# A Framework for Patents, Innovation, and Economic Growth

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## I. INTRODUCTION

There are no scientific certainties about the relationship between patents and innovation. It is imperative, therefore, to understand the relationship between patents and innovation better. Machulp's famous conclusion is still standing; empirically, we still do not know with certainty what is the relationship between patents and innovation, as has been pointed out by many.[1] This Article present a methodology to tackle this, which comprises the use of empirical data to assess different economic growth models, in which –in most accounts– innovation is a vital variable. This is already being done for endogenous growth models, as mentioned later in this Article.[2] The methodology plays with the concept of meaningful changes to the current global patent agreement of the World Trade Organization, in order to test the global system and its reactions to such changes. This will require a difficult-to-achieve deal between developed and developing nations.[3] To that end this

[*]A mi abuelo Pepe.

[1] Does the patent system "confer a net benefit or a net loss on society"? SUBCOMM. ON PATENTS, TRADEMARKS, & COPYRIGHTS ON THE JUDICIARY, 85TH CONG., AN ECONOMIC REVIEW OF THE PATENT SYSTEM (Comm. Print 1958), https://cdn.mises.org/An%20Economic%20Review%20of%20the%20Patent%20System_Vol_3_3.pdf.

For an analysis of how Machlup´s conclusion is still standing see Esteban Donoso, *Application of a Mechanism of Proportional Reward Towards Global Innovatio*n, 4 N.Y.U. J. INTELL. PROP. & ENT. L. 105, 108 (2014).

[2] Jakob Edler & Jan Fagerberg, *Innovation Policy: What, Why, and How*, 33 OXFORD REV. ECON. POL. 2, 2–23 (2017).

[3] *See* William Samuelson & Richard Zeckhauser, *Status Quo Bias in Decision Making*, 1 J. RISK & UNCERTAINTY 7, 46 (1988) (discussing the difficulty of such changes. A reform of the TRIPS Agreement of the WTO requires virtual unanimity, which on its own is not the most difficult part. To aggravate things, these kinds of changes are hard, due to status quo bias resulting in canal-oriented policies. Nonetheless, decision making resides in the hands of WTO member countries, which could agree to improve it to fit their interests, obviously.).

Article proposes, as an example with political symmetry,[4] two substantial changes to the global patent system for a clearer empirical picture to emerge.

Conventional wisdom conveys that patents and innovation must have a relationship. This comes from a logical economic belief, which is the cornerstone of the system. If developing a drug costs 1.000.000 *X* and reproducing it cost 0.1 *X*, no one will make the investment required for the innovation to appear if it not for a patent right. Richard Epstein summarizes this view. "[A]fter the fact, patents are inconvenient because they restrict the use of valuable inventions. But before the fact, they are necessary to create those same inventions. No one can assume that valuable inventions will pop up magically in the public domain if their inventors received no reward for their labor and capital. Most inventions are costly to design […]."[5] Also, it is known that patents create "deadweight loss," harming consumers, as explained by Suzanne Scotchmer.[6] This Article introduces an analysis tool from an accident prevention model, to assess patents' downsides and virtues.

Moreover, since 1986,[7] endogenous growth models, which represent the mainstream neoclassical approach, have popularized the belief that innovation is the engine of economic growth.[8] Evolutionary theory, a contemporaneous and competing theory, also sees innovation as the engine of economic growth, with its own conception of technology.[9] These views generated a powerful notion which could accurately explain economic development, both

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[4] *See* ESTEBAN DONOSO, A GLOBAL SOLUTION FOR THE PROTECTION OF INVENTIONS 8–44 (2014) (discussing the current polarization. Most developing countries claim the entire system was imposed on them. To aggravate things, meaningful reforms to the TRIPS Agreement have been blocked by their distrust of the system.); for the original Spanish version of the text, see ESTEBAN DONOSO, JUSTICIA, VIGENCIA Y EFICACIA DEL RÉGIMEN INTERNACIONAL DE PATENTS DE INVENCIÓN (2011).

[5] RICHARD A. EPSTEIN, INTELLECTUAL PROPERTY FOR THE TECHNOLOGICAL AGE 10 (2006).

[6] "Deadweight loss occurs when people are excluded from using the good even though their willingness to pay is higher than the marginal cost." SUZANNE SCOTCHMER, INNOVATION AND INCENTIVES 36 (2006).

[7] Paul M. Romer, *Increasing Returns and Long-Run Growth,* 1002–37, 94 J. ECON. PERSP. 94, (1984).

[8] Juan Ricardo Perilla Jimenez, *Mainstream and Evolutionary Views of Technology, Economic Growth and Catching Up*, 29 J. EVOLUTIONARY ECON. 823 (2019). "The contemporary consensus in growth theory views technology as "something" that improves productivity and hinges fundamentally on the creation of "ideas": blueprints that offset the curse of decreasing returns to capital, allowing the economy to obtain endogenous exponential growth." *Id.* (citing Paul Romer, *Idea Gaps and Object Gaps in Economic Development*, 32 J. MONETARY ECON. 543 (1993) [hereinafter Romer (1993)]; Charles I. Jones, *Growth and Ideas*, 1 Handbook of Econ. Growth 1063 (2005)).

