

5/21/09

# Market Structure and Property Rights in Open Source

## Industries

Michele Boldrin

David K. Levine\*

### INTRODUCTION

From a historical perspective, open source industries are the opposite of an exception: They are the rule that almost every emerging industry has followed through the centuries. Economic growth, one is tempted to argue, owes more to the open source approach to economic and industrial innovation than to almost any other institutional arrangement apart from private property. We are not trying to be provocative; the last statement should be taken literally, at least from a historical perspective. Reciprocal imitation-*cum*-improvement among a relatively large set of innovators is the way in which new and

successful industries have almost always developed in societies where some form of private property was allowed and profit-seeking private initiative permitted. There are, among emerging industries, a few remarkable exceptions to the innovation-imitation-improvement ("3-I") dynamics. One example is the various "tele"-something enterprises of the first half of the 20th century: telegraph, telephone, and television. But even in these cases, it was not for lack of many simultaneous innovators-entrepreneurs that the 3-I dynamics did not emerge. Rather, patent laws and a bit of luck allowed a few (even likely undeserving ones, as in the case of Alexander Graham Bell<sup>1</sup>) to play the role of the big monopolist from the start. Absent a dominant monopolist, well protected by an armor of patents, most industries seem to develop by means of the 3-I dynamics that open source arrangements make possible and fuel.

Open source ("OS"), as a general method of allocating

property rights among the products of innovative activity, can be formalized in a few simple rules.

First, the inventor owns the objects produced, but not the general "idea" or "principle" behind them, which can be used by others and are not kept secret intentionally. Other individuals and firms are not legally excluded from the using such ideas or principles.

Second, competitors are, therefore, free to imitate and improve on others' discoveries, as long as this is achieved voluntarily and without coercion, and as long as the goods and services used are lawfully purchased.

Finally, ideas are more or less voluntarily disseminated, either via organized networks or informally, through the interaction of industry participants.

Upon a little reflection, it is easy to see that these are the characteristics of any competitive industry in which legal

instruments that exclude competitors from using others' ideas are not used to erect barriers to entry. In spite of the current trend toward Universal Intellectual Property ("UIP"), competitive industries are still widespread, including the OS system. A few of the most frequently encountered industries include the retail trade and wholesale distribution sectors; the transportation sector and the airline industry in particular; the clothing industry (especially fashion); the food and beverage industries; the furniture and home appliance industries; and the (now temporarily infamous) mortgage industry and the financial sector more generally, where imitation and innovation go hand in hand. If we take time to look back at history, OS appears everywhere, so much so that it is worth mentioning only the more dramatic cases. These include situations in which the transmission and dissemination of ideas among competitors took place in a semi-organized or even

cooperative form: the Cornish engine of the first half of the 19th century; the Japanese cotton-spinning industry between the 19th and the 20th centuries; the Bangladesh garment industry in the late 20th century; the oxygen steel-making industry in the middle 20th century; the horticultural industry of Almeria since the 1980s; and the Italian shoes, apparel, ceramic, and leather districts at least since the end of World War II.

Interestingly, economists, especially those concerned with the theory of innovation and economic growth, have tended to ignore such examples. This might be why the many contemporaneous OS markets (among which the one for OS software is attracting special attention) are not well understood by them. The only three studies considering the economic implications of OS software are by Hann, Roberts, Slaughter, and Fielding;<sup>2</sup> Lerner and Tirole;<sup>3</sup> and Llanes.<sup>4</sup> A central source of surprise is that innovation can thrive in a market without traditional

intellectual property; this is something that, according to established economic theory, should not happen. This leads many pundits and economists alike to interpret the OS organization in the software (and now bioengineering) sector as a kind of "gift exchange" arrangement. Established economic theory fails to understand which set of incentives could motivate people to engage in the costly activity of innovating in absence of intellectual property; OS is an aberration that standard economic theory cannot explain.

In fact, as a matter of theory, we have argued that there is no reason to believe that intellectual property or monopoly power is needed for innovation.<sup>5</sup> The market for OS software is the poster child for this perspective. Llanes is the first paper that appears to understand how OS and proprietary models of innovation can coexist in the same industry, and to provide a theoretical model of such coexistence.<sup>6</sup>

We will use this introduction to summarize briefly the reasons why OS industries should not come as a surprise to economists well trained in traditional competitive theory, and to dissect the economic logic underpinning them. Next we discuss the logical contradictions (or the plain neglect of facts) behind the common misconception that an OS industry is not viable. Because this misconception is the dominant view both among economists and legal scholars, we will spend more time on the *pars destruens* than on the *pars construens*, for, paradoxically, the former seems to be still more necessary than the latter. This is again explained by the fact that OS markets are the rule, not the exception. Nevertheless, people working in the area of intellectual property appear unable to see their existence and account for it theoretically, due to the distorting analytical lenses they are wearing. It is upon those distorting lenses we aim our fire.

First, understand that an OS market is the classic example of a competitive market. It is characterized by the voluntary renunciation of copyright and patent rights. Buyers are entitled to make copies of the original product they purchased, modified or not, and sell them. "Free software" in this context means free as in freedom, not free as in beer.<sup>7</sup> There is also voluntary renunciation of trade-secrecy; the original creator publishes the source code—the "blueprint" for producing the software—along with the software itself. Some OS software has the further requirement that as a condition of use, buyers make their modifications available under the same terms.<sup>8</sup> More generally, in OS industries other than the software industry, different kinds of formal or informal arrangements ensure that users of "common inventions" do not exclude potential competitors from access and that the relevant information about innovations circulates widely. The OS movement has been criticized, described in ways



ranging from a hindrance<sup>9</sup> to socialistic,<sup>10</sup> so it might be surprising to hear it called a model of perfect competition. Yet that is what it is, as much so as the market for wheat. Every purchaser of software can compete with the seller and one another, and they often do.

Given that there are fixed costs of producing software and (it is commonly thought) competition drives profits to zero, how does this market function? How are the fixed costs covered? In the absence of profits from monopoly power, the source of income used to pay fixed costs is competitive rent. In our research we have investigated three issues. First, what is the source of the competitive rents that pay the bills of software developers? Second, is the market a real market? That is, do software producers get adequate compensation for the fixed costs of their efforts? Or is OS software, as is sometimes alleged, simply an elaborate altruistic charity? Finally, we ask how significant

the OS software market is. Is it a thriving source of innovation or a free-rider off the innovations of more traditional closed-source IP-protected software, making cheap imitations of software that never would have been produced in the first place absent monopoly power?

The evidence (and the common sense of anyone involved with OS software) shows that the source of competitive rents is the complementary sale of expertise. That is, to earn a rent through the sale of something, it must be something in short supply.

Copies of software may be in short supply, but we shall see that the duplication of copies is sufficiently quick so that only small rents can be obtained through the sale of copies.

Purchasers of copies of software programs, however, also have a demand for services, ranging from support and consulting to customization.<sup>11</sup> They naturally prefer to hire the creators of the programs who in the process of writing the software have

developed specialized expertise that is not easily matched by imitators.

To understand the sources of competitive rents in this market, it is helpful to look at an example. A leading OS software firm is Red Hat, a company that sells distributions of the operating system GNU/Linux.<sup>12</sup> This is a modified and customized version of the underlying system with many features that can be optionally installed. Although the base system is in principle obtained by Red Hat for free, in fact the company pays the developers. Alan Cox, one of the main kernel developers, previously worked for Red Hat.<sup>13</sup> Red Hat also is a contributor to the Open Source Development Lab ("OSDL") that employs Linus Torvalds, who also benefited from a substantial "gift" of stock options from Red Hat.<sup>14</sup> Beyond this, the customization and testing conducted by Red Hat is costly. So Red Hat faces a substantial fixed cost of providing "Red Hat" brand software.

Let us first consider rents earned through the sale of physical copies. First, in this market, physical copies of software sell for greater than marginal cost. Using prices quoted on the Internet on July 10, 2002, Red Hat charged \$59.95 for a package containing its system.<sup>15</sup> Because it is based on the underlying GNU/Linux system, competitors can legally duplicate and sell the exact same "Red Hat" system. In fact, at least two companies, Hcidesign and Linuxemporium, did exactly this. On July 10, 2002, Hcidesign offered for sale Red Hat Linux 7.2 for a price of \$16.00, about one-third the price charged by Red Hat.<sup>16</sup> Linuxemporium.co.uk offered a similar deal.<sup>17</sup> Nevertheless, Red Hat sold many more \$59.95 packages than Hcidesign and Linuxemporium did \$16.00 packages.<sup>18</sup> These companies never represented a dangerous market threat to Red Hat.

Notice that the premium charged by Red Hat was not likely due to the physical scarcity of copies. Rather, the premium

resulted from the sale of expertise that came with developing the system. Anyone who has used computer software knows that it rarely functions as expected. If you bought software and had a question or problem, whom would you prefer to call: the people who wrote and developed the program, or the people who duplicated the CD? In fact, the sale of expertise by charging a premium on physical copies has not turned out to be the most successful business model. Red Hat eventually concluded that it was not selling enough \$59.95 copies and switched to a different revenue model.<sup>19</sup> What previously had been sold is now given away for free as "Fedora Core" and is used as a platform to get feedback on features that are incorporated into the commercial system called "Red Hat Enterprise Linux."<sup>20</sup> The latter is available only by annual subscription at a price that, depending on features, on August 24, 2005, ranged from \$349 to \$2,499.<sup>21</sup>

The following blurb from Red Hat promotional material on its Web

site makes clear what it is for which people are paying:

"Unlimited access to service and support: Subscriptions include ongoing service and support to guarantee your systems remain secure, reliable, and up-to-date. When you have a technical question, you'll speak to Red Hat Certified Engineers. Or you can access a self-serve knowledgebase of technical information."<sup>22</sup>

Notice how this market works: First expertise is passed from the developers to "Red Hat Certified Software Engineers." As time goes on, others acquire the expertise, the stock of expertise expands, and the price at which it can be sold decreases. Of course, in the meantime new innovations are created and new expertise is generated.

