventions to see the light of day (having despaired of Xerox ever successfully bringing them to market), the executives in part because Xerox received substantial stock shares in Apple.

Economists have sometimes objected: Who cares about justice to the inventors? Only consumers matter. I respond that justice is a value that is built into us and can be articulately defended. But assume the opposite—that we care only about consumers. If we fail to provide justice to inventors, they will have less incentive to invent and

3. With Jobs gone, Apple has adopted a more pragmatic position (Wakabayashi and Winkler 2014).

fewer means. In the long run, a world with less invention is not a good world for consumers.

Injustice for inventors also hurts consumers by undermining the economic system that creatively and efficiently produces the goods for consumers. People will accept inequality if they believe that most of those who do well have deserved to do well (Zingales 2009, 2012). If entrepreneurs are allowed to benefit from their innovations, but inventors are not allowed to benefit from their inventions, then the entrepreneurs will be seen as unjustly free-riding on the inventors.[4] The likely political result is that voters will support higher taxation of the innovative entrepreneurs. But this will hurt us all, if George Gilder (1992) and I (Diamond 2012) are right that allowing innovative entrepreneurs to keep more of their income provides them the funds to innovate more in the future. Justice is good for the soul, and it is good for consumers, too.

The primary moral benefit of a successful patent system is that it provides justice for inventors. But an important secondary moral benefit is that it democratizes the opportunity to invent (Khan 2005). The independently wealthy can continue to invent either in the presence or in the absence of a patent system. For the working poor or the lower middle class, however, patents provide the funding that makes inventive activity possible. Working-class tinkerers were crucial to some of the key mechanical inventions of the Industrial Revolution (Rosen 2010). And an Argentine auto mechanic recently invented a device that promises to save lives in difficult childbirths. He has financed continued improvements in the device through royalties from his patents (McNeil 2013).

I emphasize the inventor's receiving of money through patents as just and enabling; I do not emphasize it as an incentive, although I think that it sometimes plays that role—and if money provides an incentive for some inventor, that inventor may be less noble, but the invention may still be useful. Our institutions should mainly not block the noble from acting nobly, but it is all for the best if they also provide incentives for the rest of us to act as if we were noble.

The Economic Case for Patents: Incentive, Enabler, and Source of Information

Before Abraham Lincoln was president, he was sometimes invited to give a lecture in which he praised the benefits of new technology and the patent system as a motivator of invention (Khan and Sokoloff 2001, 244). Lincoln would presumably be comfortable with the first standard economic rationale for patents: if patents provide

4. In this paper, I adopt the common though by no means universal distinction made by Schumpeter that an inventor shows that a new good is technically possible, whereas an innovator (a.k.a. "innovative entrepreneur") overcomes the obstacles to bring the good to market at a price that consumers are willing to pay and that allows a profit for the producer (1950, 132).

inventors with an income, they provide an incentive for the inventors to invent by allowing them to obtain a higher level of utility.

Proponents of the open-source movement and other critics of intellectual property argue that the patents-as-incentive approach assumes a less noble and inaccurate picture of humans in general and of the inventor in particular. They argue that the inventor's motive power is the desire to create. To the extent that the open-source movement is correct, a stronger economic argument for patents focuses on patents providing funding for inventors that serves not as an incentive for invention, but as an enabler of invention.

The importance of patents as an enabler of invention can be appreciated by considering the First Industrial Revolution (the one in the late eighteenth century associated with the steam engine). Robert Gordon (2000) has strongly argued that the most important examples of creative destruction occurred during that Industrial Revolution, which is associated with the application of steam power to manufacturing and transportation. William Rosen (2010) points out that many of the great inventors of this First Industrial Revolution were inarticulate tinkerers. They lacked the voice to tell us with credibility and passion how the money from patents enabled them to continue to invent. Thomas Newcomen may have been a greater inventor than James Watt, but we remember Watt because Watt and his friends were articulate, whereas Newcomen and his friends were inarticulate. So when Watt articulated the importance of patents, he was providing a voice for the wider group of tinkerers of the First Industrial Revolution.

Another articulate defender of intellectual property as a means to fund creators is Bill Gates. In a famous open letter to the Homebrew Computer Club in 1976, Gates complained that the flagrant copying of software resulted in software programmers receiving little for their efforts, which "prevents good software from being written. Who can afford to do professional work for nothing? [Who] can put three man-years into programming, finding all bugs, documenting his product and distribute for free?" (qtd. in Phelps and Kline 2009, 132–33, bracketed word in quote as given). Gilder (1992) emphasizes that the main reason for funding entrepreneurs is not to provide them the *incentive* to innovate—the best of them are already driven to do that—but rather to provide them the *enablement* to innovate. Gates's friend Nathan Myhrvold similarly emphasizes that the main reason for funding inventors is not to provide them the *incentive* to invent but rather to provide them the *enablement* to invent (2004, xi). It should also be added that patents often provide the funds to enable entrepreneurs to turn inventions into innovations. In survey research, high-tech start-up entrepreneurs report that patents are not very important as an incentive but more often are important as an enabler of funding, not only from angel and venture investors, but even from "'friends and family' and commercial banks" (Graham et al. 2009, 1325–326).

Because of failures of the patent system, some inventions do not exist that would otherwise exist—the erstwhile inventors could not afford the time and equipment to

make the invention a reality. An absent or flawed patent system not only can reduce the number of inventions but, even more importantly, can especially reduce the more ambitious inventing that requires more resources for equipment, staff, and the like or the inventing that has a longer time horizon before success or the inventing where the benefits of success are higher, but the chances of success are lower.

Patents have other economic benefits. Mark Blaug (2005), for instance, has argued that an early and important economic rationale for patents was to promote the quick sharing of knowledge about new technologies by reducing the incentive inventors have to keep their inventions secret. At least in the United States in the 1800s, patents often had this effect—helping to spread knowledge of new technologies more widely and quickly (Thomson 2009; Moser 2011; Winder 2012). Firms subscribed to journals that summarized relevant new technologies revealed in patent applications (Lamoreaux and Sokoloff 2001, 40; Lamoreaux, Sokoloff, and Sutthiphisal 2013, 12–14). Firms also assigned some of their employees the job of staying informed about new technologies revealed in patent applications (Lamoreaux and Sokoloff 1999, 42–44), and firms could hire patent agents and patent attorneys, who used patent filings to keep up to date on specific areas of technology (Lamoreaux and Sokoloff 1999, 23). In addition to helping an inventor draft and file patent applications, a patent attorney also often advised the firm on the merits of new technologies in the firm's industry (Lamoreaux and Sokoloff 2001, 40; Lamoreaux, Sokoloff, and Sutthiphisal 2013, 17–19).

Empirical studies have shown further economic benefits from patents. For example, firms that patent are more likely to survive (Helmers and Rogers 2010, 2011; Wagner and Cockburn 2010) and are more likely to receive venture capital (Audretsch, Bönte, and Mahagaonkar 2012). A prominent example of the latter is when Google founders Larry Page and Sergey Brin received venture capital funding to develop Google based in part on their patent for their search algorithm (Adam Mossoff in Myhrvold 2013, 9).

The Economic Case against Patents: Monopoly Pricing, Legal Costs, and Barriers to the Interaction of Ideas

The standard theoretical argument against patents has traditionally been that they create monopolies and that monopolies result in lower output and increased prices for consumers (see, e.g., Cole 2001a, 113, and 2001b, 80–83). The implication of lower output has not always been supported empirically. For example, Darius Lakdawalla and Tomas Philipson (2012) present evidence that patent-induced monopoly does not reduce by much the output of prescription medicines. They attribute this outcome to firms having a greater incentive to invest in marketing when they have a monopoly due to patents.

But most of the focus in the standard argument has been on consumers being harmed by higher prices from patent-created monopolies. Schumpeter provided the

broadest partial response to this concern when he emphasized that the competition that matters most to consumers is the dynamic competition that creates new products, not the static textbook competition that lowers prices (1950, 84). The benefits that the consumer gains from new products are larger and more durable than the costs the consumer bears from higher prices.

George Stigler (1968) provided a further partial response when he emphasized that the higher prices would be of limited duration. He showed that a seventeen-year (now a twenty-year) patent would provide inventors about 80 percent of the returns they would receive from an infinite patent and still provide consumers traditionally competitive prices at the end of seventeen (now twenty) years. And in a world of accelerating creative destruction, the new patented product can be leapfrogged by the even newer product well before the seventeen- or twenty-year patent on the first product has expired. Demand will shift from the new product to the newer product, and although the new product may still be protected by a patent and still have a monopoly, the price of the new product can fall well before that patent expires.[5]

Two common aspects of the initial high prices from patent monopolies may mitigate their burden. One is that the high prices are often borne by higher-income consumers. The other is that they often provide funding for the improvement of early versions of the product. At the start and in the short-run, some new technologies (cars, VCRs) are affordable only by the rich. But the early versions are often fragile, buggy, and hard to use. Both Schumpeter (1950, 132–33) and Amar Bhidé (2008, 308–23, and 2009, 16) have emphasized that technological progress requires a critical mass of consumers who are open to change. Rich consumers may become early adopters because the new products, even in nascent form, improve their lives or because the rich consumers may want to play some role in "making a ding in the universe," as Steve Jobs is often quoted as saying, or because they may want to conspicuously consume what others cannot afford. But even in the last case, when the motive of the rich is conspicuous consumption, the consumption serves, as if by an invisible hand, to fund the development and improvement of early versions of the products (Darlin 2010). Within several years (fewer years now than with the technologies that were new one hundred years ago), the new technologies are much better and much cheaper. Many examples can be given: the automobile is an obvious one, the bathtub a less obvious one (Bryson 2010, 372).

