



Intellectual Property Rights and Economical Development: A Brief Overview

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ABSTRACT

A "strong" IPRs regime, in the sense of providing robust protection of private intellectual property rights, was not a necessary prerequisite for their economic growth, according to the historical experiences of the now-developed nations while they were growing themselves, which we reviewed. Most of them did not provide PIPRs with any real protection until quite late in their development related to life science and especially biotechnology. Even the most developed nations, like the UK and the US, didn't create robust PIPRs regimes until the middle of the 19th century (with the exception of copyright protection in the US's instance), while the less developed nations didn't establish such regimes until much later. The legal framework governing the ownership and protection of intangible works of human intelligence, such as inventions, literary and creative creations, designs, symbols, names, and pictures used in commerce, is known as the Intellectual Property Rights (IPRs) regime. This system consists of international agreements, rules, and laws

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that provide owners or inventors of intellectual property the exclusive right to profit from their creations or investments in them. For the purposes of this paper, it is more important to note that all of these nations were quite willing to v30isolate the intellectual property rights (IPRs) of other nations, even when they had put in place laws protecting the IPRs. Examples include hiring illegal foreign labor, smuggling machinery, industrial espionage, violating trademark laws, allowing the patenting of imported inventions, and outright refusing to adopt the patent system (in the case of the Netherlands and Switzerland) related to life science and especially biotechnology. Some nations approached this issue in ways that can only be described. The best examples include the routine infringement of British trademarks by German producers in the late 19th century, when the nation was pressuring Switzerland to enact a patent law, and the US pressing other nations for the "improvement" of their patent laws in the lead-up to the adoption of the Paris Convention while flatly refusing to protect foreign copyrights related to life science and especially biotechnology. We talked about the issues with the dominant IPR regime that is now in place, which is centered on the patent system, and the TRIPS agreement that represents its apex. Contrary to popular belief, a "good" IPRs regime need not provide the strongest protection for private IPRs. Next, we looked at whether developing nations would likely gain from a stronger PIPRs system, particularly the one required under the TRIPS. Given that most developing nations do minimal R&D and that much of the new information they produce is not patentable, the "domestic" advantages of a stronger IPRs system—that is, an increase in knowledge production by the citizens—are probably relatively minor related to life science.

Keywords: Intellectual property rights; economic; development; TRIPS.

1. INTRODUCTION

The function of intellectual property rights (hereafter, IPRs) in economic growth has long been debatable, as will become obvious later in this article. But since the Trade-Related Intellectual Property Rights (TRIPS) Agreement, the dispute has only gotten hotter. TRIPS initially received little attention because it was not even a primary topic in the Uruguay Round of the GATT negotiations that resulted in the establishment of the World Trade Organization (WTO)" [1]. However, a series of recent occurrences have coincided to make people comprehend that this could end up being the main bone of contention in the WTO's operation in the years to come related to life science and especially biotechnology [2]. Regarding the availability of inexpensive medications, especially in poor nations, TRIPS has long been a source of dispute. The capacity of these nations to manufacture or import less expensive generic versions of necessary medications may be restricted by the agreement's rules on patents and other intellectual property rights. As a result, discussions concerning striking a balance between the necessity to safeguard intellectual property rights and the objective of guaranteeing that everyone has access to necessary medications have continued inside the WTO [3]. TRIPS was first brought to the public's attention because, with the exception of the least

developed countries, who were given until 2006, the "transition" period that allowed developing nations to "upgrade" their IPR regimes in accordance with the TRIPS Agreement was coming to an end and placing them at greater risk of trade sanctions by developed nations. Second, recent attempts by individuals and companies in advanced nations to patent goods that incorporate information that is well known in certain poor countries have outraged many (for example, the infamous turmeric case; see UNDP [4] related to life science and especially biotechnology. When jobs are outsourced, people lose their jobs immediately, experience financial instability, and may have trouble finding new work, particularly if they don't have transferable skills or live in an area with few job possibilities [5]. Third, the recent controversy over pharmaceutical companies' attempts to use TRIPS to stop some developing nations (such as Argentina, India, Thailand, and Brazil) from exporting affordable AIDS/HIV drugs has brought attention to the potential tension between TRIPS and promoting human welfare [6]. Due to the fact that TRIPS, like other WTO accords, is an agreement on a legal framework, its specific mode of operation must be figured out as more cases are amassed related to life science and especially biotechnology [7]. This makes it impossible to say with precision what the TRIPS regime will look like exactly in the future at this time. But as the aforementioned

Table 1. Review of literature

Authors	Paper	Country	Period	Data source	Methodology	Type of firm	Number of firms
Arundel (2001)	The Relative Effectiveness of Patents and Secrecy for Appropriation	European countries	1993	CIS	Ordered logit regressions	R&D performing firms	2849
Arundel and Kabla(1998)	What Percentage of Innovations are Patented? Empirical Estimates for European Firms	European countries	1993	PACE survey andSESSI survey	Simple ordered logitmodel	Largest R&D performing industrial Firms	604
Baldwin et al (1998)	Innovation in Dynamic Service Industries	Canada	1996	Statistics Canada's Survey of Innovation	Descriptive statistics	Firms from three sectors of the service economy: communications, financial services and technical business services	Communication sfirms (excluding postal services): 895; banks and trust companies and life insurers: 160 firms; businesses engaged in computer or related services, offices of engineers, and other technical services: 3,830
Basant (2004)	Intellectual Property and Innovation. Changing Perspectives in the Indian IT Industry	India	2004	Gupta, 2004	Descriptive statistics	IT firms	120
Blind et al (2003)	Patents in the Service Industries	European countries	1998-2000 and 2001	Second Community Innovation Survey	Descriptive statistics and case studies	Service firms	65
Blind et al	Motives to Patent:	Germany	2002	Questionnaire to	Factor	Firms that in 1999	Over 500