The presence of profitable firms such as Red Hat—not to mention IBM—in the OS industry suggests that it is a viable business and not an altruistic activity. Lerner and Tirole have

documented some of the financial benefits that are available for contributors to OS projects.<sup>23</sup> For example, the programmers who develop the Apache webserver are ranked according to the significance of their contributions and hold other jobs. Work by Hann, Roberts, Slaughter, and Fielding shows that the salaries they receive in these other jobs is heavily influenced by their rank within the Apache organization.<sup>24</sup> In other words, the "expertise" model at the Apache Foundation is much like that in academia: The software writers write software to receive recognition and financial payment for the expertise they demonstrate through their published product.

Examination of particular individual developers reinforces this point. Linus Torvalds is a multi-millionaire,<sup>25</sup> and Bram Cohen, the developer of BitTorrent, recently received \$8.75 million in venture capital funding for his OS project.<sup>26</sup> These figures and the success of OS software also teach us something

important about the (expected) payments needed to get smart people such as Torvalds or Cohen to develop innovative software.

It is unlikely that Linus Torvalds originally wrote Linux with the aim of becoming a multi-millionaire, yet he must have had some hope for revenue stream when starting his work. His current wealth is probably higher than he actually expected, yet it is considerably less than that of someone like Bill Gates.<sup>27</sup> Hence, at least in the case of Linus Torvalds, the opportunity cost for writing innovative software is not in the tens of billions of dollars, but only in the millions. This is worth keeping in mind when someone claims that, without the huge monopoly, rents innovators would not be innovating. It is equally significant that this thriving and innovative industry is financed largely through competitive rents.

Finally, it is possible to imagine that OS is not a real industry at all. It could be that it exists only because it is



able to free-ride off the innovations created in the proprietary part of the industry, in which the monopoly power of copyright plays a key role. Certainly, it is true that Linux is a knock-off of Unix and that Openoffice Writer is a knock-off of Microsoft Word. But this means little because practically all software, proprietary or not, is an imitation of some other software. Microsoft Windows is an imitation of the Macintosh, which is an imitation of Smalltalk. Microsoft Word is an imitation of Wordperfect, which is an imitation of Wordstar. Microsoft Excel is an imitation of Lotus 1-2-3, which is an imitation of Visicalc.<sup>28</sup> And so forth, and so on.

A good example is the webserver.<sup>29</sup> The first webserver was written by Tim Berners-Lee at CERN in 1990<sup>30</sup> and was followed shortly by the NCSA webserver written by Robert McCool.<sup>31</sup> Neither of these saw much commercial use, both were public domain, and both were effectively publicly funded. This initial pattern is

similar to the way that basic research (for example in pharmaceuticals, which is generally publicly funded) gets new lines of innovation and production started. Following this, Netscape Corporation introduced a proprietary webserver and at about the same time Apache took over the code from the NCSA webserver.<sup>32</sup> Both of these servers survive today, with the Netscape server having mutated into the Sun One webserver, and Apache having become the dominant force in the webserver industry.

Apache is currently the leading webserver on the Internet, holding a greater than 45% market share.<sup>33</sup> Many new features have been added to Apache since its inception, as well as to the competing Microsoft product.<sup>34</sup> The evidence suggests that Apache has been at least as innovative as the others in introducing new features. Certainly there is no evidence here that the OS model was less able than the proprietary model to turn a basic

experimental idea into a commercially viable product, or that it free-rode off of ideas developed in a proprietary product.

Another interesting case is that of word processing. Many OS alternatives to Microsoft Word exist, including Kword, AbiWord, and OpenOffice Writer, the latter being the most widely used.<sup>35</sup> How did the cost of developing this software—financed as it was by an OS model—compare to the cost of developing Microsoft Word? The fact is that most of the cost of writing software is not in the observation that it might be nice to have a button to justify text, or in the algorithms for spacing lines (which were, after all, developed by Gutenberg back in 1450<sup>36</sup>) but rather in the detailed implementation and debugging of computer code. As far as we know, none of these OS projects benefited at all from the work done by Microsoft in developing its detailed computer code. Indeed, the development of these OS projects was probably more expensive than the development of

Microsoft Word. The single most difficult and expensive programming task faced by the developers of these projects appears to be the need to reverse engineer Microsoft Word documents and to provide compatible formatting capability so that documents in Microsoft Word are usable and other documents can be exchanged with Microsoft Word. Had these projects gone first, this substantial cost would have been avoided. It is also worth noting that the competitive rents generated by these projects are significantly smaller than they would have been had they hit the market before Microsoft Word. It thus seems reasonable to conclude that perfect competition would have delivered both these programs, as it did, and Microsoft Word as well.

Probably the most innovative program in the past few years is BitTorrent, a program that decentralizes and vastly increases the speed at which very large files can be downloaded off the

Internet. It is commercially successful in the sense that 50,000 copies a day are downloaded.<sup>37</sup> It is also sufficiently innovative that it is now being imitated by Microsoft.<sup>38</sup> BitTorrent, however, is OS and, according to its Web site, Bram Cohen, the author, maintains the program for a living.<sup>39</sup>

The final point to emphasize here is that the market for software is not unique. Innovation and competition have gone hand-in-hand in other industries ranging from the market for financial securities<sup>40</sup> to the fashion industry.<sup>41</sup> The message of OS software is a message for all industries: Intellectual property ("IP") is not needed for innovation here.

Llanes provides the first fully articulated model of such behavior.<sup>42</sup> In his theory, proprietary and OS firms generally coexist, producing goods and services that are highly substitutable to each other.<sup>43</sup> Both kinds of firms invest in research and development ("R&D") and, although the OS firms

share with one another the results of their R&D expenditure, proprietary firms keep it exclusively for themselves by means of patents.<sup>44</sup> In Llanes' theory, proprietary firms are larger and fewer than OS firms and often, but not necessarily, produce goods of higher quality unless there are only OS firms, in which case they produce the same goods the proprietary firms would have produced.<sup>45</sup> Interestingly, although OS firms always appear as long as there is demand for a good or service that is supplied in limited quantity, proprietary firms need not emerge (even if IP is allowed) if the complementary good is important enough in relation to the patentable product.<sup>46</sup>

#### I. WHAT'S WRONG WITH INTELLECTUAL PROPERTY?

One might wonder if an explicit anti-IP position such as the one we are taking is unreasonable in light of recent evolutions. Around the world, the opposite tide is in fact rising: India has just adjusted its patent laws to comply with

TRIPS requirements,<sup>47</sup> in particular in the areas of pharmaceutical and biotechnologies; China is slowly but surely doing the same for both copyright and patents;<sup>48</sup> the European Union pushes forward with the European Patent harmonization plan;<sup>49</sup> and Mexico, Brazil, and other developing countries are hard pressed to follow soon. That the European Parliament, in a rare moment of wisdom and foresight, rejected the proposal to patent software is only a temporary setback quickly compensated by Mr. Sarkozy's recent decision to dramatically tighten the screw around the neck of anyone exchanging copyrighted files through peer-to-peer networks.<sup>50</sup> The tide is rising, and nothing seems capable of stopping it; as a successful pamphlet reminded us a few years ago, "Rembrandts [are hiding] in the attic" and the "greatest untapped asset opportunity" will be tapped by dexterous users of patents and copyright.<sup>51</sup> But is there a reason to try stopping it? What is wrong with the idea and the practice

of UIP?

To start seeing what is wrong with UIP, we want to consider the basic metaphor that appears to be inspiring its supporters. It goes like this: The process of securing IP over ideas is logically and economically equivalent to the establishment of well-defined property rights on parcels of unowned land. Without well-defined and secure property rights, the fertile lands of the Western frontier could not be efficiently cultivated or put to pasture, greatly reducing economic development. Similarly, if ideas are not someone's exclusive private property, they cannot be developed and brought to fruition. The wide open and uncharted territories of profitable and appropriable ideas are there, just ahead of us—mostly lawyers—the brave colonizers of the Third Millennium.

This is common wisdom. But is something wrong with it? Our answer is radical, for we find that almost everything is wrong



with this vision. We focus on legal theories of IP that have an economic underpinning, that is, on legal theories arguing that UIP is a desirable state of the world because it somehow maximizes social welfare and allocates it efficiently among potential claimants.

*A. Ideas in the Public Domain*

A historical battle for the advancement of the UIP frontier was fought and won a few years ago in the United States Congress, and its result subsequently was engraved in stone by the U.S. Supreme Court. In 1998, Congress extended the term of copyright by twenty years (through the Copyright Term Extension Act<sup>52</sup>) while simultaneously extending its breadth and stiffening the penalties associated with its violation (through the Digital Millennium Copyright Act<sup>53</sup>). The extension of copyright term has been retroactive, applying not only to new works but also to existing ones. In spite of the obvious and well-known economic

argument that extending copyright on existing works cannot possibly increase their supply,<sup>54</sup> a number of specious arguments<sup>55</sup> have been advanced as to how retroactive extension somehow serves to "promote the progress of . . . useful arts."<sup>56</sup> Subsequently, the Supreme Court acquiesced to these principles in its ruling in *Eldred v. Ashcroft*.<sup>57</sup> The Court majority ruled that:

The court found nothing in the constitutional text or history to suggest that a term of years for a copyright is not a "limited Tim[e]" if it may later be extended for another "limited Tim[e]" . . . . In petitioners' view, a time prescription, once set, becomes forever "fixed" or "inalterable." The word "limited," however, does not convey a meaning so constricted. At the time of the Framing, "limited" meant what it means today: confined within certain

bounds, restrained, or circumscribed. Thus understood, a timespan appropriately "limited" as applied to future copyrights does not automatically cease to be "limited" when applied to existing copyrights. . . . History reveals an unbroken congressional practice of granting to authors of works with existing copyrights the benefit of term extensions so that all under copyright protection will be governed evenhandedly under the same regime. Moreover, because the Clause empowering Congress to confer copyrights also authorizes patents, the Court's inquiry is significantly informed by the fact that early Congresses extended the duration of numerous individual patents as well as copyrights. Lower courts saw no "limited Times" impediment to such extensions. Further, although this Court never before has had

occasion to decide whether extending existing copyrights complies with the "limited Times" prescription, the Court has found no constitutional barrier to the legislative expansion of existing patents. . . . Congress' consistent historical practice reflects a judgment that an author who sold his work a week before should not be placed in a worse situation than the author who sold his work the day after enactment of a copyright extension. The CTEA follows this historical practice by keeping the 1976 Act's duration provisions largely in place and simply adding 20 years to each of them.