And when the new products have become much better and much less costly to make, even those innovators with active patents may find it more profitable to follow Henry Ford in selling at low prices to the masses rather than selling at high prices to the rich. A similar result can occur with process inventions; the patented-monopoly new process can result in lower prices than the static textbook-competitive old process. McCloskey provides a graphical illustration showing that the *monopoly* price

5. The price usually does fall when the patent expires, an effect that is larger where creative destruction is slower.

of railroad hauling may be lower to the consumer than the textbook-*competitive* price of pack-mule hauling (1985, 368).

A more recent part of the economic case against patents emphasizes the high and increasing costs of patent litigation (Bessen and Meurer 2008, 131–38, 259). The direct costs of litigation are substantial, but another cost of litigation is in the large loss of stock value, often suffered mainly by accused patent infringers. These costs may be justified if they are borne to defend the property of breakthrough inventors. But the costs seem particularly egregious when they are caused by lawsuits based on low-quality patents. One way in which patents can be of low quality is for them to be written and approved in a highly ambiguous form, which results in other firms not knowing when they might be violating a patent (Bessen and Meurer 2008, 53–64). Another way in which patents can be of low quality is for them to be granted in spite of their failure to be truly new and nonobvious. Jeff Bezos, founder and CEO of Amazon, opposes low-quality patents of this kind even though Amazon has benefitted from holding one—the patent for the "one-click" purchase button on online sites (Brandt 2011, 15).

The rising costs of litigation are sometimes blamed on "patent trolls" (Bessen and Meurer 2008, 159–60). The moniker has negative connotations, but its exact meaning is not clear. The phrase is generally believed to have originated when Peter Detkin, then a vice president at Intel, was sued for libel by lawyer Ray Niro after Detkin called him a "patent extortionist."[6] Because Detkin needed a less litigiously provocative pejorative phrase for "patent extortionist," he started using *patent troll* (Wild 2008; Levy 2012). So "troll" equals "extortionist." However, to make the phrase *patent troll* precise, it is now common to equate it with *nonpracticing entity,* which literally refers to a person or company that owns patents without using them to manufacture a product or sell a service. For instance, James Bessen and Michael Meurer adopt a version of the definition of *nonpracticing entity:* "patent trolls" are "individual inventors who do not commercialize or manufacture their inventions" (2008, 17).

To equate the patent troll with the nonpracticing entity, however, is to imply that all nonpracticing entities are extortionists, which is false and unfair and leads to unsound policy. Why is it false? Because of the many examples in which nonpracticing entities have served useful functions and have not been extortionists. Consider how Robert Kearns, who received a patent for his invention of the intermittent windshield wiper, never himself manufactured the wiper but sued Ford and Chrysler for patent infringement. Kearns was a nonpracticing entity but is generally viewed as a hero fighting for justice rather than as a despicable troll trying to extort ransom from productive firms (see *Flash of Genius,* the 2008 movie on Kearns [Abraham 2008], as well as Hagiu and Yoffie 2013, 47).

6. Peter Detkin is currently cofounder, vice chairman, and 20 percent owner of Intellectual Ventures, which is frequently accused of being a patent troll. (If Intellectual Ventures is justly accused, then Peter Detkin must be a very conflicted man.)

Charles Goodyear was another nonpracticing entity who was not guilty of extortion. Goodyear did not himself manufacture tires or other items made out of the vulcanized rubber he invented. Goodyear was very poor most of his life (Slack 2002), but some of what money he did raise early on was due to the hope that he might eventually receive a patent. And most of what money he did eventually receive arose from his being awarded and being able to license an American patent.[7]

Another "patent troll," by Bessen and Meurer's definition, would be Thomas Edison. Edison fully or partially transferred the rights to twenty of his first twenty-five patents, leading Naomi Lamoreaux, Kenneth Sokoloff, and Dhanoos Sutthiphisal to conclude "that Edison depended heavily on [the transfer of patent rights] to finance the early stages of his career" (2013, 6). More generally, Thomas Hughes's "golden era for independent inventors" (1989, 15) from 1876 until World War I was due "to the opportunities that the ability to trade in property rights to new technological knowledge allowed them" (Lamoreaux, Raff, and Temin 1999, 12).

Beyond individual inventors, many biotech companies, such as Genentech, never plan to manufacture and market the medicines that they create and hence are nonpracticing entities. Their ability to patent their medicines allows them to license them to the big pharmaceutical companies, which go on to manufacture and market the medicines (Hughes 2011, 94 and passim; Myhrvold 2013, 9–10).

Kearns, Goodyear, Edison, and Genentech are just a few examples of nonpracticing entities that are innocent of extortion. But this, of course, does not imply that all nonpracticing entities are innocent. Perhaps the most infamous case of extortion was when nonpracticing entity NTP induced Research in Motion to pay $612.5 million to avoid a possible injunction for allegedly infringing patents, many of which the patent office soon threw out as invalid (Levy 2012; Watkins 2013, 21–22). Steven Levy (2012) documents another infamous case, that of Mitchell Medina, who received a very broad and opaque business method patent on November 2, 1993, for an "information-processing methodology." Medina's Eon-Net company proceeded to sue more than one hundred e-commerce companies for violation of the patent, seeking licensing fees of $25,000 from each. All of the companies settled out of court, except for Flagstar, which as a matter of principle decided to dispute the validity of the Eon-Net patent in court, despite knowing that the litigation would cost more than simply settling with Eon-Net. Judge Marsha Pechman issued a summary judgment, throwing the case out and concluding that Eon-Net's claims were "wholly without merit" and that "indicia of extortion are present in the case" (Levy 2012). But Eon-Net appealed, and the appeals court said that the lawsuit deserved a full hearing in court, greatly increasing Flagstar's

7. Which may have partly compensated for the unjust award of the British patent to Thomas Hancock, who stole the patent based on reverse engineering of the vulcanized samples that Goodyear had sent to him as an overture to a possible business relationship (Slack 2002). (The Goodyear Tire Company was founded after Goodyear's death and was named to honor him, not to indicate that Goodyear was directly commercializing his own patents.)

litigation costs. The full case was decided by Judge Ricardo Martinez, who concluded that Eon-Net's claims were so baseless that Eon-Net had "to pay Flagstar's legal fees" (Levy 2012).

Although cases such as NTP and Eon-Net should be considered, Michael Risch has warned that much of what we think we know about nonpracticing entities is based on such highly visible cases and is wrong (2012, 458). In particular, Risch finds that, compared with other litigated patents, those litigated by nonpracticing entities are not more dominated by business method patents and are not of substantially lower quality (460–61).

In the interests of justice and funding for inventors, a distinction must be made between the nonpracticing entities that extort and those that do not extort. Policies should be sought that allow legitimate nonpracticing entities to function, while restricting the extortionists. Most notably, policies that assure that a higher percentage of patents issued are of high quality and that the occasional issuance of a low-quality patent can be readily reviewed would reduce the opportunity for extortion. (I have more to say about these and other reforms in a later section of the paper.)

Besides monopoly pricing and litigation costs, a third economic argument against patents rests on the claim that patents impede the interaction of ideas. For example, Matt Ridley's (2010) main argument against patents is that they slow down the promiscuous mating of ideas. Like Ridley, Steven Johnson (2010) and Kevin Kelly (2010) also make much of the interaction of ideas. These analysts and others argue that the current system severely limits inventors' ability to use and build upon the intellectual creations of others and hence stifles creativity and the spread of worthy creations.

The most common alternative to patents that is suggested to increase the interaction of ideas is some version of the open-source approach. Here the argument is that open source either is nobler than intellectual-property systems or results in greater creativity. Eric von Hippel's (1988, 2005) examples of innovation that arise from tinkering by user communities illustrate a version of the open-source approach. Chris Anderson (2012) discusses other versions of this approach.

Open-source communities are a modern version of the property-free utopian communities that have occasionally appeared in the West in the past two hundred years, so we can learn something about the new communities' prospects for success by remembering the track record of such communities in the past. In most cases, they collapsed because of a combination of low productivity and the disillusionment of key members. Productivity in a community increases when those who have been productive in the past are allowed to reinvest their profits in order to be even more productive in the future. This is not possible in property-free utopian communities. Also, in utopian communities the productive eventually become disillusioned at supporting the unproductive free riders. Diverse examples illustrate these claims. Colonial Jamestown failed to produce much food in its property-free phase (Acemoglu and Robinson 2012, 23), resulting, we now know, in cannibalism

(Wade 2013). Most New Age communes of the 1970s failed (see, e.g., Beston 2008). Kibbutzim failed and moved toward incentives (Kerschner 2007). Louisa May Alcott's parents' commune failed (Price 2010). In each case, the cause was low productivity due in part to free-riding and the failure to recruit or retain the productive members of the community.

Despite these challenges, open source can "work" for a while so long as the open sourcers are independently wealthy or philanthropically supported and so long as they maintain their mission-oriented dedication (Perlroth 2014). Open source can work as long as enough able inventors, entrepreneurs, and sacrificing supervisors remain dedicated to it, as perhaps has happened with "Jimbo" Wales in the case of *Wikipedia* and Linus Torvalds in the case of Linux ("Informed Reader" 2007). But it is rare for such dedication to continue for long—the sacrificing supervisor eventually becomes less mission-oriented and believes she should have her just reward or wants more resources to pursue new and perhaps more ambitious projects.