Authors	Paper	Country	Period	Data source	Methodology	Type of firm	Number of firms
(2006)	Empirical Evidence from Germany			German enterprises which had applied for a minimum number of three patents at the EPO in 1999	analysis and multivariate probit analysis	had applied for a minimum number of three patents	
Brouwer and Kleinknecht (1999)	Innovative Output, and a Firm's Propensity to Patent. An Exploration of CIS Micro Data	Netherlands	1992	Dutch part of the Community Innovation Survey (CIS)	Multivariate analysis	Firms with 10 and more workers in all manufacturing sectors	1,300
Byma and Leiponen(2007)	Can't Block, Must Run: Small Firms and Appropriability	Finland	2002-03	Survey data collected by ETLA	Simple probit and multinomial logit models	Small and medium-sized firms in all economic sectors except agriculture, finance, and real estate	312
Chabchoub and Niosi (2005)	Explaining the Propensity to Patent Computer Software	US and Canada	2000-02	Different databases providing financial information and the USPTO data on software patents	Logistic regression analysis and linear regression	Computer software-producing companies	Over 1,700
Cincera (1997)	Patents, R&D and International Spillovers at the Firm Level: Some Evidence from Econometric Count Models for Panel Data	European countries	1983-91	EPO database, Compustat (Standard and Poor's) and the firms' annual reports	Poisson, count panel data, GMM panel data	International manufacturing firms investing substantial amounts in R&D	181
Cohen et al (2000)	Protecting their Intellectual Assets: Appropriability	US	1994	Survey questionnaire to R&D managers	Factor analysis	Manufacturing firms that perform R&D with at least 5 million US\$ in sales or	1,165

	Conditions and Why US manufacturing Firms Patent (or Not)					more than 20 employees	
Cohen et al (2001)	R&D Spillovers, Patents and the Incentives to Innovate in Japan and the United States	US and Japan	1994	Survey of managers of R&D units of manufacturing firms in the US and Japan	Weighted logistic regression	Manufacturing firms that perform R&D (US) and firms with capitalization over 1 billion yen conducting R&D in manufacturing industries (Japan) with annual sales of 50 million USD or above	826 (US) and 593 (Japan)
Combe and Pfister(2000)	Patents Against Imitators: An Empirical Investigation on French Data	France	1993	SESSI appropriation survey	Multinomial ordered logit models	Innovative manufacturing firms	950

instances demonstrate, the system appears to be growing in a way that prioritizes advanced nation producers above everyone else (including consumers in both advanced and developing countries and producers from poor countries). A unified, high standard of intellectual property protection is enforced by TRIPS, which may be better suited to the requirements and capacities of developed countries. This involves having strict guidelines for trademarks, copyrights, and patents. Because of their low financial resources and technological capabilities, developing nations may find it difficult to comply with IP protection standards, whereas advanced nations frequently have well-established companies and technology that profit from it [8]. Therefore, it is time to reconsider the implications of TRIPS and determine whether and how they might be amended to improve everyone's well-being. In this essay, we attempt to add to the discussion by reexamining the function of intellectual property rights (IPRs) in economic growth and by outlining potential implications for a TRIPS agreement revision related to life science and especially biotechnology [9]. This paper's unique aspect is that it attempts to accomplish this both historically and from the standpoint of modern emerging nations. The first section will analyse the role that intellectual property rights (IPRs) played in the industrialization of the now-developed countries and make some implications for the developing nations of today and the future. presents a debate on IPRs' significance in economic growth in the modern setting, with a focus on the patent system in particular. The ramifications of TRIPS are then critically examined in the chapter that follows in light of the earlier debate. The last part summarizes and ends the essay related to life science and especially biotechnology [10].

2. TECHNOLOGY TRANSFER, IPRS AND ECONOMIC DEVELOPMENT IN A HISTORICAL PERSPECTIVE

Technology transfer has always been important in the history of industrialization. Britain's transformation from a backward producer of raw materials to a top industrial power throughout the 16th and 17th centuries depended heavily on technology transfer from the continent's then more developed economy, particularly Venice and the Low Countries [3] Cipolla, 1993) related to life science and especially biotechnology [11]. The efficiency of technology transfer from Britain (and to a lesser extent from the Low Countries) after the British Industrial Revolution became the

primary determinant of a country's prosperity is the definitive work on the transfer of British technology to the Continental European countries; see Jeremy, 1981, on the transfer to the US) related to life science and especially biotechnology. It seems clear that some of these transactions were organized through "legitimate" methods [12]. An expert-led tour of a factory during the early stages of industrialization, when the technologies used were reasonably easy to grasp, might be sufficient to convey the essence of technology. However, some highly developed producers refused to offer such tours from the start or at the very least kept some information from the tourists that they felt was important. Another popular method for absorbing cutting-edge foreign technology was through apprenticeship related to life science and especially biotechnology. However, until the middle of the 19th century, when machinery became the primary embodiment of technological knowledge, the transfer of skilled people, in whom the majority of technological information was then embodied, was the most significant method of technological transfer [13]. As a result, nations attempted to hire qualified laborers from the more developed nations and also bring home citizens who were working in other nations' businesses. This endeavor was occasionally coordinated and backed by the government related to life science and especially biotechnology Royalty and Licensing fees, World (1950-2003) [14].