The CTEA is a rational exercise of the legislative authority conferred by the Copyright Clause. On this point, the Court defers substantially to Congress. . . . The CTEA reflects judgments of a kind

Congress typically makes, judgments the Court cannot dismiss as outside the Legislature's domain. A key factor in the CTEA's passage was a 1993 European Union (EU) directive instructing EU members to establish a baseline copyright term of life plus 70 years and to deny this longer term to the works of any non-EU country whose laws did not secure the same extended term. By extending the baseline United States copyright term, Congress sought to ensure that American authors would receive the same copyright protection in Europe as their European counterparts. The CTEA may also provide greater incentive for American and other authors to create and disseminate their work in the United States.<sup>58</sup>

Two points are worth noticing here: first, that extension of term that the CTEA implements is a "rational exercise" of

legislative authority by Congress, which is certainly the case, and second, that the retroactive extension is justified by three reasons: (1) as a way of providing equal treatment to all copyright holders, (2) as an "equilibrium" response to the EU move of extending copyright to seventy years, and (3) because it may provide greater incentive for the creation and dissemination of copyrightable work. We argue that none of these justifications make sense.

The copyright term has been repeatedly increased since its initial adoption in 1790 when a term of fourteen years was established,<sup>59</sup> with major increases taking place in 1831,<sup>60</sup> 1909,<sup>61</sup> and 1976.<sup>62</sup> The last extension, in The Copyright Act of 1998,<sup>63</sup> added twenty years to the then-existing term.<sup>64</sup> The CTEA retroactive provision, therefore, further extends the term for exactly those items for which the 1976 Act already had provided a retroactive extension.<sup>65</sup> In spite of this obvious fact, the

Court states rather incredibly: "Concerning petitioners' assertion that Congress might evade the limitation on its authority by stringing together an unlimited number of limited Times, the Court of Appeals stated that such legislative misbehavior clearly is not the situation before us."<sup>66</sup>

Let us forget the Court's peculiar interpretation of reality and of what Congress may or may not be planning to do; after all, we must wait until 2018 for a further extension to take place, and, even in that case, the arithmetic fact that ninety is not an unlimited number will be available to our Supreme Court Justices. Let us try, instead, to see why the substantive reasons provided under the second point above do not make any sense.

Consider, first, the equal treatment argument. The Court notes: "[S]ince 1790, it has indeed been Congress's policy that the author of yesterday's work should not get a lesser reward

than the author of tomorrow's work just because Congress passed a statute lengthening the term today."<sup>67</sup>

This is quite fine, indeed. One wonders, though, if the same logic should not be applied whenever Congress passes legislation that, by affecting, say, the fiscal code impacts on the economic reward that private agents receive also are affected. Any income tax cut should, then, be retroactive, for it clearly makes no sense to tax past income at a higher rate just because Congress passed a statute reducing the tax rate today. Quite obviously, the same applies to tax increases, Social Security contributions, tariffs, and numerous other areas, making for a rather interesting, if not volatile, economic environment. This would require very creative budgeting and national income accounting procedures, very much to the delight of financial markets that notoriously thrive under volatility. Most interestingly, though, this would be a case in



which Congress—in an uncharacteristic act of economic rationality—decided to reduce copyright and patent terms at some future date. By the same token for which both Congress and the Supreme Court argued for retroactivity in 1998, we suppose, the copyright term's reduction should also be retroactive to make sure that the "Congress's policy that the author of yesterday's work should not get a" larger "reward than the author of tomorrow's work just because Congress passed a statute" shortening "the term today" be dutifully implemented.<sup>68</sup> Maybe we are not properly trained in the subtleties of legal logic, and maybe there is a hidden paragraph somewhere in the Court's ruling explaining why copyright holders are exceptional. We could not find such a paragraph.

Let us move next to the motivation in (2.ii), that is, reacting to the EU's decision to extend copyright term to life plus seventy years. Again, we quote from the majority opinion:

By extending the baseline United States copyright term to life plus 70 years, Congress sought to ensure that American authors would receive the same copyright protection in Europe as their European counterparts. . . . [M]atching th[e] level of [copyright] protection in the United States [to that in the EU] can ensure stronger protection for U.S. works abroad and avoid competitive disadvantages vis-à-vis foreign rightholders.<sup>69</sup>

In case you were wondering from where our Supreme Court gets its economic wisdom, footnote twelve reports that "[t]he author of the law review article cited in text, Shira Perlmutter, currently a vice president of AOL Time Warner, was at the time of the CTEA's enactment Associate Register for Policy and International Affairs, United States Copyright Office."<sup>70</sup> Let us leave the political economy of UIP for later

and stick to the logical argument for the time being. From the Court's own words, it seems purely a redistributive concern: If the United States does not raise its copyright term, U.S. authors publishing in Europe will receive less money in that market than their European counterparts. Again, this is quite fine, in the sense that the U.S. Constitution does not prevent Congress from redistributing income by various statutory means from one subgroup of the population to another. In this case, clearly, Congress must have feared that writers, musicians, and assorted movie stars who are citizens of the United States would have faced poverty and denutrition lacking the *additional* twenty years of copyright revenues from the European markets.

Redistributing income to the poor and indigent movie stars from the rich and powerful consumers is certainly a commendable aim of Congress, if not one explicitly stated by the Founding Fathers in the Bill of Rights. One wonders why a lump-sum

transfer has not been chosen by Congress and recommended by the Court; it would have achieved the same egalitarian aim while sparing us the distortionary effect of twenty additional years of monopoly in the markets for copyrighted materials. One wonders if the median voter might have found a new tax financing Hollywood stars' expensive consumption habits somewhat unpatriotic.<sup>71</sup>

The substantive economic point is that the EU decision to extend the length of copyright term for its citizens is perfectly immaterial to the well being of either U.S. citizens or authors; if anything, it makes them better off as long as the copyright term is not extended also in the United States. Let us see why. Consider first the fundamental economic reason for providing copyright. This says that copyright is given to allow creators to collect enough revenue to compensate for their creative effort. Consumers, therefore, benefit indirectly from

copyright because, while paying a monopoly price to creators, consumers receive the creation in exchange. Without copyright, consumers would receive nothing. The EU move increases such rents for European creators and leaves them unaltered for everyone else; copyright terms for citizens of other countries were not lowered, either in the EU or anywhere else. This implies: (1) EU creators are richer; (2) EU consumers may or may not be better off (supposedly, they get more creations but, certainly instead of supposedly, also more monopoly distortions); (3) U.S. creators are not poorer as they receive at least the same rents they received before;<sup>72</sup> and (4) U.S. consumers are better off as they pay the same price as before for creative work but now enjoy the supposedly higher number of EU creations. In plain words, by extending its copyright by twenty years, the EU forced its consumers to face a risky proposition (more distortions for possibly more culture) in

order to make its creators richer. It also did a somewhat equal favor to U.S. creators and consumers by strengthening their market position. With the CTEA, Congress has ensured that U.S. consumers are forced to face a risky proposition, making them worse off than they were in the interim period; this is the price paid to transfer additional rents to U.S. creators. We therefore reach the same conclusion as before, namely that the CTEA is explained by a desire to transfer income from U.S. consumers to U.S. producers of copyrighted materials, and that it neither improves economic efficiency nor is the appropriate equilibrium response to the EU's move. In particular, the "competitive disadvantages" that AOL vice-president Shira Perlmutter mentions<sup>73</sup> remain completely mysterious. What could they be? If the United States had not extended its term, U.S. publishers of books, movies, and music could have put on the U.S. market many European creations with a copyright expired in

the U.S. while their European counterparts would have been unable to do so for another twenty years. This seems to us an advantage, not a disadvantage. At the same time, in the EU markets, EU subsidiaries of U.S. publishers could have exploited the longer copyright term to earn more monopoly profits at the expense of European consumers. At worst, should the EU not have allowed the European subsidiaries of U.S. companies to use the additional twenty years of copyright protection, they would have had the same competitive stance they had had until 1998.