The case against patents usually does not emphasize the issue of how invention will be funded. But sometimes alternatives are discussed. Firms that want to keep others from imitating their inventions are usually seen as having two choices: either patent the inventions or keep the inventions secret. If the patent system were abolished, the only remaining choice would be secrecy, which would skew invention toward areas where secrecy could be maintained (e.g., away from products where reverse engineering is easy). But those who criticize patents and praise collaboration, such as Anderson (2012), Johnson (2010), Kelly (2010), and Ridley (2010), do not suggest that inventors fund their inventions by keeping them secret. Instead, they assume that the inventor will need to self-fund his or her inventing.

Chris Anderson's account of patentless invention makes this assumption, implying two possible sources of self-funding. Sometimes he mentions the importance of an inventor having a "day job" (2012, 3, 12, 188–89, esp. 128). Elsewhere he suggests a model he himself is pursuing, in which the inventor combines invention with entrepreneurship and funds himself with the profits from entrepreneurship. This might work if all good inventors were able and desirous of also being good entrepreneurs (Hagiu and Yoffie 2013, 48–49). But the record is rife with counterexamples (Wasserman 2012). Edison is generally viewed as a great inventor, but a not-so-great entrepreneur.[8] The steam engine required both James Watt's invention and Matthew Boulton's entrepreneurship. The commercialization of a machine to make fertilizer out of nitrogen gas required both Fritz Haber's invention and Carl Bosch's entrepreneurship (Hager 2008). The Apple microcomputer required both Steve Wozniak's invention and Steve Jobs's entrepreneuship.[9]

8. Henry Ford is claimed to have called his friend Edison "the world's greatest inventor and world's worst businessman" (attributed to Ford by Stross 2007, 165).

9. Several episodes in Wozniak's autobiography (Wozniak and Smith 2006) illustrate the point.

Dean Kamen is widely viewed as one of our greatest living inventors. He generally funds his new inventions by selling or licensing the patent rights to his previous inventions (Schwartz 2004, 159–60). But with his invention of the Segway, a two-wheeled, battery-powered vehicle, he tried to be the entrepreneur as well as the inventor. Nathan Myhrvold argues that this was a mistake (Schwartz 2004, 160). The opportunity cost of Kamen's time spent as a mediocre marketer could be measured in terms of breakthrough inventions foregone. For those inventors who are not independently wealthy, do not have a lucrative day job, and are not talented entrepreneurs, Anderson's approach limits the extent to which they can specialize in their inventing and, if they succeed, support themselves on the basis of it.

I discussed the economic case in favor of patents in the preceding section. In this section, I have discussed the economic case against patents. In both sections, the focus has been on the theoretical arguments, although I have frequently brought historical or recent evidence to bear to support or oppose various theoretical claims. In the next two sections, I provide historical narratives, arguing in one section that the British patent system during the First Industrial Revolution and the U.S. patent system during the second half of the nineteenth century worked well enough to be considered successful and suggesting in the other section reasons why in recent decades the United States patent system began to fail.

How Patent Systems Once Worked Well

Those who advocate abolishing patents often place overwhelming weight on the failures of the current patent system and show little, if any, interest in the record of past patent systems (e.g., Boldrin and Levine 2013). But past patent systems' track record is of more than antiquarian interest. If past patent systems were successful at encouraging inventiveness, then we can conclude that any failure of the current patent system may be due to changes in the patent rules or in the implementing of those rules. If so, then the case is stronger for reform than for abolition.

Deirdre McCloskey suggests that the British patent system's track record is mainly a record of failure (2010, 337). In rejecting patents, she relies heavily on a brief but rich article by Joel Mokyr (2009).[10] Mokyr sets up the "usual" account of the role of patents in the Industrial Revolution, attributes that account to Douglas North (1981), and then says that "almost everything" about the account is wrong (2009, 349). But there is more to the Mokyr article than the opening salvo. As Mokyr proceeds, he adds qualification and nuance: he grants that for some industries, such as

10. A secondary reason for rejecting patents could be based on McCloskey's view that, since roughly 1900, the process of invention has become "routine" (2010, 454 n. 9), which would also be consistent with a view that patents are not necessary. To the contrary, I believe that for crucial breakthrough inventions the process of invention is not and never will be routine. Some support for my view can be found in Baumol 2005.

machinery, "innovation would tend to be concentrated in economies in which patent protection was stronger" (352).

William Rosen's *The Most Powerful Idea in the World* (2010) argues that the steam engine was the key invention of the Industrial Revolution and that the relatively enlightened patent law of England (compared, for example, to that of France) explains why the steam engine was first developed in Britain, mainly by Newcomen and Watt (the latter a strong advocate of patents).[11] In contrast to Ridley, who reifies ideas and views their mating and exchange as an inevitable consequence of growing populations, Rosen believes *people* create and learn and remember and apply ideas, and people need the means to survive and support their families and to have the free time and the space and the tools to invent. For Rosen, Sir Edward Coke's formulation of a clear and broadly applicable patent statute that was put into effect in 1624 (Rosen 2010, 52) provided ambitious and inventive craftsmen the means to support themselves and develop their inventions. And Rosen does not just make this argument theoretically plausible. He gives several examples of modest craftsmen whose key inventions would not have been possible if it were not for the means made available by the British patent system.

Some economic historians have expressed doubts that patents could have mattered much in causing the Industrial Revolution because of the high costs of obtaining patents, both in terms of time spent in the legal process and in terms of fees. Sean Bottomley has gone far in answering these doubts by documenting the growing importance of patent agents starting in the 1770s (2012, 180). The patent agent could represent the patent applicant in some legal proceedings, reducing the amount of time that the applicant had to spend in London (47–48). And the patent agents, through their connections with entrepreneurs, manufacturers, and capitalists, could help the inventor find funding, both to pay patent fees and eventually to bring the invention to market (49–50, 180).

For a somewhat later period, Petra Moser's (2005, 2012) influential work on the technological inventions displayed at the Crystal Palace exhibition found that in

11. Sean Bottomley finds support in Allen 2009 for the importance of patents in the development of steam power (2012, 16–18). However, Michele Boldrin and David Levine (2008) argue that Watt's patent for his steam engine slowed the progress of steam power in Britain during the Industrial Revolution. George Selgin and John Turner (2009) have presented a credible case that a full account of steam power during the period does not support Boldrin and Levine's argument (see also Selgin and Turner 2006, 2011). On balance, Bottomley's evidence and analysis on Boulton and Watt (2012, 126–35, esp. 134–35) supports Selgin and Turner's account. One of the key points made by Selgin and Turner (2009, 1104–6) and Bottomley (2012, 134–35) and based largely on the quantitative analysis in Kanefsky and Robey 1980 is that the trend line in the number of new steam engines shows neither a downward shift during Watt's patents nor an upward shift soon after their expiration (as one would have expected if the patents had indeed held back the application of the technology). Allesandro Nuvolari, Bart Verspagen, and Nick von Tunzelmann (2011) have reappraised Kanefsky and Robey 1980 and explained county differences in adoption rates without overturning its main results. Nuvolari also has done interesting research on the Cornish high-pressure engine. The Cornish engine had superior fuel efficiency to the Watt engine (Nuvolari and Verspagen 2009, 685), was improved by community tinkering (Nuvolari 2006, 474), and was not patented (Nuvolari and Verspagen 2009, 687). But, outside of Cornwall, the Watt patented engine was far more widely adopted (Nuvolari and Verspagen 2009, 685), further supporting the idea that the Watt patents were not a significant deterrent to the technology's diffusion.

industries such as machinery, where copying of technology was relatively easy, much of the inventing occurred in countries with effective patent systems, such as Britain. Conversely, in industries where secrecy was easier to maintain, a higher degree of invention occurred in countries that lacked patent systems, such as Switzerland and Denmark, or in countries with poorly enforced patent systems, such as Bavaria. Moser's work is usually interpreted as mainly undermining the importance of patents by showing the large number of inventions that were not patented. But if Moser's work supports the role of patents in enabling invention in industries such as machinery that were key to the Industrial Revolution, then the usual interpretation may be wrong.

In papers with Zorina Khan and Naomi Lamoreaux, Ken Sokoloff presents evidence that in the United States patents provided funding that helped enable more invention, especially by ordinary citizens (Sokoloff 1988; Sokoloff and Khan 1990; Khan and Sokoloff 1993, 2001, 2006; Lamoreaux and Sokoloff 1999, 2001; Lamoreaux, Sokoloff, and Sutthiphisal 2013). In an elaboration of some of this work, Khan has shown that the early patent system provided an important source of income for many inventors (which plausibly could have served either as an incentive to invent or as an enabler by providing financing for further inventions) (2005, 202–7). She argues that U.S. citizens had easier access to patents than did British citizens and that this helps explain why U.S. economic growth in the period was greater than Britain's (see also Merges 2007, 452).

In the nineteenth-century United States, a vibrant and productive market for inventions existed in which individual inventors received patents for their works and then sold their patents to firms interested in developing and manufacturing the inventions (Lamoreaux and Sokoloff 1999, 2000, 2001; Lamoreaux, Sokoloff, and Sutthiphisal 2013). In some cases, the inventors would serve as consultants or employees of the firms set up to develop their inventions. In other cases—for example, the U.S. glass industry in the late nineteenth and early twentieth centuries—inventors often lived in geographically distant locations from the manufacturers who made use of their inventions (Lamoreaux and Sokoloff 2000). Note that the latter inventors meet the definition of nonpracticing entities, and yet there was no stigma attached to their activities.

Although the most thoroughly documented historical examples of successful patent systems come from Great Britain and the United States, other examples can be found. Tom Nicholas and Hiroshi Shimizu (2013) present evidence that a vibrant patent market helps explain Japanese technological development and economic growth during the Meiji period (1868–1912). And in discussing Johann Peter Murmann's (2003) extensive analysis of the evolution of the successful German dye industry in the 1800s, Richard Nelson explains that "German patent law was tightened up[,] better enabling German firms to protect the new dyestuffs they created" (2008, 5). Later, the German dye industry proved useful in the development of the first antibiotics (Hager 2007).