It goes without saying that these initiatives were most successful when they were supported by the policies designed to improve what current technology economics refers to as "technological capabilities" [11] Many governments create institutions for research (like different non-teaching academies) and instruction (like technical schools) related to life science and especially biotechnology. They also took steps to increase "awareness" of cutting-edge technologies in various ways. They set up museums, planned international expositions (or "expos"), gave private businesses new machinery, and built "model factories" utilizing cutting-edge technology. Additionally, these governments gave the businesses financial incentives to adopt more modern technologies, particularly through rebates and duty-free imports of industrial equipment related to life science and especially biotechnology [15,16].

It should be mentioned that the purchase of superior technologies was frequently organized

via "illegal" methods. Naturally, businesses sought to keep their technology a secret, so they restricted access for outsiders to their plants. Furthermore, the governments of the more developed nations were crucial in preventing the export of important technology (although it is questionable how effective they were in doing so) related to life science and especially biotechnology [17]. The governments of the more developed nations focused primarily on regulating skilled worker movement during the early stages of industrialization since skilled employees were then the embodiment of the majority of technology. Britain introduced a ban on the migration of skilled workers, and especially on attempts to recruit such workers for jobs abroad ("suborning"), in 1719, spurred primarily by the French attempt (organized by the legendary Scottish-born financier John Law of the Mississippi Company fame) to recruit hundreds of skilled workers related to life science and especially biotechnology. This statute made suborning a crime that might result in a fine or perhaps prison time [18]. Emigrant workers would effectively forfeit their right to lands and property in Britain and lose their citizenship if they did not return home within six months of receiving a warning to do so from an authorized British authority (often diplomats stationed overseas). Industries including wool, steel, iron, brass or any

other metal, and watchmaking were specifically specified in the statute, but in practice the rule applied to all industries (for further information, see Jeremy [6] and Harris, [7] Up until 1825, suborning and the emigration of skilled laborers were prohibited [19]. As a result, machine exports were under control as more and more technology were incorporated into them related to life science and especially biotechnology. In 1750, Britain passed a new Act that strengthened the penalties for subornation while outlawing the export of "tools and utensils" used in the wool and silk industries. In later laws, the prohibition was tightened and made more comprehensive. Another Act was introduced in 1774 to regulate the export of machinery used in the cotton and linen industries. The language "tools and utensils" in the 1774 Act was amended to "any machine, engine, tool, press, paper, utensil or implement whatsoever" in 1781 to reflect the growing mechanization of the industries related to life science and especially biotechnology. The Tools Act, which contained a restriction on suborning, was adopted in 1785 to prohibit the export of certain types of machinery also see Jeremy [20]. According to Landes this prohibition persisted until 1842 related to life science and especially biotechnology. The less developed nations used a variety of "illegal" methods to obtain modern technologies



Fig. 1. Graph showing Royalty and licensing fees scenario

in reaction to these steps taken by the industrialized nations to stop the transfer of technology outside related to life science and especially biotechnology [21]. Entrepreneurs and technicians in these nations frequently participated in industrial espionage, frequently with explicit governmental approval or even active encouragement (such as rewards for obtaining certain technology) [22]. Numerous studies, including those by Landes Harris and Bruland describe a wide variety of industrial espionage against Britain carried out by nations including France, Russia, Sweden, Norway, Denmark, the Netherlands, and Belgium. It was difficult to catch up technologically despite all these "legitimate" and "illegitimate" attempts related to life science and especially biotechnology. Technology contains a lot of tacit information that cannot be easily shared, as the most current research on technology transfer demonstrates [23]. Even in the days when they embodied the majority of the critical technologies, this challenge was not readily remedied, even by the importation of experienced employees. These folks had issues with their native tongues and cultures, but more crucially, they lacked access to the same technological infrastructure that they did back home related to life science and especially biotechnology. Even in the days when technologies were relatively simple and a technological follower could theoretically replicate what the leader was doing by importing some skilled workers and perhaps a key machine, Landes [24] documents how it took decades for the Continental European countries to assimilate British technologies. By the late 19th century, technology transfer (and information transmission in general) were heavily reliant on whether or not patents and other intellectual property rights were observed related to life science and especially biotechnology. By the middle of the 19th century, Britain's export restrictions on machinery and skilled worker migration had been abolished due to their growing inefficiency. By the middle of the 19th century, the most important technologies had advanced to the point that mastery of them could no longer be attained simply by importing machinery and skilled labor [25]. An active transmission of technological information by the owner through the licensing of patents has become a major conduit of technology transfer in several fields related to life science and especially biotechnology.

Indicating these indicators' relative relevance or contribution within each category throughout time, the table also shows the shares (%) of these indicators for each income group or location. For instance, you can see patterns like these: In general, all metrics show greater values in high-income nations than in low- or middle-income ones. The percentage of particular indicators may have changed over time in some areas or income brackets, pointing to changes in their economic structure or areas of expertise. All things considered, this table sheds light on how, throughout the previous three decades, economic dynamics, trade patterns, and investment flows have changed across various income categories and geographical areas [26,27].