Finally comes the third and most substantive economic point: "In addition to international concerns, Congress passed the CTEA in light of demographic, economic, and technological changes . . . and rationally credited projections that longer terms would encourage copyright holders to invest in the restoration and public distribution of their works . . . ." <sup>74</sup>

To which "rationally credited projections" the Court

refers, we do not know; there is always someone somewhere with a Ph.D. who is willing to forecast that elephants will eventually fly if the tax code is appropriately changed as recommended by the lobby that financed his or her research. The Court reports no numbers, and nowhere in the literature are serious numbers to be found that support such a forecast. We thus will move on to the theoretical underpinnings of this motivation. These are not very clearly spelled out in the Court's opinion. In particular, the footnotes found between pages 202 and 205 of the opinion to substantiate the incentive effect are rather disappointing. Apparently, the Supreme Court believes that life expectancy for creators has increased about twenty years since 1976, which is more than ten times the actual value. Equally apparent, the same Court also believes that Quincy Jones, Bob Dylan, Carlos Santana, and Don Henley wrote what they wrote and played what they played because of the "belief that the copyright system's



assurance of fair compensation for themselves and their heirs was an incentive to create."<sup>75</sup>

No further argument is given in support of the incentive theory, so out of respect for the Supreme Court, let us move on to debate those academics that, in a somewhat more articulated form, have argued that such an incentive exists, is substantial, and follows from well-founded and well-reasoned microeconomic theory. As William M. Landes and Richard A. Posner appear to be the two most prolific and coherent supporters of this view within the law and economics literature, it is to their recent writings that we turn.<sup>76</sup>

#### *B. Scholarly Pursuits*

The two most significant arguments are that creations of any kind should not be left in the public domain because the public domain suffers from congestion and overuse,<sup>77</sup> and that IP rights are necessary to provide appropriate incentives not only

to "create" but also to "maintain" existing works.<sup>78</sup> Notice the similarity with the "land ownership is good" argument, and notice also what this argument says: IP is not just good for creating new things, but also for maintaining them. Hence, in the case of copyright at least, this line of reasoning ends up arguing that an unlimited copyright term may be desirable. This line of argument rests on the principle that a normative foundation for the law is the maximization of social wealth, i.e., the achievement of economic efficiency in the sense of Pareto, irrespective of its redistributive consequences among economic agents. We are not questioning this principle here, in fact, and in spite of personal and philosophical misgivings with both its logical foundations and moral implications, we will use it as a yardstick in all that follows.

Let us start from the fundamental metaphor according to which ideas=pasture; "[t]he counterpart to the common pasture in

intellectual property is the public domain. . . . The term refers to the vast body of ideas and expression that are not copyrighted, patented, or otherwise propertized."<sup>79</sup>

One reason for rights in ordinary property is indeed to prevent congestion and overuse. For example, if a pasture is public, I do not take account of the negative effect my grazing sheep have on the availability of grass for your sheep. Because roads are public, I do not consider that my driving on the road makes it more difficult for you to get to work. Because the ocean is public, I do not consider that catching fish leaves fewer for you. This is the "tragedy of the commons," and in each case it means that the pasture, road, or ocean will be overused.<sup>80</sup>

Contrary to common wisdom, the public domain for ideas is the logical and practical *opposite* of the common land/pasture/ocean. The public domain of ideas is the necessary

(not sufficient, but necessary) precondition for competition in these markets and social efficiency therein. On this we focus, and this is the content of the present section.

Is the public domain for ideas like a common? Does my using ideas in the public domain have an adverse effect on your ability to use them? Certainly common sense suggests "[t]here can be no overgrazing of intellectual property . . . because intellectual property is not destroyed or even diminished by consumption."<sup>81</sup> That I might make use of an idea does not make you less able to use it. Indeed, it seems obvious that welfare is increased when more people become cognizant of a useful idea, whereas overall productive capacity is not increased when more sheep try to eat from the same square foot of pasture or when different rescue teams compete in salvaging a single sunken ship first.

As we have seen, Congress and the Supreme Court apparently

do not agree, and Landes and Posner also claim that

"[r]ecognition of an 'overgrazing' problem in copyrightable works has lagged."<sup>82</sup> In fact it has not, for there is no coherent theory or evidence that points to such a problem.

There are three key elements to understanding why the arguments in favor of retroactive copyright are incoherent. Understand first, only copies of ideas matter from an economic standpoint; in fact, only copies of ideas matter from any practical standpoint. If all the copies in books and minds alike were to vanish, the abstract existence of the idea would be of no use, at least to the practical human. Understand second, the public domain is not a common of unowned ideas or public property. When an idea is in the public domain, someone still *owns* each copy of the idea or work. To make copies you will have to own or purchase a copy of the idea first. Rather than being like a common, the public domain is like the ideal of a

competitive market (such as that for wheat) with many owners or producers of essentially the same product competing with one another. Understand finally, although my using an idea does not make you less able to use it, it might well make you less able to sell it. This means my ownership of a copy of the same idea as you own does not make the idea less valuable from a social point of view, but it certainly reduces the market price of your copy. Economists call this phenomenon "pecuniary externality";<sup>83</sup> my selling to a customer changes his demand for your product, and subsequently, economists find it a valuable feature of competitive economies. Consumers are made better off by the fact that numerous copies of a given good exist, as the market price of such good is set by the marginal consumer, that is, the one who values it the least, thereby allowing all those who value it more to acquire a substantial surplus by purchasing their copies of the good at less than its marginal utility.

Consider the case of food. If my restaurant sells Richard a large meal, he is not likely to go across the street to your restaurant and buy another. My selling him a large meal does not prevent you from using your food, but it does reduce the chances you will sell it to Richard. So too with ideas. If I sell Richard a copy of my Bible, I do not prevent you from making copies of your Bible, but I will reduce your profit because Richard will not buy from you. This is a pecuniary externality. By way of contrast, by taking fish from the sea I am not merely competing with you for customers; I am taking an economically useful good or service. Economists refer to the former as a "pecuniary" externality, and the latter as a "technological" externality.<sup>84</sup> Pecuniary externalities are a good thing; the incentive to steal customers is an essential part of the normal and efficient functioning of the competitive system. Technological externalities are a bad thing, leading to overuse.

Supporters of IP, and of copyright extension in particular, seem to be blind to such distinction. Landes and Posner, who provide the most coherent exposition of why retroactive extension of copyright might be a good thing, acknowledge that the "assessment of welfare effects of congestion requires distinguishing technological from mere pecuniary externalities."<sup>85</sup> They then go on to say, concerning the Mickey Mouse character, that "[i]f because copyright had expired anyone were free to incorporate the Mickey Mouse character in a book, movie, song, etc., the value of the character might plummet."<sup>86</sup> The value for whom? It cannot be the social value of the Mickey Mouse character that plummets—this increases when more people have access to it. Rather, it is the market price of copies of the Mickey Mouse character that plummets. As Landes and Posner admit, "If this came about only as . . . the ordinary consequence of an increase in output, aggregate value would



actually increase . . . ."87 They then assert that "the public might rapidly tire of Mickey Mouse."<sup>88</sup> But this is in fact the ordinary consequence of an increase in output. If I eat a large meal, I am less hungry—the value to me of a meal is diminished, and restaurants will find I am not willing to pay them much money. No externality is involved; as more of a good is consumed, the more tired people become of it. For there to be an externality, it would have to be the case that my consumption of Mickey Mouse made you more tired of it—an improbability, to say the least.

Although Landes and Posner make the verbal distinction between pecuniary and technological externality, they do not appear to understand it. They quote from a book on Disney marketing: "To avoid overkill, Disney manages its character portfolio with care. It has hundreds of characters on its books, many of them just waiting to be called out of retirement . . .

Disney practices good husbandry of its characters and extends the life of its brands by not overexposing them . . . They avoid debasing the currency."<sup>89</sup> This is of course exactly how we would expect a monopolist to behave. If Disney were to be given a monopoly on food, we can be sure it would practice "good husbandry" of food, most likely leaving us all on the edge of starvation. This would be good for Disney because we all would be willing to pay a high price for food. But the losses to the rest of us would far outweigh the gain to Disney. It is a relief to know that, after all, Mickey Mouse is not such an essential ingredient of the U.S. diet.

In passing, notice here a serious problem with the interpretation of economic efficiency that seems to have become common among legal scholars writing in this field. In the example above, taking the monopoly power over food away from Disney is often interpreted as not necessarily efficient. This

is because, although consumers are better off, the entity called "Disney" is worse off after competition in the market for food is established. This is not the appropriate place to go through the theorems of modern welfare economics, but it is the appropriate place to mention the faulty argument to the interested reader, just in case.

Landes and Posner go on to say:

One purpose of giving the owner of a copyright a monopoly of derivative works is to facilitate the scope and timing of the exploitation of the copyrighted work—to avoid, as it were, the 'congestion' that would result if once the work was published anyone could make and sell translations, abridgements, burlesques, sequels, versions in other media from that of the original (for example, a movie version of a book), or other variants . . . . The

result would be premature saturation of the market, consumer confusion (for example, as to the source of the derivative works), and impaired demand for the original work because of the poor quality of some of the unauthorized derivative works.<sup>90</sup>

This seems to us to be both at odds with reality and profoundly anti-market and anti-competition. Yes, the competitive market is full of interesting products. We can buy many brands, styles, and colors of shirts, jackets, and shoes. Yet apparently consumers are not so profoundly ignorant as to be unable to figure out which brands, styles, colors, and products they wish to purchase; they apparently do not need the Disney Corporation to work this out for them. In the competitive markets of the free world, there are lots of good products, lots of excellent products, and even more cheap and low-quality products. So what? Seabright celebrates the diversity produced

by competition;<sup>91</sup> Lindsey warns us against those who do not trust the decentralization of the free market and wish to bring the "dead hand" of central authority to sort out the confusion.<sup>92</sup>

Unlike Landes and Posner, we do not see the need for the organizing authority of the monopolist to substitute for the diversity of the marketplace.