[9] *Id.* at 834. The debate is currently framed on "the distinction between the economic contributions of the adoption of foreign technology and local innovation from the perspective of two contrasting theoretical developments, namely the mainstream neoclassical [Romer's model] and evolutionary economics." *Id.* at 823–24 (citing Romer (1993), *supra* note 8; Paul M. Romer, *The Origins of Endogenous Growth*, 8 J. ECON. PERSPECTIVES 3 (1994) (representing the neoclassical view); RICHARD R. NELSON & SIDNEY G. WINTER, AN EVOLUTIONARY THEORY OF ECONOMIC CHANGE (1982); Richard R. Nelson & Sidney G. Winter, *Evolutionary Theorizing in Economics*, 16 J. ECON. PERSPECTIVES 23 (2002) (representing the evolutionary view)).

understanding innovation as the global engine of growth, and economic policy and the environment it creates as the gas for this engine.[10] (Nonetheless, they deeply disagree on the policy they each recommend).

Some developing countries have not yet joined the innovation-driven growth, though, as corroborated by global growth data.[11] (Freeman pointed to this first.)[12] This has deflated some excitement around these theories, especially about the mainstream neoclassical approach.[13] In any case, it is clear the system is working for some and that it is not necessarily working for others, which naturally renews attention to the warning made by economic heterodoxy. (It is worth noticing that the application of our methodology is not going to attend to the main point made by economic heterodoxy –heterodoxy is conceptually against highly aggregated models. It, nonetheless, recommends testing mainstream beliefs. Testing the system could lead to proving mainstream understanding wrong, so even heterodoxy also should be invested in it.)

Following our methodology, meaningful changes to the Trade-Related Aspects of Intellectual Property Rights Agreement of the World Trade Organization (TRIPS Agreement) should be chosen, first, for the virtue of those reforms, and, secondly, to test our current understanding of economic growth and innovation. The macro impacts of such changes could be measured, read and interpreted against the backdrop of economic theories such as endogenous growth models –and any other take on the economy for that matter. Analyzing data concerning other parameters within any given model could yield empirical-based insights for all of its variables -it could shed light on economic growth, for example-, and their interrelationship, or even prove it wrong.

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[10] For a critical review, see Sergio Cesaratto's extensive, and certainly broader, review of endogenous grow theory. SERGIO CESARATTO, ENDOGENOUS GROWTH THEORY TWENTY YEARS ON: A CRITICAL ASSESSMENT (2009).

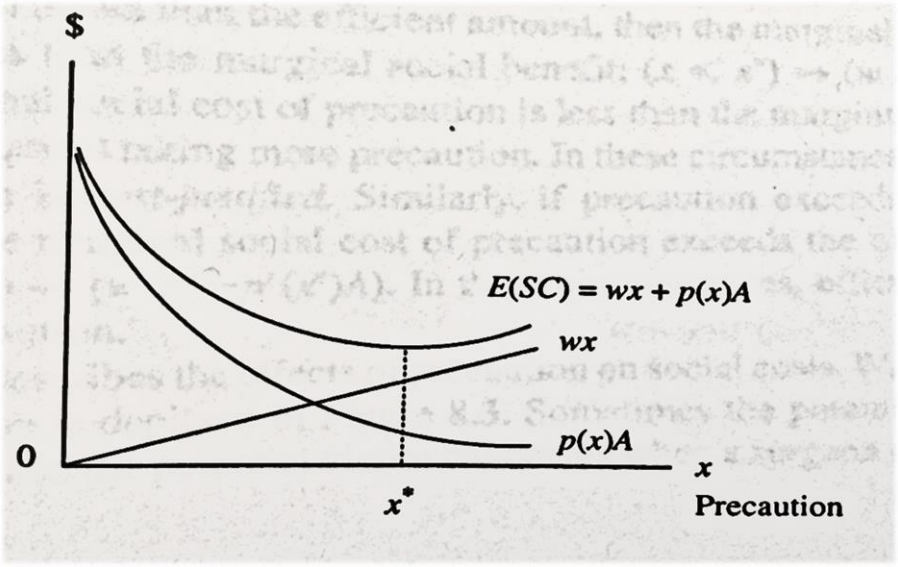
[11] Jimenez, *supra* note 8. "The importance of technology in explaining income and income growth differences across countries is apparent. A vast amount of specialized literature agrees that the productivity of workers is closely related to a country's available technology. On some accounts, productivity, or technology, differences are held to explain up to between 60% and 90% of the growth differences and more than 90% of the difference in levels of income between poor and rich countries." *Id.*, at 824 (citing William Easterly & Ross Levine, *It's Not Factor Accumulation: Stylized Facts and Growth Models*, 15 WORLD BANK ECON. REV. 177 (2001)).

[12] CHRISTOPHER FREEMAN, TECHNOLOGY, POLICY, AND ECONOMIC PERFORMANCE: LESSONS FROM JAPAN (1987).

[13] *See, e.g.*, Paul Krugman *The New Growth Fizzle*, N.Y. TIMES (August 18, 2013, 3:06 PM), https://krugman.blogs.nytimes.com/2013/08/18/the-new-growth-fizzle/?_r=0.

