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The Rationale of the System and the Diversity of the Forms of Protection

Before going back to the fundamental reasons that account for how intellectual property rights have been established, we need to outline a few reminders of the origins of the intellectual property system.

1.1. Going back to the origins and goals of intellectual property law

When were intellectual property rights established and which fundamental need does intellectual property meet in terms of innovation?

1.1.1. *Some historical points of reference*

The need to adopt an intellectual property system has been felt for a long time, as a short historical contextualization focused on a few key stages can illustrate. The history of patent systems started in Europe during the period between the Renaissance and the end of the 18th Century. The first law on patents as exclusive right conferred to an inventor dates back to 1474 in the Republic of Venice and provided protection for a period of up to ten years [GUE 07]. The actual turning point was in England in 1623-4, when the Parliament passed a "Statute of Monopolies" that limited the royal power to create monopoly rights to patents. Over the following two centuries, this text

was also a model both for British colonies and other countries. As for France, Louis XV's edict of 1762 provided protection to inventors for a period of 15 years through patents. Most other European countries only established this type of rule in the 18th – or even in the 19th – Century, especially Austria (1794), Russia (1812), the Netherlands (1817), Portugal (1837), etc. [MAC 58].

As for copyright, the legal framework similarly aimed at first to limit the arbitrariness of executive power. In France, the laws of 1791 and 1793 established that, after an author's death, his or her work would be protected for up to five years. In the United States, Article I (section 8) of the Constitution of 1787 conferred to the Congress the power to "promote the progress of science and useful arts, by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries". In Japan, the adoption of a legal framework for intellectual property, especially the "Patent Monopoly Act" of 1885, began in the Meiji period [GRA 16].

Beyond national borders, the legal framework of intellectual property also developed quite precociously in its multilateral dimension, as is shown by the Paris Convention of 1883 and the Bern Convention of 1886, which focused on industrial property and literary and artistic property respectively.

Therefore, the reasons that justify the establishment of intellectual property rights are not new. They are part of a debate of ideas that is several centuries old. However, they become particularly significant in the context of what is conventionally called the knowledge-based economy, namely a world where knowledge has become the main driving force for the creation of wealth.

In this knowledge-based economy, whose relative significance has been growing for several decades and is currently increasing with the development of digital technology, intellectual property plays a key role, especially as a means of valorization and diffusion of knowledge and information, in particular in their technological dimension.

1.1.2. *Some market failures that must be addressed*

From an economic point of view, the central issue raised by knowledge and information goods is that they present the two main features of a public good, namely the fact of being a non-rival and non-excludable good. Taking into consideration that a non-rival good is a good whose consumption by one user does not decrease another user's consumption, it is clear that the problems raised by non-rivalry are especially tricky when we deal with digital goods, which can *a priori* be replicated at zero cost and used simultaneously by an infinite number of individuals. Non-excludable goods are those whose use cannot be easily denied to certain users, even if these users do not contribute to the funding of said goods. They lead to a "free-rider" problem that can direly affect the profitability of the economic models involved for the holders.

As we know that it is very hard to determine the value of an invention without revealing its content, the very fact of disclosing this knowledge allows anyone to appropriate it and exploit it as he or she pleases if it is not protected. As a result, the market mechanisms on their own do not allow innovators to cover their costs. Therefore, and to the extent that the efforts made by someone to create new knowledge may thus benefit imitators, the private value of investing in innovation tends to be lower than its social value. Consequently, there is a high risk of global underinvestment in innovation in relation to society's needs [ARR 62].

The establishment of intellectual property rights aims precisely to tackle this fundamental issue of market failure. To overcome these difficulties concerning appropriation, it limits access to certain intellectual works by conferring to individuals or organizations exclusive rights to the result of their innovation and creation activities. Therefore, it is a matter of protecting these activities by making it possible to reap the resulting benefits, all the more so as creating knowledge by investing in innovation is a risky activity with unpredictable returns, which occasionally entails extremely high costs.

Although a solution may involve the institution of a certain degree of private property, several other mechanisms can be conceived to promote the production of the knowledge necessary for innovation,

especially in the domain of R&D. Before delving deeper into the issue of the advantages and drawbacks of intellectual property rights, it is useful to mention those of these alternative solutions.

A first possibility involves public authorities that provide regular funding to public institutions or organisms devoted to research. This solution, however, is not suitable for downstream research, close to the market outlets where companies are in competition with one another.

A second approach, which is adopted very often, involves the public authorities' allocation of direct (subsidies, repayable advances, public procurement, etc.) or indirect support (tax exemptions, cuts in social security contributions) to encourage companies to get involved in R&D activities. Therefore, this is a kind of R&D funded at least in part with public money but carried out by the private sector.

A third method, which is a variant of the previous one, involves awarding prizes for innovation to reward the progress made towards a publicly relevant and pre-established goal. In theory, it presents numerous advantages, insofar as it makes it possible to obtain the equivalent of the *ex-ante* incentivizing aspect of intellectual property (the prospect of a substantial reward) without implying *ex post* the market distortion problems and therefore the "social cost" involved in any kind of monopoly right. In practice, its application remains limited to the small number of cases where public authorities can assess beforehand the value of the innovation considered. However, in most cases companies have special information about the potential of the innovations in question and their likely market value, posing a moral hazard as they can *ipso facto* manipulate the estimates of public authorities [CLA 13].