The majority of today's industrialized nations formed their patent laws between 1790 and 1850, and they established additional components of their IPR regimes, such as copyright and trademark laws, which were first enacted in Britain in 1709 and 1862, respectively [28]. By today's standards, each of these IPRs regimes was incredibly "deficient." Many nations' patent laws lacked disclosure requirements, were extremely expensive to file and process patent applications, and provided the patent holders with insufficient protection related to life science and especially biotechnology [29]. Few of them permitted patents on chemical and medicinal materials (as opposed to procedures), a practice that several nations persisted long into the 20th century. The fact that these laws provided only very insufficient protection for foreign people's intellectual property rights is extremely relevant to this subject (for more information, see Williams [10], Penrose [12], Schiff, [30], McLeod, 1988, Crafts, and Sokoloff & Khan, [13] related to life science and especially biotechnology. For instance, many patent laws have relatively loose standards for determining an invention's originality. More significantly, patenting of imported inventions by citizens was frequently expressly permitted in the majority of nations, including Britain (until the 1852 reform), the Netherlands, Austria, and France. Prior to the 1836 revision of the patent law in the USA, patents were issued without any justification for uniqueness. This prompted racketeers to engage in "rent-seeking" by patenting gadgets already in use (called "phony patents") and collecting money from their users under fear of

Table 2. Transmission of technological information

Value (\$bn)	Capital-intensive		Skill-intensive		High-technology		Royalties		Net FDI outflows	
	1990	2021	1990	2021	1990	2021	1990	2021	1990	2021
High income	45.8	1,108.0	43.7	736.7	25.8	739.3	2.8	71.2	6.9	472.1
Low income	2.8	32.8	2.4	13.1	1.2	16.1	0.0	0.02	0.3	8.1
Lower middle income	8.4	183.4	5.7	60.0	3.5	104.3	0.0	0.7	0.9	105.6
Upper middle income	7.7	318.0	5.2	126.9	3.8	200.0	0.0	1.8	0.6	69.4
Sub-Saharan states	1.5	10.6	1.5	6.0	0.7	5.6	0.0	0.02	0.1	5.5
Shares (%)										
High income	70.8	67.5	76.6	78.7	75.4	69.8	99.7	96.7	79.9	72.0
Low income	4.4	2.0	4.2	1.4	3.5	1.5	0.0	0.0	3.2	1.2
Lower middle income	12.9	11.2	10.0	6.4	10.1	9.8	0.0	0.9	9.9	16.1
Upper middle income	11.9	19.4	9.1	13.5	11.0	18.9	0.0	2.4	7.1	10.6
Sub-Saharan states	2.3	0.6	2.8	0.6	2.0	0.5	0.0	0.0	1.2	0.8

Exports of Capital-Intensive, Skilled Labor-Intensive and Technology-Intensive Goods, Royalty Income Earned and Net FDI Outflows from High-Income OECD Countries, 1990 and 2021 (billion US\$ and percentage)

legal action for infringement [31,32] related to life science and especially biotechnology. This not only resulted in the patenting of foreign inventions. Even more consideration should be given to the patent law disputes involving Switzerland and the Netherlands [33]. The Netherlands, which first enacted a patent legislation in 1817, did away with it in 1869, in part because it was fairly inadequate (even by the standards of the time)¹⁰, but it was also a result of the broad anti-patent campaigns that were taking place in Europe at the time. According to this movement, patents were no different from other monopolistic practices [30] Machlup & Penrose, 1951, provides a detailed account of the anti-patent activities of the time) related to life science and especially biotechnology. Up until the passage of a patent legislation in 1888 that exclusively protected mechanical inventions (defined as inventions that could be represented by mechanical models; Schiff, A patent law deserving of the term didn't exist until 1907, in part due to the fear of trade sanctions from Germany in reprisal for the Swiss exploitation of its chemical and medicinal innovations [34]. Even this, however, had a number of exceptions, most notably the denial of patents for chemical compounds (as opposed to chemical processes) related to life science and especially biotechnology. Chemical compounds were not patentable until 1978 [11] (but the Swiss patent law didn't catch up to those of other developed nations until 1954 [34]. The need for a worldwide IPRs system inevitably began to increase as more and more nations passed IPRs laws in the late 19th century (the following information is from Penrose [12] chapter 3). The 1873 Vienna Congress represented the first effort to establish a worldwide IPRs framework related to life science and especially biotechnology. The "compulsory working" rule that Austria and some other nations possessed—in the Austrian example, a patented item had to be manufactured in Austria within a year of the patent's issuance or the patent would be revoked—raised significant controversy at this Congress. Despite opposition from several nations, most notably the USA, the Congress ended with a resolution that suggested "compulsory licensing" rather than "compulsory working" [35].

In 1878, there was yet another convention in Paris. It was another "unofficial" event without any official government delegates, similar to the Vienna Congress. It was, nevertheless, a highly pro-patentee assembly, unlike the Vienna

Congress. Its resolution did, however, acknowledge certain "public interest" reasons and supported the idea of mandatory labor. A commission was established by the Paris Congress of 1878, and it finally produced a draught convention that was considered during the first "official" conference on the international IPRs system in Paris in 1880 related to life science and especially biotechnology. The Paris Convention of the International Union for the Protection of Industrial Property was ultimately ratified by 11 nations in Paris in 1883 (the original signatories were Belgium, Portugal, France, Guatemala, Italy, the Netherlands, San Salvador, Serbia, Spain, and Switzerland). It encompassed not just patents but also trademark regulations (allowing Switzerland and the Netherlands, who lack patents, to join the Convention despite this). The Berne Convention on copyrights was ratified in 1886. The Paris Convention, together with the Berne Convention, has served as the cornerstone of the international IPRs system up until the TRIPS Agreement. Subsequent revisions to the Paris Convention, most notably those made in 1911, 1925, 1934, 1958, and 1967, strengthened patentee rights related to life science and especially biotechnology.