Just as history provides examples of how well-enough-designed patent systems provided incentives and enabled funding for important inventions, it also provides examples of how an ill-designed or absent patent system slowed invention. For instance, no one went fast to market with sulfa drugs because they could not be patented, and so no one could profit from them (Hager 2007, 172). Patents and how they are designed provide incentives and funding that matter. In the past, when patent systems have had good enough rules and implementation, they have often provided inventors with the funds that have enabled the inventors to continue to invent.

How the U.S. Patent System Stopped Working Well

Starting in the 1970s, the U.S. Patent Office increasingly failed to make the traditional distinctions between what was patentable and what was not patentable (Levy 2012). This lowering of the standards may have been due in part to increasingly complex and specialized technology and in part to understaffing at the Patent Office. The result was a substantial growth in patents and especially a growth in low-quality patents.

Adam Jaffe and John Lerner identify two main changes in patent law that they believe further reduced the patent system's effectiveness (2004, 1–3). The first change was the creation in 1982 of the centralized Court of Appeals for the Federal Circuit to replace the previous circuit appeals courts (Hall and Ziedonis 2001; Hall 2005). The earlier system had inefficient and arbitrary aspects, with litigants shopping for the district court most likely to favor their side. For litigants willing to bear the added cost of appealing an initial district court ruling, the creation of the Court of Appeals for the Federal Circuit at least reduced the arbitrariness of differing district appeal courts. But it also had a couple of unintended consequences. One was a decline in the rigor of reevaluations of the validity of issued patents (Henry and Turner 2006). Another was that decisions from the new specialized court were much more consistently favorable to those claiming that their patents had been infringed, thus substantially increasing the number of lawsuits filed and defendants' litigation costs (Hall and Ziedonis 2001; Hall 2005; Henry and Turner 2006).

The second change that Jaffe and Lerner (2004) argue reduced the patent system's effectiveness occurred in the early 1990s when Congress changed the funding of the Patent and Trademark Office (PTO) from tax revenues to applicant fees, making PTO funding depend directly on the number of patents the PTO approved and at the same time diverting some of the applicant fees to provide revenue for general federal expenses. The changes in funding, combined with the explosion in patent applications, resulted in an underfunded PTO and changed the PTO's incentives from serving the public interest to serving the patent applicant's interest. As a result, patent applications received less scrutiny, and a growing number of low-quality patents were approved.

A third plausible change that reduced the patent system's effectiveness was the increase in venue shopping at the district court level, especially the substantial growth in patent cases litigated in the Eastern District of Texas (Creswell 2006). An early case that drew attention to the district as a mecca for plaintiffs was when Texas Instruments filed a patent-infringement lawsuit there against Samsung in 1996. The number of patent lawsuits filed there grew from less than fifty in 2002 to more than two hundred in 2006 (Creswell 2006). The growth has continued: of all defendants sued in 2011 in United States patent cases, 24 percent of them were sued in cases filed in the Eastern District of Texas, where plaintiffs win 78 percent of the time, in contrast to an average of 59 percent of the time in the rest of the United States (Watkins 2013, 29). Watkins documents the many dubious judicial practices in the Eastern District of Texas (2013, 29–33), leading Antonin Scalia to call the district "a renegade jurisdiction" (qtd. on 29).

Not all recent news, however, has been bad news. A U.S. General Accounting Office (2013) report found that in spite of a large increase in patent applications from 1991 through 2011, the number of patent-infringement lawsuits filed has varied little.[12] This could be interpreted as indicating that the costs of litigation are being exaggerated. Also, the percentage of cases won by plaintiffs has not increased over time. However, patent critics might follow Steven Levy (2012) in arguing that the costs of patent litigation should include the out-of-court settlements that result from threats of litigation. The incentive for the defendant to settle out of court is especially high when there is a chance that the plaintiff might win an injunction against the sale of the defendant's product during legal proceedings, which can often last several years.

Another important feature of recent patent history is the length of time required to resolve a patent lawsuit through the courts. An unexpected consequence of this time cost may be that those seeking to enforce their patents have increasingly turned to the U.S. International Trade Commission (ITC) under Section 337 of the Tariff Act of 1930 (Watkins 2013, 54). One advantage to plaintiffs of turning to Section 337 is the greater speed of decisions made by the ITC as compared with decisions made by federal district courts. Another advantage for plaintiffs is that for products produced abroad and then imported into the United States, a ban from the ITC based on patent infringement can have a similar effect as an injunction from a district or appeals court: a huge decline in the defendant's sales. The possibility of such a ban, like the possibility of an injunction, can provide a powerful incentive for a defendant to settle with the plaintiff, even where the merits of the case are dubious. In addition, it has been plausibly argued that Section 337 amounts to double

12. The number of lawsuits went up substantially in 2011, but that was attributed to the prohibition in the America Invents Act of including multiple defendants in the same lawsuit. (The act went into effect in 2011.)

jeopardy for defendants, is inconsistent with the principles of free trade, and is discriminatory against importers (Watson 2012).

The current common wisdom among economists is that in recent decades patents do not seem to increase invention except in the chemical and pharmaceutical industries (see, e.g., Crovitz 2009 and the sources cited in Hall and Harhoff 2012, 548–49). This stylized fact is used to argue that patents usually do not matter much and we might be better off without them: there appears to be little gain in terms of increasing incentives for invention and enabling funding for invention. And this lack of gain has to be weighed against the pain caused by patents hampering inventors' ability to build upon other inventors' contributions and the pain caused by patents increasing the cost of new products and hence slowing their adoption.

But there is a better interpretation of the stylized fact: the U.S. patent system, as currently implemented, may on balance have limited incentive and enabling effects. But this does not rule out the possibility that some patent systems in the past and a reformed patent system in the future (one adequately funded, wisely designed, and efficiently executed) have had and could have substantial incentive and enabling effects in a wide range of industries. And this outcome is more than just an idle theoretical possibility: the success of earlier patent systems provides credible grounds for believing that a reformed system can once again succeed.

Government Policy Reforms

Although admitting the problems with the current patent system since 1982, Jaffe and Lerner (2004) plausibly argue that the wise response is not to abolish the system, but to reform it. Bessen and Meurer (2008) are less sanguine but also suggest that useful reforms are possible. The exuberant polymath Nathan Myhrvold (2010) has provided an even more ambitious agenda for private entrepreneurial innovation of patent institutions. Promising improvements can take two forms. In this section, I consider the reform of government patent policies. In the next section, I consider private entrepreneurial institutional innovation, sometimes enabled by clever application of newly developed technologies.

The government policy reforms suggested here are tentative and will undoubtedly need to be revised in the light of further research and evolving technologies and institutions. There is much to learn about how changes in institutions and policies affect the quantity and quality of inventions. And even when we have learned what we can, there will always be unintended consequences. For instance, when Congress consolidated the patent appeal judiciary into one specialized court, they did not expect or intend that a consequence would be a much more favorable environment for plaintiffs.

The America Invents Act (AIA) was signed into law on September 16, 2011, and took effect on March 16, 2013. Patent-system analysts differ in their evaluation of the AIA. For instance, Alex Tabarrok believes it "did very little to improve the patent

system" (2011, loc. 310–11), whereas Watkins sees it as "a positive step" (2013, 57, see also 26–27). The first and most prominent feature of the law is that it aligns the United States with the rest of the world in awarding patents to the first to file rather than to the first to invent (Hurst 2013). Under the previous system, a patent holder always faced the uncertainty that her claim might be challenged by someone who came forward claiming to have invented earlier. Because it is easier to establish who was first to file than it is to establish who was first to invent, the expectation is that the AIA will both speed the patent-review process (thereby reducing the backlog) and reduce litigation costs. A second prominent feature of the AIA is that it offers larger discounts in patent fees to inventors holding four or fewer patents. Individual inventors will still need to bear the expense of paying lawyers to prepare the patent applications, but that was also true prior to the AIA. A third prominent feature of the AIA that would make it harder for nonpracticing entities to enforce their patents against infringers is that the AIA no longer allows more than one defendant to be sued in one patent-infringement lawsuit (Mossoff 2013). So now multiple lawsuits must be filed, where one previously sufficed. A fourth prominent feature of the law is the strengthening of the postgrant reexamination of patent validity with the establishment of the Patent Trial and Appeal Board. There is still uncertainty, however, about the effects of the AIA's various features because of the possibility of unintended consequences and because much depends on how the act is implemented.

But early evaluations of the implementation of the Patent Trial and Appeal Board suggest that the board has been inclined to side with those alleged patent infringers who challenge the validity of patents after being sued for patent infringement (Jones 2014; Powell 2014). Moreover, when both parties try to settle before a ruling, the board has been inclined to continue the proceeding anyway, putting the public interest in promoting high-quality patents above the litigating parties' desire to settle. If this implementation continues, it might reduce the likelihood that nonpracticing entities can obtain out-of-court settlements by threatening to sue for violation of low-quality (i.e., ultimately invalid) patents, which would discourage those nonpracticing entities that act as extortionists (or "trolls" in the original clear sense of the term).

The early evidence on the AIA supports Nathan Myhrvold's plausible suggestion that before we rush to implement additional reforms, we might want to wait a little bit to be able to better judge the AIA's effects (2013, 18, 20). But when we do consider additional reforms, one place to start would be to consider the advice of those who have carefully studied the U.S. patent system when it was functioning most successfully. Lamoreaux and Sokoloff, who have contributed much to documenting the important role of patents in early U.S. invention and innovation, are optimistic that if appropriate reforms to the patent system are implemented, the patent system may again play a major positive role in financing innovation in the United States (2007, 472). They emphasize in particular the implementation of the reforms in Jaffe and Lerner's (2004) thorough and much-discussed research on the recent history of the patent system in the United States.