## II. HARM AS A PROBABILITY WITHIN THE GLOBAL PATENT SCHEME

By extrapolating microeconomic tools to our macro endeavor, we present a methodology to assess and improve the current system. It comprises an abstract formula that adds the negative effects the patent system may produce to the cost of taking care of them, i.e., precautions, which signals an equilibrium. We develop our analysis against the backdrop of Calabresi´s classic accident-prevention model, trying to make empirical sense of the downsides and the precautions that may be taken as palliatives or corrections for the downsides of the global patent system. The model was formally presented in Judge Guido Calabresi's classic book, The Cost of Accidents,[14] which arguably gave birth to Law and Economics. Since then, it has been applied in many fields and, frankly, to use it for the case of patents is not entirely innovative; it is simply a feature of this versatile model. This simple model adds, E(SC), only two elements, the cost of harm, p(x)A, and the cost of avoiding it, wx. Thus, its equilibrium, x*, is very simply understood graphically:




Graph 1: The expected social costs of [patents] shown as the sum of precaution costs and the expected cost of harm."[15]

The intent of this Article at this point is just to introduce this conceptual model to construct our argument, which is accomplished by the graphic above. Nonetheless, we do provide a mutatis mutandis textbook description by Cooter and Ulen of Calabresi's accident prevention model at the footnote, noting the few applicable changes in brackets.[16]

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[14] Guido CALABRESI, THE COSTS OF ACCIDENTS: A LEGAL AND ECONOMIC ANALYSIS (1970).

[15] ROBERT COOTER & THOMAS ULEN, LAW AND ECONOMICS 200 fig6.3 (Berkeley L. Books, 6th ed., 2016).

[16] *Id.* at 200-201. This very well written textbook statement of Calabresi's original model by Cooter and Ulen could very well represent its application for any given field. It is certainly a versatile

In a first stage, the harm that patents may bring about and how it may be reduced with precautions is taken as a given, a fixed reality, the status quo. This is represented by p(x)A. Within this first limited and static frame, we will conceptually analyze the potential downsides and the potential palliatives for those downsides of the system.

In the same way there are no certainties about the relationship between innovation and patents, as we will see, there is not always an agreement on the downsides the system creates for society, i.e. the harm it produces. This Article will consider the following potential focus of harm the current intellectual property system may be creating, for which we create our own terminology and concepts: deadweight loss, from which we will draw the concept of superfluous and vacant deadweight loss protection, contradictory protection, tech-gap damage, and disruptive damage.

When consumers are priced-out by the monopolistic price set by a patent owner, deadweight loss is created. Importantly, priced-out consumers can generate very sensitive issues, especially when it comes to health innovation,

model. Case in point, here it is for the global patent scheme, with very few changes and comments noted in brackets: "The probability of [negative externalities] –which we denote $p$, decreases with increases in precaution which we denote $x$. Thus, p = p(x) is a decreasing function of x . . . Let $A$ denote the monetary value of [the negative externalities]. $A$ multiplied by $p$ equals the expected harm in dollars ("expected" because of the probabilistic element). Like $p(x)$, the harm $p(x)A$ is a decreasing function of precaution $x$. To keep the graph simple, we assume that A is a constant. The analysis would not be changed by assuming that A is a decreasing function of x, so long as p(x)A is a concave function. To depict this fact, the horizontal axis in [the figure] indicates the quantity of precaution, $x$, and the vertical axis indicates monetary amounts, including the cost of harm $p(x)A$. The curve labeled $p(x)A$ in the figure slopes down, indicating that harm decreases as precaution increases. Taking precaution often involves the loss of money, time, or convenience. We assume that precaution costs $w per unit. To keep the analysis simple, we assume that w is constant and does not change with the amount of precaution x. Consequently, wx equals the total amount spent on precaution. The graph of wx in the figure is a straight line through the origin whose slope equals w. The figure depicts the two kinds of costs produced by the patent system: the cost of precautions and the cost of expected harm. Consequently, we may add the costs of precaution and expected harm to obtain the expected social costs . . . which we denote SC: SC = wx + p(x)A. The expected social cost curve in the figure is thus obtained by adding vertically the line wx and the curve p(x)A at every level of precaution x. The result is the U-shaped curve, which is labeled SC = wx + p(x)A. Because the expected-social-cost curve is U-shaped, a value of x exists that corresponds to the bottom of the U. This value denoted x* in the model is the level of precaution that minimizes the expected social costs of the patent system. Efficiency requires minimizing social costs, so x* is the socially efficient level of precaution or, simply, the efficient level of precaution. Let us characterize x* mathematically. The cost of a little more precaution (marginal cost) equals the price per unit w. A little more precaution reduces the expected cost of harm (marginal benefit). This reduction in the expected cost of harm equals the reduction in the probability of an accident, which we denote –p'(x) multiplied by the cost of harm A. (The prime (') after p indicates the slope of the graph of the function p(x) at x. The slope is negative in the model, so that minus sign in front of the p makes the expression –p'(x) positive.) When precaution is efficient, the cost of a little more precaution (marginal cost) equals the resulting reduction in the expected cost of harm (marginal benefit). Thus, the efficient level of precaution x* can be found by solving the following equation: w = p(x*) A. If precaution is less than the efficient amount, then the marginal social cost of precaution is less than the marginal social benefit: (x < x*) - (w < -p'(x*)A). When the marginal social cost of precaution is less than the marginal social benefit, efficiency requires taking more precautions. In these circumstances, we say that more precaution is cost-justified. Similarly, if precaution exceeds the efficient amount, then the marginal social cost of precaution exceeds the marginal social benefit: (x > x*) - (w > -p'(x*)A). In these circumstances, efficiency requires taking less precaution."