There were several traits of the Paris Convention [12]. First off, it firmly chose a "non-reciprocity" policy, where foreign residents got national treatment but nations were not compelled to provide them the same IPRs that they had in their home countries, in spite of significant US opposition. Second, it recognized the "right of priority," which provided the applicant the right to have his or her claim recognized in all other nations where the applicant's invention qualified for patent protection after submitting a patent application in one of those nations related to life science and especially biotechnology. Most importantly, it embraced both mandatory licensing and mandatory working. In 1925, the mandatory working agreement was altered to only be permissible if forced licensing proven ineffectual.

Even the most developed nations continued to habitually violate the citizens' IPRs far into the 20th century, despite the establishment of a worldwide IPRs framework. We have said that the Netherlands and Switzerland did not have a patent law prior to this period. It is also noteworthy that the USA, which was a staunch supporter of patentee rights even then, did not

recognize foreign copyrights until 1891 related to life science and especially biotechnology. There was also significant worry in Britain over German trademark infringement as recently as the late 19th century, when Germany was on the verge of technologically surpassing Britain [10], provides many fascinating data; also see Landes [4].

Kindleberger [15] observes that despite the absence of a trademark law in Britain until 1862, "a number of British manufacturers were continuously engaged in litigation to protect trademarks". It established a trade mark legislation (the Merchandise Mark Act) in 1862 that outlawed "commercial thievery" including the falsification of trademarks and the labeling of fake amounts. The location or the country of production was deliberately inserted as a component of the required "trade description" by the British Parliament in the 1887 modification of the Act in response to German (and other foreign) trademark law violation. This modification outlawed deceptive statements as well as descriptions that were obviously untrue, such as the then-common practice in Germany of selling Sheffield silverware with bogus emblems related to life science and especially biotechnology. This Act stated that "it a penal offence to sell an article made abroad which has upon it any word or mark leading the purchaser to believe that it is made in England, in the absence of other words denoting the real place of origin" [10].

The Germans, however, used a variety of strategies to circumvent this Act [10]. The country of origin stamp was placed on the packaging rather than the actual items, making it impossible for purchasers to determine the country of origin of the goods once the wrapping was removed (reported to be typical among imports of watches and files). related to life science and especially biotechnology. Additionally, they transported certain items in parts and had them put together in England (a practice allegedly frequent with pianos and cycles). Additionally, they would put the origin country's stamp in a very unnoticeable location. All of the aforementioned arguments highlight how ignorant many TRIPS supporters are regarding the historical significance of IPRs in fostering economic progress. For instance, the National Law Centre for Inter-American Free Trade, based in the US, claims that "the historical record in the industrialized countries, which began as developing countries,

demonstrates that intellectual property protection has been one of the most powerful instruments for economic development, export growth, and the diffusion of new technologies, art, and culture" [16] related to life science and especially biotechnology. Contrary to this type of assertion, historical data demonstrates that IPRs, particularly those of foreign nations, were not properly recognized throughout the early stages of industrial growth in the modern-day affluent countries. The modern emerging nations appear to be acting in many respects considerably better than the developed nations of the past related to life science and especially biotechnology. And if that is the case, it would seem unreasonable to expect modern-day developing nations to act in accordance with a norm that was not even remotely met when the now-advanced nations were in the same or even farther along phases of development. Let's go to the following chapter, where we explore the significance of IPRs in economic growth in the modern setting, keeping this historical backdrop in mind related to life science and especially biotechnology.

Works that are freely available for use, modification, and distribution by anybody and are not held by any one person or organization are referred to as public intellectual property. Open-source software is among the most well-known instances of public intellectual property. Communities of programmers work together to produce open-source software, such as the Linux operating system and the Apache web server, sharing their knowledge and code without claiming exclusive rights. As per the conditions specified in the software's open-source license, users are free to access, alter, and distribute it. Private intellectual property, on the other hand, refers to works that are owned by people or organizations and are legally protected. Trade secrets, copyrights, trademarks, and patents fall under this category. For example, a pharmaceutical corporation may be the owner of a patent for a newly discovered medication. This patent gives the business the exclusive authority to produce, market, and make money off of the medication for a predetermined amount of time, usually 20 years. The corporation can recover its R&D expenditure during this period as rivals are not permitted to produce and distribute the identical medication without authorization. These kinds of specific instances make the differences between public and private intellectual property more palpable and bring to light the nuances and ramifications of each kind of IPR.

3. INTELLECTUAL PROPERTY RIGHTS AND ECONOMIC DEVELOPMENT

People who support TRIPS contend that increased intellectual property rights protection is necessary for the creation of new knowledge and, consequently, for economic growth. When they discuss intellectual property rights, however, they do not distinguish between the various types of IPRs and presume that all IPRs are, and should be, "private" IPRs. But this is incorrect. ³⁰ who fail to distinguish between various IPR types tacitly believe that free-for-all open access regime is the sole option in place of private intellectual property rights (PIPRs). Many bits of information, however, actually belong to the public or the community and must follow strict usage and disposal guidelines related to life science and especially biotechnology. For instance, the private-sector partners in a publicly-financed research consortia may be required to share the resulting patents with other project participants in addition to making all of their discoveries public. It is possible that there are laws and social conventions governing the use of specific forms of information for specific purposes even in circumstances that appear to be completely "open access" situations. Another illustration is the "open access" philosophy that many web-based software applications employ, which forbids individuals from using the resulting (better) goods related to life science and especially biotechnology. Therefore, rather than discussing IPRs as a whole, we need make a distinction between the various IPR subtypes. This also implies that those who advocate for "stronger" IPRs are actually advocating for stronger PIPRs when they speak of the importance of IPRs for the creation of new knowledge. But is it accurate to say that in order to encourage the creation of new knowledge, we need PIPRs that are fiercely protected? Is the use of patents and other "monopolies" necessary? is another topic. Let's look at each of these concerns individually related to life science and especially biotechnology. The case for and against private Intellectual Property Rights.