In response to the problems in the current patent system, Jaffe and Lerner propose four reforms, the first to improve PTO funding and the other three to implement alternative processes to improve the quality of patents (2004, 206). I discuss these four suggested reforms in turn and then add three more. Finally, I discuss two plausible reforms that deserve further debate.

The first Jaffe and Lerner reform would be for Congress to fund the PTO directly and to increase funding levels. If the funds are used to hire more and better patent examiners, those examiners would have the time and skills to reject low-quality patent applications that fail the test of being new, useful, and nonobvious inventions. Some of the funds could also be used to hire and reward better management of the PTO. A recent director of the PTO said of his agency: "There is no company I know of that would have permitted its information technology to get into the state we're in. If it had, the C.E.O. would have been fired, the board would have been thrown out, and you would have had shareholder lawsuits" (David Kappos, qtd. in Wyatt 2011).

The second Jaffe and Lerner reform would be to set up a more effective process for the public to provide pregrant "prior art"[13] information to the PTO, perhaps using some form of crowd-sourcing. One way to make the pregrant process more efficient would be to allow the prompt publication of patent applications so that interested and informed members of the public can most quickly and efficiently provide information about prior art (2004, 155–57).

The third Jaffe and Lerner reform would be to set up a more effective process for postgrant reexamination of patents. The reexamination process can be made more effective by broadening the issues that can be raised, by using previously uninvolved patent examiners for the reexamination, and by allowing those who asked for the reexamination to retain their right to later challenge the decision in court (2004, 154–55).

The fourth Jaffe and Lerner reform would be to decrease the use of uninformed juries and increase the use of technically experienced judges and special examiners.[14] Because of the evidence requirements in jury trials, technically uninformed jurors have been found to be much more likely to decide in favor of undeserving plaintiffs than deserving defendants (2004, 195–97). The juries tend to be especially uninformed in the plaintiff-popular Eastern District of Texas, where the population tends to be older, less educated, and less experienced with technology (Watkins 2013, 30).

A fifth suggested reform would be to limit litigants' ability to venue-shop. Two possible methods to accomplish this reform should be considered: tighten the requirements that the venue should be a location where the litigants have substantial

13. In patent discussions, the phrase *prior art* refers to earlier patents, inventions, or practices that resemble or provide building blocks for the technology described in the patent application.

14. If the increased use of technically experienced judges and special examiners is judged to conflict with the right to a jury trial in civil cases, then an alternative might be to establish professional juries with experience or education in technology (Watkins 2013, 52).

business activity (Watkins 2013, 50–51) and establish a specialized patent court to replace the district courts as the venue for starting a patent case (Watkins 2013, 53).

A sixth suggested reform would be to further limit the use of injunctions by plaintiffs against defendants. The rationale for injunctions was that defendants should not benefit from their use of a disputed technology until after the case is settled. But another way to interpret an injunction is that it reverses the usual assumption of innocence and instead assumes that the defendant is guilty until proven innocent. With legal proceedings often lasting many months, if not a few years, the injunction can halt production and bankrupt a company even in cases where it is ultimately decided that the company had not been violating a valid patent. As a result, a great many companies will pay requested licensing fees in the face of a threatened lawsuit and injunction even when they firmly believe that the patent violation claim is groundless. In 2006, the Supreme Court ruled that greater care should be exercised in issuing injunctions (Levy 2012). Further legislation could strengthen the court's ruling.

A seventh suggested reform would be to repeal Section 337 of the Tariff Act of 1930. As discussed earlier, Section 337 amounts to double jeopardy for patent defendants who also happen to be importers. Because the common U.S. ITC remedy of a ban against importing is so severe, defendants have an incentive to settle even when they have not violated a valid patent. The repeal of Section 337 is justified because of both its use by plaintiffs as a tool of extortion and its use by protectionists as a tool to block competition.

Two additional plausible reforms should be further debated, but not yet advocated. A first plausible reform would be to shorten the length of patent terms, which might address in part the concern that patents can limit the cross-fertilization of ideas (as expressed in Johnson 2010, Ridley 2010, and Anderson 2012). The other side of the debate would be that if patents are shortened too much, they will serve neither fairness nor the enablement of ambitious inventing. Larry Page (2011) says that when he was twelve, while reading Tesla's autobiography, he cried at how Tesla's failure to receive funding for his inventions limited his ability to change the world. Page says he was determined to avoid Tesla's problem. With the help of the patent system, he succeeded, and now consumers can look forward to the freedom and independence of owning a driverless car. My hypothesis is that when inventors and entrepreneurs have enough of their own funding, so that they no longer need to persuade outside investors for funding, they can pursue riskier but potentially higher-payoff projects (Diamond 2012). I expect that the result would be more ex post "stupid" projects but that these projects would be outweighed by the few projects that turn out to be spectacularly "smart."

A second plausible reform would be to increase and systematize the current occasional practice of having plaintiffs pay defendants' court costs when the plaintiffs lose the case. Individual judges have already done this in particular cases (Coe 2008; Levy 2012). The hope among the advocates of this reform is that increasing the risks

of bringing lawsuits will decrease the number of frivolous lawsuits. The other side of the debate would be that this reform would also increase the uncertainty and expected costs for those filing serious lawsuits where an inventor's or inventor's agent's legitimate property rights are actually being infringed upon.

Private Entrepreneurial Institutional Innovations

Reforms of the government patent system may bring a renaissance of invention. But another important and underappreciated potential source of a renaissance is institutional entrepreneurship in the private sector. Unlike the specific government reforms advocated in the previous section, I do not strongly advocate specific entrepreneurial institutional innovations. As in examples of innovation more broadly, you cannot know of entrepreneurial innovations until someone has thought of them, so they cannot be predicted in advance. What you can do is provide past examples or present possible examples-in-progress. These examples provide a crucial proof of concept that institutional entrepreneurship can occur and be important. I do strongly advocate that we adopt policies that permit institutional entrepreneurship to occur. But first, for proof of concept, I offer three examples: (1) micropayments for Web content remains at the idea stage; (2) the iTunes system for paying for music content has been well implemented; and (3) Intellectual Ventures as a full-fledged marketplace for patents is at the early stages of implementation.

Bill Gates, perhaps with assistance from Nathan Myhrvold, wrote in *The Road Ahead* about tiny micropayments being made every time a website is visited (1995, 122). Many of his suggestions in the book have been implemented, but unfortunately this one is not among them. Micropayments would be small enough to allow the creative cross-fertilization advocated by Ridley (2010), Johnson (2010), and others, while still enabling creators to receive revenues that are their just reward and that provide them the means to continue to create. Micropayments might have been implemented and could still be, but they would require financial innovations from an entrepreneurial company, like the early PayPal, that would be hard to accomplish in the current regulatory environment. One of the cautionary aspects of Eric Jackson's account of the early years of PayPal is how the company was constrained by regulations lobbied for by rent-seeking incumbent banks that were threatened by PayPal's innovations (2004, 254).

What Bill Gates advocated for the written word, Steve Jobs achieved for the musical performance. Napster and similar music-downloading services had resulted in widespread pirating of music. Music label revenues had plummeted, and observers feared that music creation would increasingly be underfunded. Jobs believed that most people wanted to respect property rights if it was not made too hard for them to do so. So he created the iTunes system, which allowed customers to easily pay a small amount for each song they wanted to own. The magnitude of the breakthrough contributed to Apple's achieving in 2012 the highest market capitalization of any

company in the history of the world (Bradshaw and Dembosky 2012). One wonders whether Jobs might have made similar breakthroughs for the written word if only he had lived longer.

Nathan Myhrvold (2010)—formerly chief technology officer at Microsoft and cofounder of Intellectual Ventures, which is described by some as a "patent troll" and by Myhrvold as "a marketplace for intellectual property" ("Nathan Myhrvold" 2014)—is attempting to do for inventors what Jobs did for musicians: provide a viable institutional framework in which they can receive funding for their creative contributions (see also Levitt and Dubner 2010, 178; Lohr 2010). Myhrvold believes that a better system for funding individual inventors will result in more invention. Inventors will benefit from having more funding to pursue their creative inventions, and society will benefit from more and better inventions. Intellectual Ventures organizes its patents into pools, grouped by industry or technology.[15] The pooling serves several purposes: firms can buy the rights to pools in their area of activity and thereby increase the probability that they will not be shut out of a key technology; investors can invest in pools and diversify against the risk they would experience if they invested in a small number of inventions, each of which had a high probability of failure.

Myhrvold (2010) argues and economist Steven Levitt concurs (Levitt and Dubner 2010) that Intellectual Ventures is providing a service for both inventors and technology firms by helping make the market for inventions more transparent and efficient. Intellectual Ventures is intended in part to cut off the extortionist's power to impose huge gratuitous, unexpected litigation expenses. Myhrvold creates industry-related patent pools; firms subscribe, have access, and avoid litigation. The pools are intended to spread risk, reduce litigation, speed the diffusion of inventions, and, most importantly, provide enabling resources for inventors. Some inventors and licensees have testified that dealing with Intellectual Ventures has been mutually beneficial. Inventor Robert Osann explains the benefits of dealing with Intellectual Ventures: "I was planning to market my patents myself, but I paused to look at IV's offer. Could I have gotten more money? Very possibly. But how much work would it have taken? That was part of my decision [to sell to IV]—opportunity cost. This way I can put my time into my current start-up activities and work on other patents" (qtd. in Hagiu, Yoffie and Wagonfeld 2011, 7, bracketed words in original). Jeong Hwan Lee, an executive vice president at LG, explains the benefits to licensee LG of dealing with Intellectual Ventures: "Our alliance with IV gives us access to patents outside our core and allows us the freedom to focus on what's important in our industry—constant innovation" (qtd. in Hagiu and Fisher 2012, 1).