In an effort to give substance to their argument, Landes and Posner point to three examples of "works even of elite culture that may have been damaged by unlimited reproduction," namely, the Mona Lisa, the opening of Beethoven's Fifth Symphony, and several of Van Gogh's most popular paintings.<sup>93</sup> It would be nice to know what evidence Landes and Posner have for this assertion. Searching Amazon.com for "Beethoven" in classical music brings up three items as most popular.<sup>94</sup> The first is a collection of all nine symphonies; the second is a compilation of the Fifth and the Seventh. Apparently, despite

the damage done by unlimited reproduction, the Fifth is still well liked by many people—or are we to imagine that they skip the opening because it has been so damaged by unlimited reproduction? Or are Professors Landes and Posner suffering from the snobbish tendency to consider works of art “debased” after they become known and appreciated by the “unrefined” masses?

More or less the opposite of the “overgrazing” argument is the “maintenance” argument. Here it is argued that only with a monopoly is there adequate incentive to “maintain” ideas. The extreme example of the “maintenance” argument is the argument that providing a copyright monopoly will actually increase availability, the Register of Copyrights going so far as to say “lack of copyright protection . . . restrains dissemination of the work.”<sup>95</sup> Lemley, who criticizes what he refers to as *ex post* arguments for copyright along lines that parallel our own,<sup>96</sup> puts it succinctly: “It is hard to imagine Senators, lobbyists, and

scholars arguing with a straight face that the government should grant one company the perpetual right to control the sale of all paper clips in the country, on the theory that otherwise no one will have an incentive to make and distribute paper clips."<sup>97</sup>

Lemley also cites empirical evidence showing, not surprisingly, that public domain works are far more widely available than works from the same time period that are still under copyright.<sup>98</sup>

A bit less illogical is the following type of argument. We can imagine that Disney might have less incentive to produce new Mickey Mouse movies if it faces competition in the market for Mickey Mouse dolls; some of the good feeling for Mickey Mouse generated by the movie will spill over into increased demand for other producers' Mickey Mouse dolls. This would appear to be, indeed, a case of real externality, albeit positive instead of negative. Lacking a way of compensating Disney for the positive effect it is having on the demand for Mickey Mouse dolls,

Disney's movie output would be too low from a social viewpoint.

This analysis is wrong. Mickey Mouse movies and Mickey Mouse dolls are examples of goods that are complements; increasing the quantity of one raises the demand for the other. But many goods are complements, such as peanut butter and jelly. And quite rightly, no one worries that there will not be enough peanut butter produced because part of the effect of producing more peanut butter is that it will raise the demand for jelly.

Basically, what this argument overlooks is the reciprocal effect: When the competition produces more Mickey Mouse dolls, it also will raise the demand for the Mickey Mouse movie.

Landes and Posner also try a more subtle tack. They focus not so much on tie-ins between related goods, but rather on "promotional" efforts. "[C]onsider an old movie on which copyright had expired that a studio wanted to issue in a colorized version . . . . Promoting the colorized version might



increase the demand for the black and white version, a close substitute. . . . [T]he studio would have to take into account, in deciding whether to colorize, the increase in demand for the black and white version."<sup>99</sup> Here it seems that promotion of the colorized film is a complement to both consumption of the colorized film and the black and white version; insofar as it is merely a statement about goods being complements, we already have seen there is no economic issue. But more to the point, in all competitive markets, producers lack incentives to promote the industry. Individual wheat producers do not have much incentive to promote the healthy virtues of wheat, fisherman do not have much incentive to promote the healthy virtues of fish, and so on.<sup>100</sup> It is hard to see that the problem with old movies, books, and music is different either qualitatively or quantitatively than in these other competitive markets. Yet quite rightly no one argues that we need to grant wheat or fish

monopolies to solve the "problem" of under promotion.

It is worth reflecting briefly on promotional activities in competitive industries. Surely information about, say, the health benefits of fish is useful to consumers; equally surely, no individual fisher has much incentive to provide this information. Is this some form of market failure? No. In a private ownership economy, consumers will have to pay for useful information rather than having it provided for free by producers. And pay they do; doctors, health advisors, and magazine publishers all provide this type of information for a fee. There is no evidence that competitive markets under-provide product information. Rather, in the case of a monopolist, because the value of the product mostly goes to the monopolist instead of the consumer, the consumer has little incentive to acquire information while the monopolist has a lot of incentive to see that the consumer has access to it. So we expect a

different arrangement for information provision ("promotion") in competitive and non-competitive markets. In the former, the consumer pays, and competitive providers generate information. In the latter, firms will subsidize the provision of information.<sup>101</sup>

## II. MORE COMMON FALLACIES

Additional theoretical and empirical work is needed to better understand the impact that IP has on innovation, creation, and overall economic welfare. In the sixty years since the end of World War II, abundant research has been produced on this subject, though very little has taken a critical approach. In fact, until the events of the late 1990s somewhat helped to re-open the debate, most research supported the general principle that IP is good for society at large. For the most part, these arguments are incorrect, and to their common fallacy we now turn.

Instead of arguing whether IP protection should be extended, if its term should be of twenty years for patents and seventy-five for copyright, or possibly vice versa, we would like to question the very same idea that IP is necessary and useful for fostering invention. Our contention is the following: Allowing for a few minor exceptions, IP is not necessary for efficient innovation. The efficient allocation of surplus from innovation can and would be achieved by properly regulated competitive markets, and such distribution of surplus among inventors, imitators, and consumers could provide, on average, the correct incentives for the efficient amount of creation to take place in society. Therefore, as a matter of legislative principles, IP should be abolished and replaced with the opposite system of property rights, a system in which creators have the same rights as other producers (that is, the right to own and sell the fruits of their work, and in which legal

monopoly power is not assigned to them over their ideas, unless a substantial case is made that the innovation could not materialize lacking the specific monopoly privilege).

To understand the common fallacy one needs to start by examining the basic principle, put forward long ago by Kenneth Arrow.<sup>102</sup> Specifically, Arrow asserted that ideas and information constituted a very peculiar kind of commodity, unsuitable to be traded in a competitive market.<sup>103</sup> This is not true; along most dimensions, ideas are not different from other commodities, and those few dimensions along which ideas are different do not generally affect the functioning of competitive markets. Here are some often-heard arguments, which we have shown to be fallacious.

*It is argued that in competitive markets innovators would be unable to appropriate more than an infinitesimal share of the social value of their ideas.*

This is a recurrent theme in business, managerial, and industrial organization literature, where it is apparently believed that economic efficiency requires innovators (or producers more generally) to appropriate all the social value of their products. Were this to be the case, any market transaction in which some positive social surplus is realized would be inefficient, for producers are "leaving something on the table" for consumers. But, obviously, socially efficient provision of ideas or goods requires, instead, that all ideas or goods with a positive social surplus (i.e., social value larger or at most equal to social cost) be produced. How such surplus is split between producers, consumers, and other entities (suppliers of intermediate inputs, government, and so on) may, and, in general will, affect whether all goods with positive social surplus are produced, but there is no general presumption that too few goods will be created unless producers appropriate the whole social

surplus. In general, we would expect producers to bring goods or ideas to the market as long as the private costs of doing so is exceeded by the private gains.

Hence, from a social perspective, one should ask: For all ideas with a positive social surplus, is it the case that competitive pricing allows producers to appropriate enough revenues to compensate for their *private* opportunity cost? Strangely enough, this question is seldom asked in the theoretical literature on innovations, and never, to the best of our knowledge, in the empirical literature. This fallacy, as we have shown,<sup>104</sup> misses the fact that ideas combine attributes of both consumption and capital goods. They can be used directly for consumption, such as reading a book or watching a movie, or they can be used as an input in production by making copies of a book or movie, or by producing other goods (for example, by using the idea for an improved production process). That the

original copy of an idea is the capital good (the tree) from which all other copies (the fruits) must originate enables innovators to appropriate the net present value of all future copies through competitive pricing. Corn seeds, for example, can be eaten or used for producing additional corn, so corn seeds combine characteristics of consumption and capital goods. Competitive markets for corn generate the appropriate incentive to invest in corn seed. The initial copy (or copies, when simultaneous innovation occurs) of an idea are generally produced through a process that is different from the one used to make subsequent copies, as in the case of original research versus teaching. Most capital goods (original research) are used to produce commodities other than themselves, but the fact that capital goods might be used to reproduce themselves poses no particular problem for competitive markets. In the semiconductor industry, for example, reduction in chip size makes it



possible to construct capital equipment that can be used to produce even smaller chips.

*There are suggestions that ideas are subject to "spillover externalities," or what we might call informational leakage.*

*That is, the existence of the idea enables people to learn it and make use of it without the permission of the owners.*

Some even argue that ideas can be copied for free. In practice, few ideas are subject to informational leakage and in all cases are costly to reproduce. In the case of copyrightable creations, where the ideas are embodied in physical objects such as books, informational leakage is not an issue. In the case of scientific advances, reflection shows that it is also not the case. Although in some sense scientific ideas are widely available, usable copies of scientific ideas are not so easy to come by. Even Newton's laws, our example in the next section, require a substantial amount of time and effort to understand.

For all practical purposes, copies are limited to those people who understand the laws and books that explain them. Without paying someone to teach you or buying a book that explains Newton's laws, you are not terribly likely to learn them merely because they are in the public domain. As teachers and professors, we earn our living by our ability to communicate ideas to others, and in doing so, we create new copies of them. Overwhelming historical evidence shows that diffusion and adoption of innovations is costly and time consuming.

*Leaving ideas in the public domain, as would be the case under a no-IP system, is socially inefficient and leads to a "tragedy of the commons" for creative activity.*

We have already explained why this claim is fundamentally incorrect. After copyright or patents have expired, there are many copies of an idea, each a good substitute for the other, and each owned by someone. If you want to use the idea, make

copies, or turn it into something else, you must first acquire a copy of it from one of the current owners. If there are many owners, each competing with one another to sell you the copy of the idea, you might be able to obtain it relatively cheaply, even though you intend to turn it into a highly valued new good. But the fact that you can buy ingredients cheaply is a good consequence of competitive markets, not a bad one. In fact, the evidence suggests that the market for goods in the public domain functions well, with copies widely available and reasonably priced. Finding a copy of a book by Dickens, for example, is no great problem.