Although it is currently widely accepted that PIPRs are an integral component of a market economy, this was not always the case globally or historically. For a theoretical explication of this idea, see Chang, forthcoming. In other words, there are the historical and geographical specificities of the dominant view on what may and cannot be owned. The best illustration of this

point comes from Thomas Jefferson, the third president of the United States, who argued that ideas cannot, by their very nature, be contained or exclusively appropriated and that, as a result, "inventions... cannot, in nature be a subject of property" (cited in Penrose [12] related to life science and especially biotechnology. Given that he owned slaves, Jefferson certainly had no issue with individuals being owned, but he opposed the ownership of ideas, which is the exact contrary of what many people now think. Others opposed the notion of granting individuals PIPRs because they thought that any type of monopoly is evil, notably those connected to the mid-19th century anti-patent movement in Europe related to life science and especially biotechnology. As we previously discussed, the Netherlands formerly did away with their patent legislation for this reason. However, later it was argued that while if PIPRs undoubtedly lead to inefficiencies, they are a cost society must bear in order to both encourage individuals to work hard on coming up with new ideas and to encourage those who already have them to share them with others. These justifications, however, are not as strong as they seem related to life science and especially biotechnology.

4. PIPRS AS AN INCENTIVE TO GENERATE NEW KNOWLEDGE

It should be first noted that individuals frequently pursue knowledge for its own purpose, therefore they do not always need the financial incentives provided by PIPRs, in order to counter the claim that PIPRs are required as incentives for innovative activity. In certain cases, such as the development of web-based computer software, open access has promoted rather than hindered the creation of new information, according to the UNDP [2]. More significantly, the innovator can benefit from several "natural" protection mechanisms even without patents, which will allow them to realize significant financial rewards related to life science and especially biotechnology. The "imitation lag" (caused by the expense of acquiring new information), the "reputational advantage" (of being the first to create), and the head start in racing down learning curves are some examples of these natural protective mechanisms [17]. This was a common criticism of patents in the 19th century (Machlup & Penrose, 1950, p. 18), and Schumpeter's theory of "creative destruction" [18] was based on it. In fact, a study by Levin et al. [19] based on a poll of 650 high-level R&D managers of publicly traded companies in the US

discovered that patents are viewed as being much less significant than other "efforts" like sales or service effort in addition to "natural advantages" like imitation lag and the ability to move down the learning curve more quickly related to life science and especially biotechnology. The poll also revealed that even secrecy was seen as being more crucial than patents in maintaining the edge when it comes to process innovation. Mansfield [20] asked the senior R&D executives of 100 US companies what percentage of the ideas they created between 1981 and 1983 would not have been developed had they been unable to get patent protection. This was an intriguing poll. Only 3 out of the 12 industrial groups polled had a "high" response (60% for pharmaceuticals, 38% for other chemicals, and 25% for petroleum). And for the remaining 6 questions, the response was essentially "none" (0% for office equipment, 1% for primary metals and instruments, and 1% for textiles, motor vehicles, and rubber products) related to life science and especially biotechnology. According to Mansfield's calculations, the total ratio came out to be approximately 14%, which is a relatively low proportion. This includes 3 additional industries where the response might be regarded as "low" (17% for machinery, 12% for fabricated metal goods, and 11% for electrical equipment). Numerous other investigations were out in the UK and Germany also support the findings of this study related to life science and especially biotechnology. The historical experiences of Switzerland and the Netherlands, as we cited above, further support the patent system's rather little impact on inventive activity. Schiff came to the conclusion that there is no indication that the absence of a patent system held these two countries behind in terms of technical growth after conducting a very insightful analysis of the two nations throughout their patent less periods [21]. In this perspective, a deeper examination of the Switzerland case is warranted. According to Schiff [30], who looked at international patent statistics (patents obtained by various nations in the major industrial economies) and other case-based studies, the Swiss were among the most inventive people in the world in the late 19th century despite the fact that their nation did not have a patent law related to life science and especially biotechnology. During this time, the Swiss produced several world-famous inventions, including the steam engine, the Honneger silk loom, milk chocolate, instant soup, stock cubes, and baby food. Additionally, he notes that there is no proof that the lack of a

patent system served as an impediment to foreign direct investment and even mentions several significant instances, particularly in the food processing industry, where its absence was unquestionably a key factor in FDI (pp. 102–3). On the other hand, he demonstrates that the establishment of patent law in 1907 did not result in a discernible rise in innovative activity. In the instance of Switzerland, he comes to the conclusion that, overall, the lack of a patent system actually aided the nation's industrial growth (particularly in sectors like dye, chemical, and electro-technical; see page 104) related to life science and especially biotechnology [21].