due to the consequences of economic exclusion (death, in some cases). This, together with the loss of consumer' surplus,[17] are the main externalities of the patent system, although much debate arises in regard to when is it justified in pursuit of innovation.[18] Not much consensus has appeared.

To make sense of this debate, we have to go one step further. Deadweight loss must be measured against the backdrop of the mainstream belief that there are at least some instances in which patents do bring about more innovation. Thus, we identify superfluous protection in the case of those innovations that would have appeared even with less incentive –fewer years– than the current twenty years incentive.[19] The second kind of harm comes from a diametrically opposed point of view to that made by those that want to see deadweight loss being reduced at all cost. There is innovation that simply does not appear due to a lack of enough protection. The benefits not delivered to society could be precious (theoretically, patents could be granted *ad eternum*, which will create deadweight losses forever as well –which surely is not at anyone's mind). Also, to consider, public goods with lower thresholds and higher rewards are more likely to be provided, as explained by Cadsby and Maynes.[20] We are going to call it 'vacant protection.'

The analysis of superfluous and vacant deadweight loss leads to an odd symmetry –or a truism. The less you protect, the less superfluous protection you have, the more you protect, the less vacant protection loss you have –its limit being perpetual patents. This, with any given patent length, is a matter of probabilities.[21] Yet, before jumping to conclusions about the possibility of a

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[17] Another comparatively less serious problem of the patent system is the reduction of consumer's surplus. Antitrust laws, for instance, are mainly devoted to protect consumer surplus; patented products' sales use to be exempted from these regulations -due to its nature-, though new takings are suggesting the use of antitrust principles to curtail patent's negative externalities. Some consumers do not get excluded from using the patented good or using the patented process by paying more for it than the marginal cost. These consumers are the ones spurring innovation. While this evaporates consumer's surplus and even may bring about distributional concerns, it is deemed necessary to reward innovation. "A dollar is a dollar, no matter whose pocket it is in. […] That […] payment is not a *social* loss because any losses to purchasers are exactly offset by gains to the patent holder." RICHARD A. EPSTEIN, INTELLECTUAL PROPERTY FOR THE TECHNOLOGICAL AGE 11 (Mfg. Inst. 2006).

[18] RICHARD A. EPSTEIN, INTELLECTUAL PROPERTY FOR THE TECHNOLOGICAL AGE 10 (Mfg. Inst. 2006). "The hard social question is whether the law should grant the exclusive right that raises the price above [the] marginal cost. The question would receive an easy affirmative answer if creating this monopoly carried no social price. But unfortunately the price paid comes in the form of dead-weight social losses."

[19] If the patent system is meant to spur innovation, superfluous deadweight loss is innovation that did not need reward at all or needed less reward than the one received in order to exist. It is all the wasteful protection the system generates.

[20] Current models apply for threshold public goods, which most potential breakthrough innovations are not. Due to the lack of certainty of a patentable result, the case of new mechanisms of action for antibiotics -as described latter- is a case on point. Regarding public good provision, *see generally* Charles Cadsby & Elizabeth Maynes, *Voluntary Provision of Threshold Public Goods with Continuous Contributions: Experimental Evidence*, 71 J. PUB. ECON. 53 (1999).

21 But-for an individualized, invention-by-invention assessment to determine a just retribution for each individual patent, this probability will always be part of any given patent scheme.

technological heaven brought by *ad eternum* patents –and *ad eternum* deadweight loss–, we must consider what we will call 'contradictory protection.' As some have argued, too much protection could actually delay innovation[22] and obstruct economic growth –as postulated by the tragedy of the anti-commons.[23] Additionally, some have argued the system is imposing an unfair limit to developing nations' growth, which we call tech-gap damage[24], while others question the very convenience of innovation-driven growth, which we will call disruptive protection.[25] Many other takes should be considered (e.g., Schumpeter´s[26] or Edler and Fagerberg´s[27] perspectives).

Since there is neither agreement nor factual conclusions about these and other potential downsides of the patent system, it is conceivable to treat them as a probability. Plus, these negative effects may even cancel each other in some way or another. Chances are, that in any given patent scheme –be it the fixed twenty yearlong patents as settled within the current system or in the hypothetical improved scheme we propose, negative effects will exist. The debate will remain open. Discussion and trial and error are key features of our incremental improvement approach.