### III. THINKING OUT OF THE UIP BOX

We have worked out elsewhere mathematical and quantitative models of why creative activity can thrive under conditions of competition and does not require, at least in principle, the monopoly privileges that current IP legislation attributes to

creators and inventors.<sup>105</sup> Here we illustrate the basic intuition underlying our analysis, using a well-known historical example to fix ideas.

Economic, and more generally social, progress is the long-run, and altogether surprising, result of the continuous creation of new commodities, of their free exchange among individuals, and of the competition among producers of different goods, be they creators or imitators. Economists have long realized that there would be but a slow and possibly inconsequential improvement in human living standards without sustained innovation. This point was argued most forcefully by Joseph Schumpeter in *The Theory of Economic Development*.<sup>106</sup> With constant technology and a constant set of goods, the process of capital accumulation, when based only on the saving of a share of the yearly income flow, would generate but a fraction of the growth in per capita income we have witnessed since the

inception of human history. History and common sense suggest that accumulation of capital under a constant technology cannot go very far due to the presence of fixed resources and the diminishing returns they cause. Innovation is the engine of change and economic development; hence, understanding its nature, internal mechanisms, and the social and institutional factors that bring it about or impede it is, we believe, the single most important problem faced by the social sciences. It is our contention that understanding innovation is tantamount to understanding competition, that the latter is a necessary condition for the former, and that, under very general circumstances, it is also sufficient. If innovation is the flow that enriches us all, then competition is the spring from which it erupts.

Innovation, for us, is the creation of the first copy of a good, process, or idea that did not exist before. As the word

"idea" is used here to denote all innovations, its usage should be briefly clarified. In our terminology, Isaac Newton's innovation did not consist just in "thinking" the gravitational laws, but in the process of embodying them in his mind first, and in formulas and written expositions later. When, in 1687, he completed the manuscript of his *Philosophiae naturalis principia mathematica* ("*Principia*") and had it published, "Newton's innovation" was completed.<sup>107</sup> All subsequent copies of the *Principia* were reproductions of that first copy of his idea, and they were produced with a technology different from the one he used to obtain his first manuscript. Notice, that with "copy" here we refer to either a physical copy of the actual book or the copy of the gravitational laws embodied in the brain of another scientist or layman, i.e., a piece of socially valuable human capital. Indeed, and this is something crucial, the social value of Newton's innovation is more properly measured by the

number of copies of his laws existing in the second form (actual human capital) than in the first (copies of the book). All such copies stemmed from Newton's original copy, and the social value of the latter would have been much smaller, or even negligible, without them. Newton's reward, in terms of either intellectual prestige or actual wealth and social status, became so high because several copies (of either type) of the *Principia* were eventually reproduced. In our terminology, the first copy of the gravitational laws is the "prototype," and it embodies, for the first time, Newton's idea; the *innovation technology* is the one Newton adopted to figure out the gravitational laws and write the *Principia*. The *imitation technology* is the one used by subsequent publishers of the book and by whoever learned and understood the content of the *Principia*. Notice that the *Principia* were published before the Statute of Anne introduced some (weak by current standard) degree of IP legislation in the

United Kingdom.<sup>108</sup>

Also notice that the final products of the two technologies are, functionally speaking, equivalent: A copy of the *Principia* is a copy of the *Principia*, and a human who understands the principles and laws of gravitation is, at least from this narrow point of view, equivalent to any other human who understands the same principles and laws. This point will become relevant later on when discussing the *public domain* for ideas. Also worth noting is that both technologies use a variety of inputs to obtain their final product, that some of these inputs are previous innovations (e.g., Kepler's Laws), and that such inputs can be acquired on competitive markets under No Intellectual Property ("NIP"), but would have to be obtained from monopolists by acquiring many licenses under IP. There are two exceptions to this. First, the innovation technology uses a particularly scarce input, Newton's geniality in this case, which greatly



limits the number of initial prototypes that can be obtained.

Had we been concerned with a less dramatic invention, simultaneous creation by a number of different and independent innovators would have been likely, as is often the case in practice. Still, the total amount of "creative ability" available at any point in time to make prototypes of new ideas is quite limited. In the jargon of economics, there is always *limited creative capacity* of prototypes at any given point in time. In the particular case of scientific inventions or of artistic creation, this limitation of creative capacity may persist for a long time: New scientific discoveries are very difficult to understand (which is why we have Ph.D. and post-doctorate programs), and live performances of new music is hard to imitate. The imitation technology also uses a special kind of input, and that is a pre-existing copy of the *Principia* (in case we are considering a publisher making copies of the book) or,

generally, someone who has already understood its content (in case we are considering a student learning gravitational laws). Either way, also this particular input is in limited supply; strictly speaking, this is true at any point in time and even now, but it is especially true in periods close to the time in which the first prototype of the *Principia* appeared. In summary, the imitation technology also faces a *limited productive capacity*, the size of which is basically determined by the number of copies of the idea "Newton's Gravitational Laws" embodied in humans and books at any point in time.

A little reflection shows that this set of properties is not specific to the particular case of the *Principia*, but applies quite widely (we would say universally) to other innovations. The differences are quantitative, never qualitative. New valuable ideas are always embodied in either people or things; innovative capacity is always limited;

imitation or reproduction always requires copies of the idea and hence stems from the original prototype even if in some rare cases imitation may not require large investments; reproductive capacity is also limited for a substantial number of periods after the innovation takes place; new ideas almost always require old ideas to be created, and creation is more and more a complex and cumulative incremental process; and finally, consumers are always impatient and want the product or good today rather than tomorrow. Our theoretical analysis builds upon such properties, and an additional one: it took quite a while for Newton to come up with the gravitational laws (falling apples notwithstanding) and, from what we know, even longer to fully articulate them in the manuscript of the *Principia*. Further, the *Principia* were not a minor, infinitesimal departure from or improvement upon previous knowledge, but a substantial advancement indeed. This property is also general, at least

qualitatively. Producing the prototype via the invention technology requires quite often a large investment, which we want to think of as an *indivisibility*. Although it is not true that a sizeable indivisibility is involved with the production of prototypes of every idea, it is true that this is often the case, and that this feature of creative activity should be taken in proper account when discussing the allocation of economic surplus from creative activity.

Finally, a few words to further clarify our approach to the problem. We ask what is socially optimal and how incentives should be provided (i.e., which market structure can provide the appropriate incentives) for the socially optimal amount of creative activity to take place. The problem of providing incentives for innovation should not be confused with the protection of rents of intermediaries or rents of established artists or creators more generally. The issue here is not what

makes creators richer or as rich as possible, but how to allocate to them enough of the surplus from creative activity so that they have the incentive to carry it out efficiently from a social view point. This requires focusing on the concept of *opportunity cost*. When a potential innovator considers the choice between engaging in creative activity or doing something else, his opportunity cost is determined by how much income he would receive from doing something else. Efficiency requires that, should the innovator opt for creation, he receive from the former at least as much as he would receive from the alternative activity; that is his opportunity cost. When the market structure allows the innovator to receive more than his opportunity cost, this additional rent serves no socially useful purpose. This additional rent may just be a pure transfer, which does not affect economic efficiency. Nevertheless, more often than not, and in particular when monopoly power is involved,

this additional rent accrues to the innovator because he or she has the incentive to provide less innovations, or less copies of his or her innovations, than the socially efficient amount. In this case the additional rent is not just a neutral transfer from consumers to innovators (which may be unfair, but irrelevant for efficiency) but a socially costly and inefficient tax on consumers, resulting in fewer copies of ideas to be available than is desirable and technologically feasible. Our critique of current IP laws focuses mainly on this second aspect.

Technological innovation continuously changes the opportunity cost and reservation values of the various agents involved in creation. So, for example, the invention of the printing press made the craftsmanship accumulated through centuries by artisans and monks unnecessary for copying or for production of new books. This was a blessing for writers and

their readers but also a curse for those artisans who suddenly lost their long-established title to a substantial share of the value of every book. Given current technologies and the continuous improvement in the innovation and reproduction of technologies, it would be crucial to measure the opportunity costs of creators and innovators. Unfortunately, this is an endeavor to which applied economists, especially in the area of industrial organization, have dedicated minimal attention, and we are not aware of any study estimating the minimum future expected income needed to attract potential innovators into creative activity.

#### CONCLUSION

Although the functioning of competition in the market for goods has been the subject of study for a long time and our knowledge of the subject appears to have progressed substantially since the times of Adam Smith, it often is felt

that the same is not true of the market for ideas. Indeed, there is a widespread view that ideas are dramatically and intrinsically different from goods and that the "economics of knowledge" needs to be grounded on different premises and must adopt modeling strategies different from the rest of economics. In our work, we reconsidered this issue and concluded that, although the economic theory of ideas requires modifications in some of the more common assumptions with which markets for regular commodities are handled, such differences are much less dramatic than one would have expected, and a great deal of common economic wisdom applies equally well to the economics of knowledge. This allows us to critically reconsider a number of theoretical issues sitting at the intersection between the innovation, technological change, and growth and trade theory, to conclude that much common wisdom, including the legal wisdom bestowed upon us by the Supreme Court, is either empirically



groundless or logically faulty, and that some old, possibly uncommon, wisdom should be brought back to bear on the study of technological change, growth, and trade.