Evaluating the success of Intellectual Ventures at achieving its initial goals is difficult in part because this privately held company does not want to reveal too much

15. Myhrvold's idea is not without historical precedent. Adam Mossoff (2011) has documented how a private patent pool was formed in the 1850s that provided an antidote to the patent "thicket" in the sewing machine industry.

to competitors, so data about it are limited and often obtained from comments by Intellectual Ventures executives themselves. Another reason for the difficulty is that building new institutions for funding inventors through commercializing patents was expected to take many years (Hagiu and Yoffie 2013, 60). But some early evidence is available.

As of 2009, Intellectual Ventures had spent $315 million purchasing patents from individual inventors (N. Page 2009, 4; Levy 2012); as of September 12, 2013, Myhrvold stated that this amount had grown to more than $500 million (Myhrvold 2013, 7). As of 2009, Intellectual Ventures also had spent about $848 million purchasing patents from small- and medium-size enterprises as well as about $135 million funding the creation of patentable inventions internally (N. Page 2009, 4). By mid-2012, it had spent altogether about $2 billion in order to acquire about thirty-five thousand patents (Hagiu and Yoffie 2013, 59). On September 12, 2013, Nathan Myhrvold stated that Intellectual Ventures had about thirty-eight thousand patents (Myhrvold 2013, 16). So far it has pursued revenues mainly from licensing its patents. By mid-2012, however, it had filed four patent lawsuits, naming a total of twenty-one companies as defendants (Hagiu and Yoffie 2013, 59). The Intellectual Ventures website reports several additional lawsuits filed through 2013.

Some critics of Intellectual Ventures take the filing of lawsuits after several years of no filing as evidence that Intellectual Ventures is joining the nonpracticing entities that engage in extortion. But filing a lawsuit would only be extortion if the patent lawsuit was in defense of a low-quality patent; otherwise, filing a lawsuit is a legitimate remedy against theft of intellectual property, a remedy that serves both to satisfy justice and to encourage funding of inventions. Supporting Intellectual Ventures' claim that it is seeking legitimate remedy are its arguments that its litigated patents are of high quality. One argument is that with a total of roughly thirty-eight thousand patents, only a tiny percentage of which are litigated, it makes sense to select the high-quality patents to license and to litigate if infringed. Another argument is based on Intellectual Ventures' understanding that its licensing revenues depend in part on its patent portfolio's reputation for being of high quality (Hagiu and Yoffie 2013, 63). To litigate low-quality patents would be to depreciate the firm's reputation capital.

Some of Intellectual Ventures' actions support its claim that it views at least some of its patents as being of very high quality. For instance, it considers its patents on a kind of small nuclear reactor and on metamaterials (a kind of nanotech technology) to be of sufficient quality that it has spun off practicing entities (start-ups) to develop and manufacture the technologies (Myhrvold 2013, 3). The small nuclear reactor practicing entity is called "TerraPower" (Myhrvold 2013, 3), and the metamaterials practicing entities are called "Kymeta" and "Evolv" (Intellectual Ventures n.d.).

Some of the limited evidence so far supports the optimistic view that Intellectual Ventures may succeed. However, the common observation that entrepreneurs who attempt breakthrough innovations usually fail supports the pessimistic view that

Intellectual Ventures will probably fail. But even though breakthrough innovations usually fail, when they do succeed, they can "make a ding in the universe" that lengthens or improves life. It is too early to conclude whether Myhrvold's ambitious company Intellectual Ventures will be one of the usual failures or a rare success. But past rare successes, such as Jobs's iTunes, suggest that the benefits of success justify Myhrvold's attempt.

Conclusion

The light bulb is iconic of invention. Thomas Edison, its inventor, supported himself, his famous lab, and his future stream of inventions by the revenue generated from his past inventions. He patented early and often—revenues from patented inventions were an important part of what supported him. According to Matthew Josephson (1959), when the Edison bulb was being tested, the testers would report to each other, "The light still burns." And when Edison was dying, Edison's son, after visiting his father's sickroom, would report to well-wishers, "The light still burns." The question I have focused on here is whether patents can continue to play an important role in keeping the light of invention burning.

The number of advantages of patents are greater than the number of disadvantages, or at least they will be after suitable government policy reforms and private entrepreneurial institutional innovations. The core of my argument is that well-implemented patents can be fair, democratize the opportunity to invent, provide an incentive for invention, and, most importantly, provide inventors the funding to enable them to continue to invent.

I have presented a plausible past and a possible future. Patents have provided income to inventors and thus have motivated and enabled further invention. The current patent system has been criticized for increasing costly litigation and for discouraging innovation. However, it might once again be an important enabler of innovation if it were better funded and more efficiently administered, if we reform its rules, and if we allow entrepreneurial institutional innovations.

References

Abraham, Marc, dir. 2008. *Flash of Genius.* Universal Pictures.

Acemoglu, Daron, and James Robinson. 2012. *Why Nations Fail: The Origins of Power, Prosperity, and Poverty.* New York: Crown Business.

Allen, Robert C. 2009. *The British Industrial Revolution in Global Perspective: New Approaches to Economic and Social History.* Cambridge, U.K.: Cambridge University Press.

Anderson, Chris. 2012. *Makers: The New Industrial Revolution*. New York: Crown Business.

Associated Press. 2008. It's a Dog's Life Only When Someone Else Gets Treat. *Omaha World-Herald,* December 9.

Audretsch, David B., Werner Bönte, and Prashanth Mahagaonkar. 2012. Financial Signaling by Innovative Nascent Ventures: The Relevance of Patents and Prototypes. *Research Policy* 41, no. 8: 1407–21.

Baumol, William J. 2005. Education for Innovation: Entrepreneurial Breakthroughs versus Corporate Incremental Improvements. In *Innovation Policy and the Economy*, edited by Adam B. Jaffe, Josh Lerner, and Scott Stern, 33–56. Cambridge, Mass.: MIT Press.

Bessen, James, and Michael J. Meurer. 2008. *Patent Failure: How Judges, Bureaucrats, and Lawyers Put Innovators at Risk*. Princeton, N.J.: Princeton University Press.

Beston, Paul. 2008. Bookshelf: A Look Back at the New Age. *Wall Street Journal,* July 22.

Bhidé, Amar. 2008. *The Venturesome Economy: How Innovation Sustains Prosperity in a More Connected World*. Princeton, N.J.: Princeton University Press.

————. 2009. The Venturesome Economy: How Innovation Sustains Prosperity in a More Connected World. *Journal of Applied Corporate Finance* 21, no. 1 (2009): 8–23.

Blaug, Mark. 2005. Why Did Schumpeter Neglect Intellectual Property Rights? *Review of Economic Research on Copyright Issues* 2, no. 1: 69–74.

Boldrin, Michele, and David K. Levine. 2008. *Against Intellectual Monopoly.* Cambridge, U.K.: Cambridge University Press.

————. 2013. The Case against Patents. *Journal of Economic Perspectives* 27, no. 1: 3–22.

Bottomley, Sean. 2012. The British Patent System during the Industrial Revolution, 1700–1852. Ph.D. diss., University of Cambridge.

Bradshaw, Tim, and April Dembosky. 2012. Apple Hits Markets Milestone. *Financial Times,* August 21. Available at http://search.proquest.com/docview/1034452305?accountid=14692.

Brandt, Richard L. 2011. *One Click: Jeff Bezos and the Rise of Amazon.com*. New York: Portfolio/Penguin.

Brosnan, Sarah F., and Frans B. M. de Waal. 2003. Monkeys Reject Unequal Pay. *Nature* 425, no. 6955: 297–99.

Bryson, Bill. 2010. *At Home: A Short History of Private Life*. New York: Doubleday.

Burke, Martyn, dir. 1999. *Pirates of Silicon Valley.* Turner Network Television.

Coe, Ross E. 2008. The Mythology of Plutus IP: Federal Court Imposes Fees on Prominent "Patent Troll." *Legal Opinion Letter* (Washington Legal Foundation) 18, no. 17 (August 8). Available at http://www.wlf.org/upload/08-08-08coe.pdf.

Cole, Julio H. 2001a. Controversy: Would the Absence of Copyright Laws Significantly Affect the Quality and Quantity of Literary Output? *Journal of Markets & Morality* 4, no. 1: 112–19.

————. 2001b. Patents and Copyrights: Do the Benefits Exceed the Costs? *Journal of Libertarian Studies* 15, no. 4: 79–105.

Creswell, Julie. 2006. So Small a Town, so Many Patent Suits. *New York Times,* September 24.

Crovitz, L. Gordon. 2009. Opinion: Information Age; Why Technologists Want Fewer Patents. *Wall Street Journal,* June 15.

Darlin, Damon. 2010. Everybody's Business; Applause, Please, for Early Adopters. *New York Times,* May 9.

De Waal, Frans B. M. 2011. *Moral Behavior in Animals*. TED Talk, November 2011. Available at http://www.ted.com/talks/frans_de_waal_do_animals_have_morals.

Diamond, Arthur M., Jr. 2012. The Epistemology of Entrepreneurship. *Advances in Austrian Economics* 17: 111–42.