The next analysis is how to reduce harm, and here is where the model allows us to take things a step further. To make sense of the policy debate

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22 Some empirical work shows interesting conclusions about follow-up innovation. For instance, *see, e.g.*, Alberto Galasso and Mark Schankerman,, *Patents and Cumulative Innovation: Causal Evidence from the Courts*, 130 Q. J. ECON 317 (2015) [hereinafter Galasso and Schankerman]; Bhaven N. Sampat and Heidi L. Williams, *How Do Patents Affect Follow-On Innovation? Evidence from the Human Genome* 109 AM. ECON. REV. 203 (2019).

23 Michael A. Heller. & Rebecca S. Eisenberg,. *Can Patents Deter Innovation? The Anticommons in Biomedical Research*, 280 SCI. 698, 698 (1998)

24 Dhar and Rao denounce that TRIPS is the mechanism to ensure a perpetual gap between developed and developing nations. Biswajit Dhar & C. Niranjan Rao, *Trade Relatedness of Intellectual Property Rights: Finding the Real Connections*, 17 SCI. COMMC'NS 304 (1996).

25 We chose this term to try to capture the net balance of innovation for society taking into account "creative destruction". The belief behind creative destruction is that with innovation vast more jobs and economic growth will be created in comparison with the jobs and output lost at the sector destroyed by innovation. Komlos, nonetheless, argues that the destructive part has gained enough weight to replace the creative benefits. See John Komlos, *Has Creative Destruction Become more Destructive?*, 16 B.E. J. ECON. ANALYSIS & POL'Y 1, 1-12 (2016).

26 Schumpeter's study also points to commercialization and selection as phenomena to look after to assess harm. Joseph A. Schumpeter, THE THEORY OF ECONOMIC DEVELOPMENT: AN INQUIRY INTO PROFITS, CAPITAL, CREDIT, INTEREST, AND THE BUSINESS CYCLE (1934). These potential downsides are attended with policy to increase the interaction among firms, thus creating and enabling the proper environment.

27 As pointed out by Edler and Fagerberg, other potential downsides could come from "the crucial role that the balance between the creation of new variety, i.e. invention/innovation, and selection play for long-run economic development. While variety-creation is the source of long-run growth, selection processes, by eliminating the least promising solutions, contribute to much-needed efficiency. However, if variety-creation for some reason dries up, the economic system may be heading for stagnation. Therefore, following this perspective, preserving the right balance between variety-creation and selection emerges as an important goal for innovation policy." Jakob Edler & Jan Fagerberg, *Innovation policy: What, why, and how*, 33 OXFORD REV. ECON. POL'Y 2 (2017), https://doi.org/10.1093/oxrep/grx001.

around the global patent system, it is important to distinguish precautions (wx), from approaches to prevent harm (which will have an effect on p(x)A). This model helps assess how much precaution to take, i.e., resources destined to curtail the negatives effects of the patent system, as well as to assess changes to the system itself that will both generate bigger impacts on the equilibrium and yield a better empirical understanding of the patent system and economic growth. Porter and Stern's was the first study to use macro-level patent data with this purpose.[28]

Resources intended for precautions translate into money spent by public or private entities to help those affected by the externalities created by the system. Subsidies by governments helping their citizens to access patented drugs, for instance, tackles deadweight loss. Patent pools intended to grant access to consumers –e.g. the global health initiative known as UNITAID´s Medicine Patent Pool[29]–or as a sharing mechanism among patent holders, tackle deadweight loss and may curtail contradictory protection, respectively. Much needed public funds for research may tackle vacant protection, as stated by Edler and Fagerberg.[30] Regulations and governmental plans or subsidies for those whose jobs are no longer needed—e.g., programs to train those displaced with new skills, or, if ever possible, more time for paid leisure making workloads lighter—are precautions for disruptive protection.

On the other hand, each country sets harm-reducing tactics or approaches when implementing the TRIPS provisions; they may choose to use, or not, one or more of the allowed flexibilities, including exception and limitations to the TRIPS standard, which are permitted by the TRIPS Agreement, as explained in Donoso.[31] For instance, countries may decide not to grant patents for diagnostic, therapeutic, and surgical methods for the treatment of humans or animals. Countries could ban the patentability of what is known as second use patents. Even when defining the patentability requirements, countries choose laxer or stricter views of what is patentable.[32] All of these various possibilities—that change from time to time within a country—have an impact

[28] Michael E. Porter & Scott Stern, *Measuring the 'Ideas' Production Function: Evidence from International Patent Output* (Nat'l Bureau of Econ. Rsch., Working Paper, Paper No. 7891, 2000), http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.466.7593&rep=rep1&type=pdf.

Not only Roomer's endogenous models must be measured but also all of its spinoffs, and any other take on reality deem plausible for that matter. This technique is just taking off, and contradictions and mistakes are expected. This technique must be improved too with an incremental approach.

[29] MEDICINES PATENT POOL HOME, www.medicinespatentpool.org (las visited Mar. 3, 2021).

[30] The effectiveness of this precaution, as with all of the other variables, must be viewed as a statistical probability. Edler and Fagerberg on public funding initiatives comment, "[i]t has nevertheless been criticized for being theoretically flawed and inconsistent with what is known from empirical research on innovation processes." Jakob Edler & Jan Fagerberg, *Innovation Policy: What, Why, and How*, 33 OXFORD REV. ECON. POL'Y 2, 7 (2017).