Central to understanding the market for ideas and the incentives for the adoption of new ideas is discovering how ideas might be different from other goods. The starting point of the economic analysis of innovation is to recognize that the economically relevant unit is a copy of an idea. Typically, many copies of an idea exist in physical form, such as a book, computer file, or piece of equipment, or in the form of knowledge embodied in people who know and understand the idea. When embodied in humans, copies of ideas are labeled with a variety of different names, which often obscure their common nature: skills, knowledge, human capital, norms, and so on. Careful inspection shows, however, that each and every one of these apparently different entities is, at the end, nothing but

the embodied copy of an idea, and that it was either discovered first by the person in whom it is currently embodied, or costly acquired (possibly via observation and imitation) from other humans, in whom it had been previously and similarly embodied.

Economically valuable copies of ideas do not fall from the heavens like manna but are the product of intentional and costly human efforts. Only these copies matter for two reasons. First, if they were all to be erased, the idea would no longer have any economic value. Second, the copies are relatively good substitutes for one another. Whether a copy of an idea is the original copy or the hundredth copy, it is equally economically useful. From the perspective of the functioning of markets, then, property rights in copies of ideas are assured by the ordinary laws against theft; what is ordinarily referred to as "intellectual property" protects not the ownership of copies of ideas but rather a monopoly over how other people make use of

their copies of an idea.

---

\* author bios needed

1. See, e.g., Wikipedia, Antonio Meucci

[http://en.wikipedia.org/wiki/Antonio\\_Meucci](http://en.wikipedia.org/wiki/Antonio_Meucci) (last visited Apr. 8, 2009).

2. Il-Horn Hann, Jeff Roberts, Sandra Slaughter & Roy

Fielding, *An Empirical Analysis of Economic Returns to Open*

*Source Participation* (2004) (unpublished manuscript, [http://www-](http://www-rcf.usc.edu/~hann/publications_files/economic_returns_to_open_source_participation.pdf)

[rcf.usc.edu/~hann/publications\\_files/economic\\_returns\\_to\\_open\\_source\\_participation.pdf](http://www-rcf.usc.edu/~hann/publications_files/economic_returns_to_open_source_participation.pdf)).

3. Josh Lerner & Jean Tirole, *The Economics of Technology*

*Sharing: Open Source and Beyond* (Nat'l Bureau of Econ. Research,

Working Paper No. 10956, 2004).

4. Gastón Llanes, *Technology Sharing in Open Source* (Dec.

2007) (unpublished manuscript,

---

[http://www.eco.uc3m.es/temp/agenda/Gaston\\_LLanes.pdf](http://www.eco.uc3m.es/temp/agenda/Gaston_LLanes.pdf)).

5. Michele Boldrin & David K. Levine, *Perfectly Competitive Innovation*, 55 J. MONETARY ECON. 435, 436 (2008).
6. See Llanes, *supra* note 4.
7. GNU Project, *The Free Software Definition*, <http://www.gnu.org/philosophy/free-sw.html> (last visited Apr. 8, 2009).
8. See GNU Project, *Various Licenses and Comments About Them*, <http://www.gnu.org/philosophy/license-list.html> (last visited Apr. 8, 2009) (describing the terms of various OS licenses).
9. Craig Mundie, Vice President, Microsoft, Remarks at the New York University Stern School of Business (May 3, 2001), <http://www.microsoft.com/presspass/exec/craig/05-03sharedsource.msp> (last visited Apr. 8, 2009).

- 
10. Tom Sanders, *SAP Dismisses Open Source Innovation*, vnunet.com, Nov. 10, 2005, <http://www.vnunet.com/vnunet/news/2145809/sap-dismisses-open-source> (describing Shai Agassi's speech).
11. On a personal note, one of the authors, Levine, wrote and maintains an open source software project, Jarnal. He has been approached several times by firms with requests to customize the software for a fee.
12. For example, in 2005, Red Hat reported net profits of nearly \$80 million. Yahoo!, <http://yahoo.brand.edgar-online.com/displayfilinginfo.aspx?FilingID=4416483-219997-224683&type=sect&TabIndex=2&Companyid=5746&ppu=%252fdefault.aspx%253fcik%253d1087423> (last visited Apr. 8, 2009).
13. Wikipedia, Alan Cox [http://Wikipedia.org/wiki/Alan\\_Cox](http://Wikipedia.org/wiki/Alan_Cox) (last visited Apr. 8, 2008).

14. Gary Rivlin, *Leader of the Free World: How Linus Torvalds Became Benevolent Director of Planet Linux, the Biggest Collaborative Project in History*, WIRED, [http://www.wired.com/wired/archive/11.11/linus\\_pr.html](http://www.wired.com/wired/archive/11.11/linus_pr.html) (last visited Apr. 8, 2009).
15. See generally Red Hat, <http://www.redhat.com> (last visited Apr. 8, 2009).
16. See generally Hcidesign, <http://www.hcidesign.com> (last visited Apr. 8, 2009).
17. See generally The Linux Emporium, <http://linuxemporium.co.uk> (last visited Apr. 8, 2009).
18. See generally Red Hat, *supra* note 15.
19. See generally *id.*
20. See generally *id.*
21. See generally *id.*

22. Redhat.com, Value of Red Hat Subscription,  
<http://www.redhat.com/software/subscriptions.html> (last visited  
Apr. 8, 2009).

23. Lerner & Tirole, *supra* note 3, at 8.

24. Hann et al., *supra* note 2, at 4.

25. Rivlin, *supra* note 14.

26. Elizabeth Millard, *BitTorrent Gets Venture Capital  
Boost*, EWEEK.COM, Sept. 27, 2005, [http://www.eweek.com/c/a/IT-  
Infrastructure/BitTorrent-Gets-Venture-Capital-Boost/](http://www.eweek.com/c/a/IT-Infrastructure/BitTorrent-Gets-Venture-Capital-Boost/).

27. See generally Wikipedia, Bill Gates,  
[http://en.wikipedia.org/wiki/Bill\\_Gates](http://en.wikipedia.org/wiki/Bill_Gates) (last visited Apr. 8,  
2009).

28. On the Windows, Macintosh and Smalltalk: [http://www.h-  
net.org/~mac/lore1.html](http://www.h-net.org/~mac/lore1.html). On the Microsoft Word etc.:  
[http://en.wikipedia.org/wiki/Microsoft\\_word](http://en.wikipedia.org/wiki/Microsoft_word). On the Microsoft



Excel etc.: [http://en.wikipedia.org/wiki/Microsoft\\_excel](http://en.wikipedia.org/wiki/Microsoft_excel)

29. Wikipedia, Web Server

[http://en.wikipedia.org/wiki/web\\_server](http://en.wikipedia.org/wiki/web_server) (last visited Apr. 8, 2009).

30. *Id.*

31. [http://en.wikipedia.org/wiki/Robert\\_McCool](http://en.wikipedia.org/wiki/Robert_McCool)

32. [http://en.wikipedia.org/wiki/Netscape#Early\\_years;](http://en.wikipedia.org/wiki/Netscape#Early_years;)

[http://en.wikipedia.org/wiki/Apache\\_HTTP\\_Server](http://en.wikipedia.org/wiki/Apache_HTTP_Server)

33. Netcraft.com, April 2009 Web Server Survey,

[http://news.netcraft.com/archives/web\\_server\\_survey.html](http://news.netcraft.com/archives/web_server_survey.html) (last visited Apr. 8, 2009).

34.

[http://en.wikipedia.org/wiki/Apache\\_HTTP\\_Server#Features;](http://en.wikipedia.org/wiki/Apache_HTTP_Server#Features;)

[http://www.microsoft.com/windowsserver2008/en/us/overview.aspx.](http://www.microsoft.com/windowsserver2008/en/us/overview.aspx)

35. <http://www.reviewsaurus.com/online-office/offline->

online-microsoft-word-alternatives/

36. [http://en.wikipedia.org/wiki/Johannes\\_Gutenberg](http://en.wikipedia.org/wiki/Johannes_Gutenberg)

[Source]

37. SourceForge.net,

[http://sourceforge.net/project/stats/detail.php?group\\_id=33044&u](http://sourceforge.net/project/stats/detail.php?group_id=33044&u)

[gn=bittorrent&type=prdownload&mode=year&year=2005&package\\_id=0](http://sourceforge.net/project/stats/detail.php?group_id=33044&u)

(last visited Apr. 8, 2009).

38. James Niccolai, *Microsoft Readies BitTorrent*

*Alternative: Avalanche Technology Could Make It Easier to*

*Distribute Big Files over the Internet*, InfoWorld.com, June 16,

2005,

[http://www.infoworld.com/article/05/06/16/HNmsbittorrent\\_1.html](http://www.infoworld.com/article/05/06/16/HNmsbittorrent_1.html)

(last visited Apr. 8, 2009).

39. BitTorrent, Management,

<http://www.bittorrent.com/company/management> (last visited Apr.

8, 2009).

40. Peter Tufano, *Financial Innovation and First-Mover Advantages*, 213 J. FIN. ECON. 25 (1980).

41. Kal Raustiala & Christopher Sprigman, *The Piracy Paradox: Innovation and Intellectual Property in Fashion Design*, 92 VA. L. REV. 1687, 1690 (2006).

42. Llanes, *supra* note 4, 2-3.

43. *Id.*

44. *Id.* at 20.

45. *Id.*

46. *Id.* at 18.

47. Prabuddha Ganguli, Indian path towards TRIPS compliance, World Patent Information, Volume 25, Issue 2, June 2003, Pages 143-149, ISSN 0172-2190, DOI: 10.1016/S0172-2190(03)00023-1.

(<http://www.sciencedirect.com/science/article/B6V5D-481FMF8-1/2/9b73ec3a41a504fe2d1e7b4f71554c70>)

48.