Insights from current research and discussions can be used to enrich this section. For instance, modern researchers frequently look at how the growth of intellectual property rights, especially in sectors like technology and medicine, can worsen inequality, impede innovation through patent tangles, and create obstacles to entry. The section might emphasize the continued significance of Jefferson's skepticism and its consequences for current policy discussions by citing these academic evaluations. Furthermore, making links between historical viewpoints and contemporary affairs and policy debates might offer readers a deeper comprehension of the nuances underlying PIPRs [22]. Examining the changing role of PIPRs in economic growth, for example, might be facilitated by conversations about patent reform, open access to scientific research, and the influence of IP on international commerce and development. The section can shed light on the ongoing conflicts and trade-offs present in intellectual property systems by incorporating these modern instances. In conclusion, the section can provide a more nuanced understanding of the changing role of intellectual property in promoting innovation and economic development by making connections between historical perspectives on PIPRs, such as Thomas Jefferson's skepticism, and current debates and scholarly insights [22].

5. PIPRS AS AN INCENTIVE TO DISCLOSE NEW KNOWLEDGE

According to Machlup & Penrose [17] the notion that PIPRs are required for us to force the creators of new ideas to divulge their new knowledge has been challenged. First off, Bell and Wallace applying for patents for the telephone on the same day serves as proof that even if an inventor withholds his new knowledge, society will not suffer because "usually the same

or similar ideas are developed simultaneously and independently in several quarters." Second, it is impossible to keep any innovation a secret for a very long period since reverse engineering is used to develop new ideas, especially by those who were near to discovering the same answer, even if there will unavoidably be imitations related to life science and especially biotechnology. Third, "where an inventor thinks he can succeed in guarding his secret, he will not seek patent protection; consequently, patent protection does not cause disclosure of concealable inventions but only serves to restrict the use of inventions that could not have been kept secret anyway" (p. 26). Fourth, the patent system "encourages secrecy in the developmental stage of inventions since patents are only granted on inventions developed to a stage at which they can be reduced to practical use related to life science and especially biotechnology"[23]. Including more specific examples and examining particular businesses impacted by the noted flaws would strengthen this section considerably. You may demonstrate the significance of these concerns and strengthen your case by using instances from everyday life. Look at case studies, reports from the industry, or actual data that shows how these flaws appear in real-world situations. Speaking with specialists or others who are personally impacted by these problems in an interview might also yield insightful information to complement your study. Using this strategy will not only make your argument more credible, but it will also help readers comprehend the issues at hand [24].

6. PROBLEMS WITH THE CURRENTLY-DOMINANT IPRS SYSTEM

More particular, the IPRs regime that is now in place and is based on the patent system has a number of issues. First off, as we mentioned above, it's unclear if patents are necessary in order to create new ideas. Furthermore, the patent system has long been criticized for its potential "wasteful-ness" Its "winner-takes-all" structure has been criticized for encouraging fierce rivalry that frequently leads to duplication of efforts and expenditures. Others have noted that rather than producing "genuine" new information, resources may be squandered trying to "get around" already-issued patents related to life science and especially biotechnology. Additionally, because technical advancement is cumulative and interactive, "strong protection of a key innovation may preclude the competitors

from making socially useful innovation" [22]. Many people also wonder why all innovations should have the same amount of legal protection, despite the fact that their societal usefulness varies, and why that protection should last for as long as 17 or 20 years related to life science and especially biotechnology. The above criticisms are all rather well-known, and we don't need to repeat them at length. Increasingly, however, there is a concern about the granting of patents and other PIPRs to certain inventions that were created by using the ideas generated by publicly-funded research activities. This is a serious problem, when even according to the information provided by the Only 43% of pharmaceutical R&D is supported by the industry itself, according to the US Pharmaceutical Industry Association, while 29% is sponsored by the National Institutes of Health (NIH) of the US government related to life science and especially biotechnology [25].

For a more concrete illustration, consider the case of the anti-AIDS medication AZT, which was created in 1964 by a US researcher with funding from the National Institutes of Health (NIH). The UK pharmaceutical company Glaxo then purchased the medication for use on pet cats. Because Glaxo declined to conduct the study, the NIH eventually completed all of the research demonstrating that AZT is effective against the HIV virus during the AIDS crisis. Despite the efforts of NIH, Glaxo is the company that is profiting greatly from the medicine since it was quick to patent it after learning about AZT's impact on HIV [26]. We may use the case of the cancer medication Taxol as an additional (even more severe) illustration related to life science and especially biotechnology. Taxol has no patent because the US government made the discovery [27]. Bristol-Myers Squibb, a pharmaceutical corporation, has complete control over the drug's pricing in Britain, but, as a result of the data privacy law's 10-year protection of its tiny (though vital in clinical conditions) work on dose calculation. Another issue that is starting to surface is the potential that patents would impede rather than advance development as ever smaller chunks of information become patented. related to life science and especially biotechnology This argument is well illustrated by the technological development of so-called "golden rice" (rice with added beta carotene), which has the potential to provide millions of people with significant nutritional advantages. Ingo Potrykus (Swiss) and Peter Beyer (German), who invented the technique, stated the challenges of negotiating for the estimated

70-105 patents as the main justification for selling the technology to the international corporation Syngenta (formerly AstraZeneca). While detractors point out that only a handful of the 6–9 patents listed by Potrykus and Beyer actually apply to nations where the golden rice would have significant advantages [28] the case demonstrates how recent technological advancements have increased the deterrent potential of patents related to life science and especially biotechnology [29].

Look for instances or incidents that have been reported where the inadequacies of the current system have resulted in real-world repercussions. This might involve instances of market distortions, regulatory failures, or situations in which systemic problems affected some stakeholders more than others. Get statistics and pertinent facts to back up your findings. This might include industry data, economic statistics, or case studies that show how the detected flaws have affected the economy [31,32].