[31] ESTEBAN DONOSO, A GLOBAL SOLUTION FOR THE PROTECTION OF INVENTIONS 131–74 (2014).

[32] *See* Jerome H. Reichman, Bunyan S. Womble Professor, Duke University School of Law, Presentation to the World Intellectual Property Organization's Open Forum on the Draft Substantive Patent Law Treaty: Patent Law Harmonization and the Draft SPLT (Mar. 1, 2006) (an example of a very critical view of how the United States defines patentability).

on the harm produced by it. Although well intended, due to the lack of empirical knowledge available about the issue, this harm-avoiding approach sometimes may actually be producing unintended consequences, as argued by Sykes.[33]

This approach—from a global standpoint—is haphazard and frenetic.[34] More importantly, it does not leave traceable evidence to get to reliable conclusions about the relationship between patents and innovation, and about the role that innovation plays on economic growth. It keeps the world in darkness regarding these essential questions, which in turn fuels more of these same practices, exacerbating the political stands on the matter all the while. Coordinated actions could do much more for the system. Moreover, taking into account both the global standard set by the TRIPS—which is expressed in minimums in the Agreement—and TRIPS Plus Agreements—the name given by academia to bilateral agreements with stronger patent protection—current efforts only scratch the surface, as argued in Donoso.[35]

This Article argues for coordinated changes of the system, characterized by modifications in the length of patents (which will have a big effect on p(x)A). This only may be done at the international level. All countries stand to gain from this approach, which might spark the needed political will to get to such an agreement. Precautions to tackle harm (wx) are dwarfed by these harm-reducing approaches. Furthermore, a key feature of our methodology is to gather factual conclusions about the biggest questions surrounding the system—the relationship between patents and innovation, the role of innovation on economic growth, and the negative effects of the patent system—by generating big changes. Such changes will generate new, distinguishable, and measurable realities, allowing the system to be refined over and over again. Changes, in the length of patents or otherwise, should be done taking an evidence-based incremental approach, measuring any and all possible variables to test any and all interpretations of reality. For example, see Ulku's

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[33] "Developing nations have long had little intellectual property protection for pharmaceuticals, and we have concurrently witnessed an apparent dearth of research into the diseases of particular importance to them such as malaria and drug-resistant tuberculosis. The lack of patent protection may have resulted at least in part from an acute collective action problem—developing nations reap the full benefits from lower prices when they do not create pharmaceutical patents, yet the costs in terms of diminished research incentives are largely externalized to the rest of the developing world." Alan O. Sykes, *TRIPs, Pharmaceuticals, Developing Countries, and the Doha "Solution"* 3 (Univ. Chicago L. Sch., Working Paper No. 140, 2002), http://chicagounbound.uchicago.edu/law_and_economics/597/.

[34] "In the final analysis, however, it is not clear whether the problem with TRIPS is, as the Declaration [The Max Planck Declaration on Patent Protection] implies, too little sovereign authority, or whether the trouble is insufficient coordination." Rochelle Dreyfuss & Esteban Donoso, *On Aiding Technological Development: The Max Planck Declaration on Patent Protection*, 6 UC IRVINE L. REV. 321, 341 (2016).

[35] DONOSO, *supra* note 32, at 48–81.

two analysis and their different conclusions.[36] Conclusions may take a long time to appear.

## III. TWO EXAMPLES WITH POLITICAL SYMMETRY

To have the experiment tried both ways, to have it enhance the assessment feature in our methodology and, importantly, for political symmetry, we suggest two changes. The first aims to tackle a crucial time-sensitive specific challenge: the issue of antibiotic resistance. The second is a broader approach, one designed to prevent harm to Developing Countries in the short run while allowing Developing Countries to catch up to the innovation-driven growth in the long run.

The first proposal is a bet on the patent incentive regime, on a pressing matter—i.e., to double down on the system.[37] To tackle antibiotic resistance we need to incentivize in a global and urgent way the development of technical solutions. Not only new antibiotics are needed, but also vaccines, diagnostics, therapeutics, stewardship programs, as suggested by doctors like Ardal.[38] The risk is here now, and it could become catastrophic at any moment.[39] Incentives under the current scheme fail to come up with a steady flow of new antibiotics and other therapeutic solutions through the innovation pipeline. Increasing the reward for this needed technology could actually be the right harm-reducing approach (which will have an effect on p(x)A). A very valuable proposal, that of *delinkage*, should be implemented as soon as possible, as proposed by the World Health Organization.[40] But, what if even with these

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[36] A good example of how testing Roomer's and different spinoffs of Roomer's models may yield different results are Hulya Ulku's two analyses. Hulya Ulku, *R&D, Innovation, and Economic Growth: An Empirical Analysis* (IMF, Working Paper No. 04/185, 2004). Ulku did her second analysis by testing non-scale endogenous models by the analysis of innovative activity using sector-level patent data. Hulya Ulku, *R&D, Innovation, and Growth: Evidence from Four Manufacturing Sectors in OECD Countries*, 59 OXFORD ECON. PAPERS 513 (2007).