[http://www.npc.gov.cn/englishnpc/news/Legislation/2009-02/10/content\\_1469484.htm](http://www.npc.gov.cn/englishnpc/news/Legislation/2009-02/10/content_1469484.htm)

49. <http://www.ip-watch.org/weblog/2005/02/12/wealthy-nations-move-ahead-with-patent-harmonisation/>

50. <http://arstechnica.com/tech-policy/news/2008/01/frances-plan-to-turn-isps-into-copyright-cops-on-track.ars>

51. KEVIN G. RIVETTE & DAVID KLINE, REMBRANDTS IN THE ATTIC: UNLOCKING THE HIDDEN VALUE OF PATENTS (2000).

52. Sonny Bono Copyright Term Extension Act of 1998, Pub. L. No. 105-298, 112 Stat. 287 (codified at 17 U.S.C. § 302 (2006)).
53. Digital Millennium Copyright Act, Pub. L. No. 105-304, 112 Stat. 2860 (codified in scattered sections of 17 U.S.c.).
54. See, e.g., Brief of George A. Akerlof et al. as Amici Curiae Supporting Petitioners at 3, *Eldred v. Ashcroft*, 537 U.S. 186 (2003) (No. 01-618), available at <http://cyber.law.harvard.edu/openlaw/eldredvashcroft/supct/amici/economists.pdf>.
55. 141 CONG. REC. § 3390 (1995) (statements of Sens. Hatch and Feinstein, article by Prof. Arthur Miller, and comments of Dennis S. Karjala), available at <http://www.public.asu.edu/~dkarjala/legmats/hatch95.html>.
56. U.S. CONST. art. I, § 8, cl. 8.

57. 537 U.S. 186 (2003).
58. *Id.* at 187-88 (internal citations omitted).
59. Copyright Act of 1790, ch. 15, 1 Stat. 124 (1790)  
(amended 1831).
60. Copyright Act of 1831, ch. 16, 4 Stat. 436 (1831)  
(amended 1870).
61. Copyright Act of 1909, ch. 320, 35 Stat. 1075 (1909)  
(amended 1976).
62. Copyright Act of 1976, Pub. L. No. 94-553, 90 Stat.  
2541 (1976) (codified as amended at 17 U.S.C. §§ 101-1332  
(2006)).
63. Sonny Bono Copyright Term Extension Act of 1998, Pub.  
L. No. 105-298, 112 Stat. 287 (codified at 17 U.S.C. § 302  
(2006)).
64. *Id.*

65. *Id.*

66. *Eldred v. Ashcroft*, 537 U.S. 186, 198 (2003) (internal quotations and citations omitted).

67. *Id.* at 204 (internal quotations omitted) (quoting Symposium, *The Constitution of Copyright Term Extension*, Professor Arthur Miller, 18 *CARDOZO ARTS & ENT. L.J.* 651, 694 (2000)).

68. *Id.*

69. *Id.* at 205-06 (internal quotations omitted) (quoting Shira Perlmutter, *Participation in the International Copyright System as a Means to Promote the Progress of Science and Useful Arts*, 36 *LOY. L.A. L. REV.* 323, 330 (2002)).

70. *Id.* at 206 n.12.

71. If readers find our tone somewhat disrespectful of the Supreme Court, we very much regret it.

---

72. Our usage of "at least" and "not poorer" is intentional. Indeed, to the extent that demand for creative work is downward sloping and creative works are partial substitutes for one another, the U.S. creators are actually richer. This is because monopoly prices are higher than competitive ones, so if the prices of EU creations increase after the copyright term increases there, U.S. creators can keep their products as competitive as they were before in the EU markets and still slightly raise their prices.

73. *Eldred*, 537 U.S. at 206 n.12.

74. *Id.* at 206-07 (citations omitted).

75. *Id.* at 207-08 n.15.

76. WILLIAM M. LANDES & RICHARD A. POSNER, *THE ECONOMIC STRUCTURE OF INTELLECTUAL PROPERTY LAW* (2003); William M. Landes & Richard A. Posner, *An Economic Analysis of Copyright Law*, 18 J. LEGAL STUD.



325 (1989); Richard A. Posner, *Eldred and Fair Use*, 1 THE ECONOMISTS' VOICE 1 (2004), available at <http://www.bepress.com/ev/voll/iss1/art3>.

77. [Source]

78. [Source]

79. LANDES & POSNER, *supra* note 76, at 13.

80. Hardin, G. (May 1998). "Extensions of "The Tragedy of the Commons"". *Science* **280** (5364): 682-683. [Source]

81. *Id.* at 223 (quoting Dennis S. Karjala, "Statement of Copyright and Intellectual Property Law Professors in Opposition to H.R. 604, H.R. 2589, and S. 505, The Copyright Term Extension Act, Submitted to the Joint Committees of the Judiciary," Jan. 28, 1998, <http://www.public.asu.edu/~dkarjala/legmats/1998statement/html>).

82. *Id.* at 223.

83. See LANDES & POSNER, *supra* note 76.
84. See *id.*
85. *Id.*, *supra* note 76, at 224.
86. *Id.* at 225.
87. *Id.*
88. *Id.*
89. *Id.* at 224 (quoting Bill Britt, *International Marketing: Disney's Goals*, *MARKETING*, May 17, 1990, at 22, 26).
90. *Id.* at 226.
91. See PAUL SEABRIGHT, *THE COMPANY OF STRANGERS: A NATURAL HISTORY OF ECONOMIC LIFE* 13-15 (2004).
92. BRINK LINDSEY, *AGAINST THE DEAD HAND: THE UNCERTAIN STRUGGLE FOR GLOBAL CAPITALISM* 10-11 (2002).
93. LANDES & POSNER, *supra* note 76, at 226.
94. Amazon.com, Amazon's Beethoven Store,

---

<http://www.amazon.com> (search "Beethoven") (last visited Apr. 8, 2009).

95. *Copyright Term, Film Labeling, and Film Preservation Legislation: Hearing on H.R. 989, H.R. 1248 and H.R. 1734 Before the H. Comm. on the Judiciary, 104th Cong. 161, 171, 188 (1996)* (statement of Marybeth Peters, Register of Copyrights and Associate Librarian for Copyright Services, Library of Congress).

96. Mark A. Lemley, *Ex Ante Versus Ex Post Justifications for Intellectual Property* 6 (Feb. 16, 2004) (unpublished manuscript, <http://ssrn.com/abstract=494424>). We should point out that Lemley's argument that if monopoly rights are provided there is no reason to provide them to the creator is incorrect. Regardless of who starts with the monopoly rights, as long as they can be sold without prohibitive transactions costs, they

will wind up in the hands of whoever can manage them the most efficiently. In practice, most copyrights are in fact transferred to corporations and publishers. If monopoly rights are to be provided, the advantage of providing them to the creator (other than the obvious difficulty of figuring to whom else to give them) is that it creates an additional incentive for creation, however miniscule it might be.

97. *Id.* at 7.

98. *Id.* at 8-9.

99. LANDES & POSNER, *supra* note 76, at 229.

100. That is why promotional campaigns for milk, cereals, and fish usually are carried out by some industry-wide association and not by individual firms.

101. Of course, the monopolist, unlike the competitive providers, will have no incentive to provide accurate

---

information. We rarely see Disney advertising that, however true it might be, its new Mickey Mouse movie is poor, and we should go see the old Mickey Mouse movie instead.

102. Kenneth J. Arrow, *Economic Welfare and the Allocation of Resources for Invention*, in *THE RATE AND DIRECTION OF INVENTIVE ACTIVITY: ECONOMIC AND SOCIAL FACTORS* 609 (1962).

103. *Id.* at 609-25.

104. See, e.g., Michele Boldrin & David K. Levine, 2003 *Lawrence R. Klein Lecture: The Case Against Intellectual Monopoly*, 45 *INT'L ECON. REV.* 327, 327-50 (2004); Michele Boldrin & David K. Levine, *The Economics of Ideas and Intellectual Property*, 102 *NAT'L ACAD. SCI.* 1252, 1252-56 (2005); MICHELE BOLDRIN & DAVID K. LEVINE, *AGAINST INTELLECTUAL MONOPOLY* (2008).

105. Boldrin, M. and D. K. Levine [2008b], "Perfectly Competitive Innovation," *Journal of Monetary Economics* **55**, 435-

453.

[Source]

106. JOSEPH SCHUMPETER, THE THEORY OF ECONOMIC DEVELOPMENT: AN INQUIRY INTO PROFITS, CAPITAL, CREDIT, INTEREST, AND THE BUSINESS CYCLE (1911).

107. ISAAC NEWTON, PHILOSOPHIAE NATURALIS PRINCIPIA MATHEMATICA (1687).

108. Copyright Act, 1709, 8 Anne c.19 (Eng.).

### ***Michele Boldrin***

Michele Boldrin holds a PhD from the University of Rochester (1987) and is currently Joseph G. Hoyt Distinguished Professor of Economics and Department Chairman, at Washington University in Saint Louis. He is a Fellow of the *Econometric*

*Society*, an Associate Editor of *Econometrica*, an Editor of the *Review of Economic Dynamics*, and a Research Fellow at CEPR, London, and FEDEA, Madrid. His new book, *Against Intellectual Monopoly*, coauthored with David K. Levine, was published by Cambridge University Press in June 2008.

### ***David K. Levine***

David K. Levine holds a PhD from the Massachusetts Institute of Technology (1981) and is currently the John H. Biggs Distinguished Professor of Economics at Washington University in Saint Louis. He is a Fellow of the *Econometric Society*, an Editor of *Econometrica*, a member of the Executive

Board of *Theoretical Economics*; a past Editor of the *Review of Economic Dynamics*, of *Economic Theory* and of the *Journal of Economic Theory*. His new book, *Against Intellectual Monopoly*, coauthored with Michele Boldrin, was published by Cambridge University Press in June 2008.