Epstein, Richard A. 2006. *Why Libertarians Shouldn't Be (Too) Skeptical on Intellectual Property.* Pamphlet in Progress on Point series. Washington, D.C.: Progress and Freedom Foundation.

Gates, Bill. 1995. *The Road Ahead*. New York: Viking Penguin.

Gilder, George. 1992. The Enigma of Entrepreneurial Wealth. *Inc.* 14, no. 10: 161–64, 166, 168.

Gordon, Robert J. 2000. Does the "New Economy" Measure Up to the Great Inventions of the Past? *Journal of Economic Perspectives* 14, no. 4: 49–74.

Graham, Stuart J. H., Robert P. Merges, Pam Samuelson, and Ted Sichelman. 2009. High Technology Entrepreneurs and the Patent System: Results of the 2008 Berkeley Patent Survey. *Berkeley Technology Law Journal* 24, no. 4: 1255–327.

Hager, Thomas. 2007. *The Demon under the Microscope: From Battlefield Hospitals to Nazi Labs, One Doctor's Heroic Search for the World's First Miracle Drug*. New York: Three Rivers Press.

———. 2008. *The Alchemy of Air: A Jewish Genius, a Doomed Tycoon, and the Scientific Discovery That Fed the World but Fueled the Rise of Hitler*. New York: Harmony.

Hagiu, Andrei, and Noah Fisher. 2012. *Intellectual Ventures (B)*. Harvard Business School Case no. 713-435. Cambridge, Mass.: Harvard Business School Publishing.

Hagiu, Andrei, and David B. Yoffie. 2013. The New Patent Intermediaries: Platforms, Defensive Aggregators, and Super-aggregators. *Journal of Economic Perspectives* 27, no. 1: 45–66.

Hagiu, Andrei, David B. Yoffie, and Alison Wagonfeld. 2011. *Intellectual Ventures*. Harvard Business School Case no. 710-423. Cambridge, Mass.: Harvard Business School Publishing.

Hall, Bronwyn H. 2005. Exploring the Patent Explosion. *Journal of Technology Transfer* 30, nos. 1–2: 35–48.

Hall, Bronwyn H., and Dietmar Harhoff. 2012. Recent Research on the Economics of Patents. *Annual Review of Economics* 4, no. 1: 541–65.

Hall, Bronwyn H., and Rosemarie Ham Ziedonis. 2001. The Patent Paradox Revisited: An Empirical Study of Patenting in the U.S. Semiconductor Industry, 1979–1995. *Rand Journal of Economics* 32, no. 1 (Spring): 101–28.

Helmers, Christian, and Mark Rogers. 2010. Innovation and the Survival of New Firms in the UK. *Review of Industrial Organization* 36, no. 3: 227–48.

———. 2011. Does Patenting Help High-Tech Start-Ups? *Research Policy* 40, no. 7: 1016–27.

Henry, Matthew D., and John L. Turner. 2006. The Court of Appeals for the Federal Circuit's Impact on Patent Litigation. *Journal of Legal Studies* 35, no. 1: 85–117.

Hiltzik, Michael A. 2000. *Dealers of Lightning: Xerox PARC and the Dawn of the Computer Age*. New York: HarperBusiness.

Hughes, Sally Smith. 2011. *Genentech: The Beginnings of Biotech*. Chicago: University of Chicago Press.

Hughes, Thomas P. 1989. *American Genesis: A Century of Invention and Technological Enthusiasm*. New York: Viking Penguin.

Hurst, Nathan. 2013. How the America Invents Act Will Change Patenting Forever. *Wired Design,* blog edited by Cliff Kuang, March 14. Available at http://www.wired.com/design/2013/03/america-invents-act/all/.

Informed Reader; Technology; Small Teams Advance Open-Source Effort. 2007. *Wall Street Journal,* June 6.

Intellectual Ventures, Spinouts & Programs. n.d. Available at http://www.intellectualventures.com/inventions-patents/spinouts-programs. Accessed March 3, 2014.

Isaacson, Walter. 2011. *Steve Jobs*. New York: Simon & Schuster.

Jackson, Eric M. 2004. *The PayPal Wars: Battles with eBay, the Media, the Mafia, and the Rest of Planet Earth.* Los Angeles: World Ahead.

Jaffe, Adam B., and Josh Lerner. 2004. *Innovation and Its Discontents: How Our Broken Patent System Is Endangering Innovation and Progress, and What to Do about It*. Princeton, N.J.: Princeton University Press.

Johnson, Steven. 2010. *Where Good Ideas Come From: The Natural History of Innovation*. New York: Riverhead Books.

Jones, Ashby. 2014. New Weapon in Intellectual Property Wars; Panel Can Upend Patent Decisions, but Some Say It Goes Too Far; "Like Getting CAT-Scanned, MRI-ed, and X-Rayed." *Wall Street Journal,* March 11.

Josephson, Matthew. 1959. Edison: Last Days of the Wizard. *American Heritage* 10, no. 6. Available at http://www.americanheritage.com/articles/magazine/ah/1959/6/1959_6_32.shtml.

Kanefsky, John, and John Robey. 1980. Steam Engines in Eighteenth-Century Britain: A Quantitative Assessment. *Technology and Culture* 21, no. 2: 161–86.

Kelly, Kevin. 2010. *What Technology Wants*. New York: Viking Adult.

Kerschner, Isabel. 2007. The Kibbutz Sheds Socialism and Regains Lost Popularity. *New York Times,* August 27.

Khan, B. Zorina. 2005. *The Democratization of Invention: Patents and Copyrights in American Economic Development, 1790–1920*. National Bureau of Economic Research (NBER) Series on Long-Term Factors in Economic Development. Cambridge, U.K.: Cambridge University Press.

Khan, B. Zorina, and Kenneth L. Sokoloff. 1993. "Schemes of Practical Utility": Entrepreneurship and Innovation among "Great Inventors" in the United States, 1790–1865. *Journal of Economic History* 53, no. 2: 289–307.

————. 2001. The Early Development of Intellectual Property Institutions in the United States. *Journal of Economic Perspectives* 15, no. 3: 233–46.

————. 2006. Institutions and Technological Innovation during Early Economic Growth: Evidence from the Great Inventors of the United States, 1790–1930. In *Institutions, Development, and Economic Growth,* edited by Theo S. Eicher and Cecilia Garcia-Penalosa, 123–58. Cambridge, U.K.: Cambridge University Press.

Lakdawalla, Darius, and Tomas Philipson. 2012. Does Intellectual Property Restrict Output? An Analysis of Pharmaceutical Markets. *Journal of Law & Economics* 55, no. 1: 151–87.

Lamoreaux, Naomi R., Daniel M. G. Raff, and Peter Temin. 1999. Introduction to *Learning by Doing in Markets, Firms, and Countries,* edited by Naomi R. Lamoreaux, Daniel M. G. Raff, and Peter Temin, 1–17. Chicago: University of Chicago Press.

Lamoreaux, Naomi R., and Kenneth L. Sokoloff. 1999. Inventors, Firms, and the Market for Technology in the Late Nineteenth and Early Twentieth Centuries. In *Learning by Doing in Markets, Firms, and Countries,* edited by Naomi R. Lamoreaux, Daniel M. G. Raff, and Peter Temin, 19–57. Chicago: University of Chicago Press.

———. 2000. The Geography of Invention in the American Glass Industry, 1870–1925. *Journal of Economic History* 60, no. 3: 700–29.

———. 2001. Market Trade in Patents and the Rise of a Class of Specialized Inventors in the 19th-Century United States. *American Economic Review* 91, no. 2: 39–44.

———. 2007. *Financing Innovation in the United States, 1870 to the Present.* Cambridge, Mass.: MIT Press.

Lamoreaux, Naomi R., Kenneth L. Sokoloff, and Dhanoos Sutthiphisal. 2013. Patent Alchemy: The Market for Technology in U.S. History. *Business History Review* 87, no. 1: 3–38.

Levitt, Steven D., and Stephen J. Dubner. 2010. *Super Freakonomics: Global Cooling, Patriotic Prostitutes, and Why Suicide Bombers Should Buy Life Insurance.* New York: Penguin Books.

Levy, Steven. 2012. The Patent Problem. *Wired* 20, no. 12 (December): 202–33. Available at http://find.galegroup.com/gic/infomark.do?&source=gale&idigest=acf013785b7f84e51f3f81659ed72a11&prodId=GIC&userGroupName=omah52829&tabID=T003&docId=A313863990&type=retrieve&contentSet=IAC-Documents&version=1.0.

Locke, John. [1689] 1967. *Two Treatises of Government.* 2nd ed. Cambridge, U.K.: Cambridge University Press.

Lohr, Steve. 2010. Turning Patents into "Invention Capital." *New York Times,* February 18.

McCloskey, Deirdre N. 1985. *The Applied Theory of Price.* 2nd ed. New York: Macmillan.

———. 2010. *Bourgeois Dignity: Why Economics Can't Explain the Modern World.* Chicago: University of Chicago Press.

McNeil, Donald G., Jr. 2013. Promising Tool in Difficult Births: A Plastic Bag. *New York Times,* November 14.

Merges, Robert. 2007. *Review of Software Patents: Economic Impacts and Policy Implications* by Knut Blind, Jakob Edler, and Michael Friedewald and *The Democratization of Invention: Patents and Copyrights in American Economic Development, 1790–1920* by B. Zorina Khan. *Journal of Economic Literature* 45, no. 2: 451–59.

Mill, John Stuart. [1848] 1909. *Principles of Political Economy.* 9th ed. London: Longmans, Green.

Mokyr, Joel. 2009. Intellectual Property Rights, the Industrial Revolution, and the Beginnings of Modern Economic Growth. *American Economic Review* 99, no. 2: 349–55.