37 This much could be said about climate change, although it is a vast and complex problem. The question of how to qualify patents as eco-friendly or not is a complex issue itself.

[38] *See* Christine Ardal et al., *International Cooperation to Improve Access to and Sustain Effectiveness of Antimicrobials*, 387 LANCET 296, 297 (2016).

[39] *See* UN Interagency Coordination Group on Antimicrobial Resistance, *No Time to Wait: Securing the Future from Drug-Resistant Infections*, at 1, 4 (Apr. 29, 2019). (Some parts of the report are chilling: "Unless the world acts urgently, antimicrobial resistance will have a disastrous impact within a generation"; "Additional effort, investments, and incentives are needed to spur innovation in antimicrobial medicines, diagnostics, vaccines, waste management tools, safe and effective alternatives to antimicrobials and alternative practices, as well as operational and implementation research, in human, animal and plant health"; "Antimicrobial resistance is a global crisis that risks reversing a century of progress in health"; "A worst-case scenario developed by the World Bank has suggested that this figure could rise to 10 million deaths every year by 2050, if no action is taken"; "Annual economic damage as a result of antimicrobial resistance could be comparable to the shocks experienced during the 2008-2009 global financial crisis – but with no end in sight.").

[40] *See* World Health Organization [WHO], *Global Action Plan on Antimicrobial Resistance*, at 11, WHA68//2015/REC/1, Annex 3 (2015), https://apps.who.int/iris/bitstream/handle/10665/193736/9789241509763_eng.pdf;jsessionid=76C44C7A5470021F17E5F6A31C84FF94?sequence=1 (proposing new processes to increase investment in research and development of new antibiotics

thoughtful precautions (wx)–public funding and other initiatives–viable solutions for antibiotic resistance fail to emerge? Should we risk leaving this innovation *vacant*?

This agreement could also entail widening protection in the entire developed world for this targeted incentive by protecting diagnostic and therapeutic methods, which are protected in the United States but not in Europe, for instance.[41] Additionally, because the technology behind antibiotics has the potential to accelerate in big leaps, e.g., when new "mechanisms of action" are identified,[42] a greater reward could be realized by those that achieve such a technological leap, thus designing the rule to avoid "contradictory protection", in accordance with our terminology. Paired with that, the term of a patent should start to run only once it is allowed for mass use, which should also be paired with control over sales to avoid excess use. Aiming for access, not excess. Public funds should probably still serve as a much-needed trigger for such daunting innovation projects. These funds could even be repaid by the recipient–if profitable–to in turn incentivize funding. Price transparency is also key.

The second proposal is broader in that it is not targeted to a specific problem, as opposed to the previous one. It entails a change to a current global rule. Not 20-years-patents in all countries of the world, but a number of years for each country or trade region determined by its economic capacity. (Poor countries less than 20 years and rich ones a little longer.) It seeks basic fairness, embodied in the premise that the ones that have more should pay more, as argued by Donoso.[43] Moreover, this change could tackle what we have called tech-gap damage.

This proposal has many virtues. It will drastically reduce deadweight loss in developing countries, which may be achieved with a vacant protection

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that protect the conservation of their effectiveness through delinkage between price and volume of sales). Thankfully, the voices of many advocates for delinkage are starting to be heard. *See* Ramanan Laxminarayan et al., *Antibiotic Resistance—The Need for Global Solutions*, 12 LANCET INFECTIOUS DISEASES COMM'N 1057, 1075, 1080, 1089 (2013), https://pubmed.ncbi.nlm.nih.gov/24252483/; *see also*, Anthony D. So et al., *3Rs for Innovating Novel Antibiotics: Sharing Resources, Risks, and Rewards*, 344 BMJ e1782, e1784 (2012), https://www.bmj.com/content/344/bmj.e1782.

[41] *See* DONOSO, *supra* note 4, at 154. Complementary technologies like rapid diagnostic tests (RDTs) are sorely needed to aid the clinician making decisions, which is an innovation that may not currently be protected in all Developed Countries. Donoso's work analyzes the differences between national legislations by comparing them with the minimums of the global standard set at the TRIPS Agreement of the WTO or, more precisely, what the study called the core of the TRIPS Agreement of the WTO (at 48-81). Nonetheless, although not a significant change to p(x)A, these differences may be very significant in terms of actual input to the global reward for innovation and may be taking a toll on innovation (at 131-74).

[42] Garima Kapoor et al., *Action and Resistance Mechanisms of Antibiotics: A Guide for Clinicians*, 33 J. ANAESTHESIOLOGY CLINICAL PHARMACOLOGY 300, 300 (2017), https://doi.org/10.4103/joacp.JOACP_349_15.