7. ALTERNATIVES TO THE CURRENTLY-DOMINANT IPRS SYSTEM

What are the potential alternatives, given all the issues with the prevalent IPRs system today? Needless to add, PIPRs might be completely eliminated. Note that this is not an argument for IPRs to be completely abolished (or for "open access"). Public rules and societal standards regulating the use of ideas would exist under this system related to life science and especially biotechnology. The natural imitation gap will also continue to provide enough opportunity for private appropriation of new information. There are several different ways to innovation that are centered on "sharing, open access, and communal innovation," as UNDP [2] underlines. If eliminating PIPRs sounds risky, keep in mind that prior to the creation of patent laws, this was the implicit attitude of every nation [33]. Nearly all nations have rejected PIPRs in certain sectors, even after the patent system was adopted related to life science and especially biotechnology. For instance, they frequently demand that the knowledge produced by publicly funding certain innovative efforts be turned over to the public domain. The problem of patents preventing future technical advancement can also be solved by replacing them with lump-sum rewards, which will encourage individuals to invest in innovative activities. Indeed, the journal *Economist* notably supported this idea, which

was widely supported by anti-patent activists in 19th-century Europe [17] related to life science and especially biotechnology. The problem with this approach is that we either have to provide every inventor with the same prize regardless of the societal worth of their innovations or we have to invest a lot of resources in deciding who deserves what size of a prize [34,35]. We might adopt Scherer's [26] idea, which is less spectacular but no less significant and unquestionably better grounded related to life science and especially biotechnology [36]. According to Scherer, "a flexible system of compulsory licensing, where the burden of proving that the patent should not expire or be licensed at modest royalties to all applicants three or five years after its issuance rests with the patent recipient" is the best option [37]. He contends that "there would be a presumption in favor of early patent licensing or expiration on the assumption that positive innovation profits could normally be attained without the added inducement of strong patent protection" when a patent-holding corporation "possesses a substantial share of the relevant market and well-established marketing channels related to life science and especially biotechnology." Scherer admits that there can be technologies in which the uncertainties are so great that only extremely strong patent protection will encourage the required expenditures [38]. It should be possible to design policies that treat such cases as exceptions, he says, by waiving the presumption in favor of early compulsory licensing or short patent lives (for inventions with high ex post private benefit-cost ratios), provided that the patent recipient demonstrated exceptional creativity or undertook unusual technical and/or commercial risks during the inventions development. The point is that if our ultimate goal is for technology to spread as widely as possible, we need to "buy off" innovators at the lowest cost possible, and there are reasons to doubt that the dominant IPR system that is currently in place, which is based on the patent system, provides the most cost-effective method related to life science and especially biotechnology [39-40]. It should be noted that the advantages of a national PIPRs system may be low for emerging nations, where technological absorption is far more crucial than the creation of patentable technology [41]. Stronger PIPRs would produce fewer innovations since the economic actors in these nations lack the capacity to innovate. There is virtually little proof that higher PIPRs promote more R&D in developing nations, as even TRIPS supporter

Primo Braga acknowledges [42]. The most crucial types of new information for emerging nations are, in fact, those that are not easily patentable, according to current study on technological difficulties in those nations. For them, the most significant knowledge is not that which is truly "novel" on a global scale, but rather that which is more tacit and localized, necessary for assimilating cutting-edge technologies (including new organizational knowledge), and which cannot be patented, except in very limited circumstances related to life science and especially biotechnology. In order to promote this sort of technological growth, most nations had to utilize policies such as newborn industry protection and other industrial policy measures (as was the case in the 19th century with the US and other following nations). Unfortunately, the WTO agreement currently places limitations on these methods, albeit perhaps not to the extent that is often thought [42,43] and Chang & Cheema, forthcoming) related to life science and especially biotechnology.

On the other hand, given their lack of technical, administrative, and legal human resources, poor nations may face significant opportunity costs in setting up and maintaining a robust PIPRs system. Additionally, developing nations may be more affected than more developed nations by the "monopoly" impact of patents due to inadequate anti-trust laws and/or enforcement capacity related to life science and especially biotechnology. Additionally, given that wealthy nations hold 97% of all patents worldwide [2] the expenses associated with paying royalties may vastly outweigh the advantages of the (insignificant) additional information that the system pulls from people in poor nations. The problems for poor nations are worse when there is an international system like TRIPS that requires compliance with the international "norm" (with certain adjustments) related to life science and especially biotechnology [44].

8. CONCLUSION

Second, even from a more "technical" perspective, there should be a wider awareness that developing countries require IPR regimes that are fundamentally different from those that exist in rich nations. The existing TRIPS system does acknowledge this to some extent, although it is severely limited, maybe with the exception of the "least developed countries". More assistance must be provided to emerging nations. It should be possible for developing nations to receive

lesser PIPRs (such as shortened patent lifespans, simpler compulsory licensing and working requirements, and simpler parallel imports) and to pay reduced licensing royalty rates related to life science and especially biotechnology. Developed nations should be aware that an international IPRs framework that supports technical advancement and economic expansion in developing nations would increase demand for developed nation exports. They will thus gain more from it than from a regime that depresses emerging nations in exchange for a small rise in royalty payments and a small decrease in export competitiveness for particular industries. There has to be a significant revision of the TRIPS framework related to life science and especially biotechnology. Without a change, it will over the next several years grow into a significant source of conflict in the newly forming global economic system. The world may eventually sink into chaos if a more equitable and dynamic global order is not established, as it did with the first globalization, which began in the late 19th century and "ended" in three decades of war and the Great Depression related to life science and especially biotechnology [45].

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Authors have declared that no competing interests exist.

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