Moser, Petra. 2005. How Do Patent Laws Influence Innovation? Evidence from Nineteenth-Century World Fairs. *American Economic Review* 95, no. 4: 1214–36.

————. 2011. Do Patents Weaken the Localization of Innovations? Evidence from World's Fairs. *Journal of Economic History* 71, no. 2: 363–82.

————. 2012. Innovation without Patents: Evidence from World's Fairs. *Journal of Law & Economics* 55, no. 1: 43–74.

Mossoff, Adam. 2011. A Stitch in Time: The Rise and Fall of the Sewing Machine Patent Thicket. *Arizona Law Review* 53, no. 1: 165–211.

————. 2013. GAO Report Confirms No "Patent Troll" Litigation Problem. Center for the Protection of Intellectual Property blog, October 4. Available at http://cpip.gmu.edu/2013/10/04/gao-report-confirms-no-patent-troll-litigation-problem/.

Murmann, Johann Peter. 2003. *Knowledge and Competitive Advantage: The Coevolution of Firms, Technology, and National Institutions.* Cambridge Studies in the Emergence of Global Enterprise. Cambridge, U.K.: Cambridge University Press.

Myhrvold, Nathan. 2004. Foreword to Evan I. Schwartz, *Juice: The Creative Fuel That Drives World-Class Inventors,* ix–xii. Boston: Harvard Business School Press.

————. 2010. The Big Idea: Funding Eureka! *Harvard Business Review* 88, no. 2: 40–50.

————. 2012. Deadline Approaches on Survival of Newspapers: Nathan Myhrvold. *Bloomberg View,* January 23. Available at http://www.bloomberg.com/news/2012-01-23/deadline-approaches-on-survival-of-newspapers-nathan-myhrvold.html.

————. 2013. The Future of Invention—What's at Risk? Interviewed by Adam Mossoff. *Intellectual Ventures,* September: 1–21.

"Nathan Myhrvold." 2014. *Wikipedia,* July 15. Available at http://en.wikipedia.org/wiki/Nathan_Myhrvold.

Nelson, Richard R. 2008. What Enables Rapid Economic Progress: What Are the Needed Institutions? *Research Policy* 37, no. 1: 1–11.

Nicholas, Tom, and Hiroshi Shimizu. 2013. Intermediary Functions and the Market for Innovation in Meiji and Taishō Japan. *Business History Review* 87, no. 1: 121–49.

Nordhaus, William D. 1969. An Economic Theory of Technological Change. *American Economic Review* 59, no. 2: 18–28.

North, Douglass C. 1981. *Structure and Change in Economic History.* New York: Norton.

Nozick, Robert. 1974. *Anarchy, State, and Utopia*. New York: Basic Books.

Nuvolari, Alessandro. 2006. The Making of Steam Power Technology: A Study of Technical Change during the British Industrial Revolution. *Journal of Economic History* 66, no. 2: 472–76.

Nuvolari, Alessandro, and Bart Verspagen. 2009. Technical Choice, Innovation, and British Steam Engineering, 1800–50. *Economic History Review* 62, no. 3: 685–710.

Nuvolari, Alessandro, Bart Verspagen, and Nick von Tunzelmann. 2011. The Early Diffusion of the Steam Engine in Britain, 1700–1800: A Reappraisal. *Cliometrica* 5, no. 3: 291–321.

Page, Larry. 2011. Highlights—Larry Page at Zeitgeist Americas 2011. Available at http://www.youtube.com/watch?v=YNGZu3WGstw.

Page, Nigel. 2009. IV Shifts Gear. *Intellectual Asset Management Magazine*, no. 36: 1–11.

Perlroth, Nicole. 2014. A Contradiction at the Heart of the Web. *New York Times,* April 19.

Phelps, Marshall, and David Kline. 2009. *Burning the Ships: Intellectual Property and the Transformation of Microsoft*. Hoboken, N.J.: Wiley.

Powell, Lane. 2014. Patent Holders Beware in America Invents Act Review Proceedings. *Lexology*, blog, February 18. Available at http://www.lexology.com/library/detail.aspx?g=bd69dec2-8756-4f5f-9e24-c092318414cc.

Price, Leah. 2010. American Girl. *New York Times Book Review,* December 12.

Rand, Ayn. 1966. Patents and Copyrights. In *Capitalism: The Unknown Ideal,* 125–29. New York: New American Library.

Range, Friederike, Lisa Horn, Zsôfia Viranyi, and Ludwig Huber. 2009. The Absence of Reward Induces Inequity Aversion in Dogs. *Proceedings of the National Academy of Sciences of the United States of America* 106, no. 1: 340–45.

Ridley, Matt. 2010. *The Rational Optimist: How Prosperity Evolves.* New York: Harper.

Risch, Michael. 2012. Patent Troll Myths. *Seton Hall Law Review* 42, no. 2: 457–99.

Rosen, William. 2010. *The Most Powerful Idea in the World: A Story of Steam, Industry, and Invention*. New York: Random House.

Schumpeter, Joseph A. 1950. *Capitalism, Socialism, and Democracy.* 3rd ed. New York: Harper and Row.

Schwartz, Evan I. 2004. *Juice: The Creative Fuel That Drives World-Class Inventors.* Boston: Harvard Business School Press.

Selgin, George, and John L. Turner. 2006. James Watt as Intellectual Monopolist: Comment on Boldrin and Levine. *International Economic Review* 47, no. 4: 1341–48.

———. 2009. Watt, Again? Boldrin and Levine Still Exaggerate the Adverse Effect of Patents on the Progress of Steam Power. *Review of Law and Economics* 5, no. 3: 1101–13.

———. 2011. Strong Steam, Weak Patents, or the Myth of Watt's Innovation-Blocking Monopoly, Exploded. *Journal of Law and Economics* 54, no. 4: 841–61.

Slack, Charles. 2002. *Noble Obsession: Charles Goodyear, Thomas Hancock, and the Race to Unlock the Greatest Industrial Secret of the Nineteenth Century.* New York: Hyperion.

Sokoloff, Kenneth L. 1988. Inventive Activity in Early Industrial America: Evidence from Patent Records, 1790–1846. *Journal of Economic History* 48, no. 4: 813–50.

Sokoloff, Kenneth L., and B. Zorina Khan. 1990. The Democratization of Invention during Early Industrialization: Evidence from the United States, 1790–1846. *Journal of Economic History* 50, no. 2: 363–78.

Stigler, George J. 1968. A Note on Patents. In *The Organization of Industry,* edited by George J. Stigler, 123–25. Homewood, Ill.: Richard D. Irwin.

Stross, Randall E. 2007. *The Wizard of Menlo Park: How Thomas Alva Edison Invented the Modern World*. New York: Crown.

Tabarrok, Alex. 2011. *Launching the Innovation Renaissance: A New Path to Bring Smart Ideas to Market Fast.* Kindle ed. only. New York: TED Books.

Thomson, Ross. 2009. *Structures of Change in the Mechanical Age: Technological Innovation in the United States, 1790–1865.* Baltimore: Johns Hopkins University Press.

U.S. General Accounting Office. 2013. *Intellectual Property: Assessing Factors That Affect Patent Infringement Litigation Could Help Improve Patent Quality.* Washington, D.C.: U.S. Government Printing Office.

Von Hippel, Eric. 1988. *The Sources of Innovation*. New York: Oxford University Press.

———. 2005. *Democratizing Innovation*. Cambridge, Mass.: MIT Press.

Wade, Nicholas. 2013. Girl's Bones Bear Signs of Cannibalism by Starving Virginia Colonists. *New York Times,* May 2.

Wagner, Stefan, and Iain M. Cockburn. 2010. Patents and the Survival of Internet-Related IPOs. *Research Policy* 39, no. 2: 214–28.

Wakabayashi, Daisuke, and Rolfe Winkler. 2014. Apple, Google End Patent Battle. *Wall Street Journal,* May 17.

Wascher, Claudia A. F., and Thomas Bugnyar. 2013. Behavioral Responses to Inequity in Reward Distribution and Working Effort in Crows and Ravens. *PLoS ONE* 8, no. 2: 1–9.

Wasserman, Noam. 2012. *The Founder's Dilemmas: Anticipating and Avoiding the Pitfalls That Can Sink a Startup*. Princeton, N.J.: Princeton University Press.

Watkins, William J., Jr. 2014. *Patent Trolls: Predatory Litigation and the Smothering of Innovation*. Oakland, Calif.: The Independent Institute.

Watson, K. William. 2012. *Still a Protectionist Trade Remedy: The Case for Repealing Section 337*. Policy Analysis no. 708. Washington, D.C.: Cato Institute.

Wild, Joff. 2008. The Real Inventors of the Term "Patent Troll" Revealed. *Intellectual Asset Management Magazine,* blog, August 22. Available at http://www.iam-magazine.com/blog/detail.aspx?g=cff2afd3-c24e-42e5-aa68-a4b4e7524177.

Winder, Gordon M. 2012. *The American Reaper: Harvesting Networks and Technology, 1830–1910*. Farnham, U.K.: Ashgate.

Wozniak, Steve, and Gina Smith. 2006. *iWoz: Computer Geek to Cult Icon: How I Invented the Personal Computer, Co-founded Apple, and Had Fun Doing It*. New York: Norton.

Wyatt, Edward. 2011. U.S. Sets 21st-Century Goal: Building a Better Patent Office. *New York Times,* February 21.

Zingales, Luigi. 2009. Capitalism after the Crisis. *National Affairs,* no. 1: 22–35.

———. 2012. *A Capitalism for the People: Recapturing the Lost Genius of American Prosperity.* New York: Basic Books.

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