[43] *See* DONOSO, *supra* note 4, at 81.

neutral approach.[44] Technology transfer to the developing world could be pursued, as argued by Donoso.[45] This scheme will generate rewards more efficiently, as demonstrated by this same author.[46] From a geopolitical perspective, the prospects of technology transfer could incite developing countries to join the conversation to make the system better and be part of the creative global community's innovation-driven growth.[47]

Additionally, this approach could introduce a much-needed balance not only in favor of developing countries, but among developed countries too. It could equilibrate the contribution of the United States with that of the rest of the developed world in regard to medicines.[48] This recently was a focal point for American policy, under the Trump Administration.[49] Under this proposal, developed nations may agree to increase their overall contribution, by adding some length of time to their patents, to compensate innovators for the reduction in the length of patents in the developing world. As a result, the United States could cap medicines prices or conduct bulk negotiations with pharmaceutical companies to lower prices for their newest drugs, as is the practice in the rest of the developed world. The logic behind this uneven situation for the United States can be explained from a contributor's game perspective, as illustrated in the works of Barrett.[50] The overall increase should help pharmaceutical companies cope with such a change in the United

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[44] By reducing the length of patents in developing countries while increasing patent lengths in the developed world, the overall reward could be maintained. You could achieve a vacant protection neutral approach, in accordance with our terminology.

[45] *See* DONOSO, *supra* note 4, at 90.

[46] Donoso, *supra* note 1, at 116-18.

[47]A suspect for developing nations' failure to join the innovation driven economic growth is the attitude towards the system that some developing countries adopted. Adapting the length of patents by economic capacity will make the system fairer, potentially increasing the international system's acceptability by the developing world. At the moment, these attitudes may be affecting *in situ* compliance and so the vary incentives the system creates. DONOSO, *supra* note 4, at 116; *see also* Dreyfuss & Donoso, *supra* note 35, at 338.

[48] THE COUNCIL OF ECONOMIC ADVISERS, REFORMING BIOPHARMACEUTICAL PRICING AT HOME AND ABROAD (2018), at 4.

[49] Among the issues within a recent regulatory action by the past United States administration that are on topic we found the following statements: "Addressing price disparities in the international market." "Working in conjunction with the Department of Commerce, the U.S. Trade Representative, and the U.S. Intellectual Property Enforcement Coordinator." "U.S. consumers and taxpayers generally pay more for brand drugs than do consumers and taxpayers in other OECD countries, which often have reimbursements set by their central government. In effect, other countries are not paying an appropriate share of the necessary research and development to bring innovative drugs to the market and are instead freeriding off U.S. consumers and taxpayers. What can be done to reduce the pricing disparity and spread the burden for incentivizing new drug development more equally between the U.S. and other developed countries? What policies should the U.S. government pursue in order to protect IP rights and address concerns around compulsory licensing in this area." U.S. DEP'T OF HEALTH AND HUM. SERV., BLUEPRINT TO LOWER DRUG PRICES AND REDUCE OUT-OF-POCKET COSTS (2018), https://www.federalregister.gov/documents/2018/05/16/2018-10435/hhs-blueprint-to-lower-drug-prices-and-reduce-out-of-pocket-costs.

[50] For a threshold case study of the historic breakthrough that meant eradicating smallpox, *see* Scott Barrett, *The Smallpox Eradication Game,* 130 PUB. CHOICE 179 (2006).

States. This methodology has the virtue of objectivity, which could allow the settlement of tensions between nations in the intellectual property arena.

The way harm is distributed globally should also be analysed. The poorest in each market hurt the most; a sort of regressive tax that is imposed on a global scale. The proposed change will redirect this pain proportionally to each country's wealth, working as a progressive innovation tax among countries or trade regions. It will still have a regressive effect for the poor in the wealthiest countries, which should be tended to by precautions deemed appropriate by each wealthy country.

## IV. CONCLUSION

The proposed framework for the analysis of the patent system and its impact on economic growth would work better if meaningful changes are adopted, as it is paired with statistical analysis of the impact of the adopted measures to reach objective conclusions (nonetheless the current scenario could be tested as well, although on a smaller scale, as Dreyfuss and Donoso have suggested.[51]) In the current scenario, every policy to reduce harm should be promoted, up to the current equilibrium (x*, according to Graph 1 above). The ultimate goal of this methodology is to understand the relationship between patents and innovation better. We present two sensible proposals to test the global system and its reaction to such changes. Big changes will generate more data to analyze and could have a bigger positive impact. The changes we suggest should not necessarily be the ones adopted, although we think that both, acting together, make political sense.

[51] We should look in the world for natural experiments. For instance, the United States Supreme Court –USSC- decided to implement international exhaustion doctrine for copyright, from where immediate consequences appeared, which furnishes a good example, *see*, *e.g.*, Kirtsaeng v. John Wiley & Sons, 568 U.S. 519 (2013). The case involved a claim that the importation of cheap textbooks from Thailand into the United States infringed on the publisher's copyrights. After the Supreme Court recognized the doctrine of international exhaustion in U.S. copyright law, thereby allowing importation of the texts, Wiley announced it would increase the price of the international editions of their books. Access to these publications by Thai students will thus decrease as well as for students of the global south in general. *See* Dreyfuss & Donoso, *supra* note 35, at 338. *See also*, Impression Products v. Lexmark International, 137 S. Ct. 1523 (2017) (implying the same for patented products, by allowing parallel imports to the United States). From it, statistical analysis will be possible and desirable. These sporadic changes are of some significance in big markets like China, the United States or the European Union and may serve to even changes regarding compliance.