This kind of difficulty – especially the problem of information asymmetry between companies and public authorities in relation to the cost and value of research programs – applies not only to the awarding of rewards (prizes or distinctions) but also to the aforementioned mechanism of public subsidy [ENC 06]. It helps to recall that public authorities are not necessarily in the best position to guide researchers effectively and quickly towards innovations needed by the economy and society, especially as, in practice, innovations quite often take

shape in fields where they were not expected at the beginning [GRE 10]. According to Stiglitz [STI 08], incentivizing through the awarding of prizes has many qualities but it also presents the major drawback of not working when the objective is not well defined, so will never replace the patent system.

In comparison, the system of intellectual property rights presents several advantages. It exempts public authorities from enquiring about sensitive economic information known only to private actors especially concerning R&D costs or the private value of the inventions. It leaves to the actors involved in innovation the responsibility to freely choose and make their investments profitable. Besides, the cost of intellectual property rights relies on users rather than taxpayers [ENC 06]. In other words, intellectual property rights are conceived as an incentivizing system that channels market forces and guides the innovation activity following a logic of decentralized initiative. Insofar as organizations and individuals are those who know best about the chances of success of the different options available in terms of innovation, this system promotes an efficient way of allocating the relevant available resources [WIP 16]. Evidently, these different mechanisms of incentivization are more complementary than alternative. Thus, and to the extent that intellectual property rights only allow the entitled parties to recover part of the profits deriving from their innovations, it is justified that companies may occasionally profit at the same time from public support for R&D.

1.2. The formal tools of intellectual property law

Innovation, however, cannot be reduced to R&D. Moreover, the canonical definition of innovation, provided by the OECD in its Oslo Manual, stopped being limited to technological innovation in the third edition of this manual, which now also includes business and organizational innovation [OEC 05]. As an example, the study carried out by Hall and Sena [HAL 17] based on the Community Innovation Survey (CIS) and involving several innovative companies in different sectors shows that R&D spending in the United Kingdom represents on average only around 22% of overall innovation spending. This part of R&D (internal or external), which hovers around 29% in the manufacturing sector, is half as much (around 15%) in the other

sectors considered: services, business, utilities and the construction industry. For this set of innovative companies, other innovation expenses involve mostly the purchase of IT equipment and software (45% of the total on average and even more if we consider SMBs and service companies) and, for the rest, correspond to marketing expenses (around 13% of the total), training expenses (around 10% of the total), design expenses (around 6% of the total) and expenses related to the acquisition of external knowledge (around 3% of the total).

For companies, innovation thus includes a range of activities much wider than R&D. It is all the more important that we do not focus solely on the issue of patents, as important as it may be, and that we also consider other tools such as trademarks, copyright or industrial design right.

1.2.1. *Patents*

In spite of all this, it is reasonable to focus on the formal tools of intellectual property law and patents in particular. This has to do with how patents are, out of these tools, those that require the most expertise and involve the largest number of economic and financial issues, at least in industry. Before analyzing in depth how patents work as mechanisms that protect innovation, it is enough at this stage to recall some of their fundamental features. In most cases, patents are characterized by a legal protection term of 20 years, they protect technological solutions, and they are granted only at the end of a fairly costly examination process. The granting of a patent mainly requires that three criteria are met: novelty, inventiveness or non-obviousness for persons "skilled in the art" and finally utility or industrial application potential. Once a patent has been granted, its rights are maintained only if its holder pays off the yearly license-fees. These filing fees and annuity amounts depend largely on the geographical coverage of the protection sought by the person who files the patent. The countries chosen are *a priori* identified as those including the main reference markets, as the exclusive right is limited to the geographical area of the jurisdiction where the patent is registered. The main patent offices are therefore national, for example the United States Patent and Trademark Office (USPTO) in the United States.

This also holds true for Europe, even if the European Patent Office (EPO), created after the Munich Convention of 1973, grants protection in several European countries. Another possibility involves applying for international protection through the procedure called PCT (Patent Cooperation Treaty), which is managed by a specialized agency belonging to the UN, the World Intellectual Property Organization (WIPO). The PCT procedure, however, does not lead to the issue of a patent that is valid all over the world. Rather, it involves the simplification of the filing procedure and the reduction of the expenses related to what filing a series of patents in several offices involves.

In some countries, and in particular in the United States, patents occasionally cover non-technological innovations such as business methods, for example financial methods, and pure software. Nevertheless, patents are most often used to protect technological innovation, notably in those sectors where innovation is especially capital-intensive and requires very significant investments in R&D, for example in the pharmaceutical field. Several empirical studies report a strong correlation between R&D spending and the use of patents, and citations are often used as an indicator for the technological importance of the patents considered.

1.2.2. *Trademarks*

The situation is completely different for trademarks and other distinctive signs (Internet domain names, etc.) applied to non-technological forms of innovation. Trademark law protection refers to commercial innovation. It corresponds to a role of identification in relation to customers. Taking into consideration the information asymmetry on the market between buyers and sellers, the primary function of trademarks is to reduce the research costs for consumers [POS 05]. For the company concerned, trademarks also make it possible to increase the selling price by distinguishing one's offer from the competitors'. Trademarks contribute in this way to the reinforcement of the product differentiation strategies used by companies to stand out from their competitors. They play a crucial part when a company produces for the final consumer.

As is the case for patents, only those trademarks that have been filed and granted at the end of an examination process carried out by the relevant office are protected. The key criterion for the validity of a trademark is its distinctive feature for the consumer in relation to competitors. Moreover, companies may protect a wide variety of signs through trademark law: brand names, logos, advertising slogans, colors, jingles, forms (packaging), etc., provided that these signs are distinctive.

The general protection term lasts ten years, but the holder may extend it indefinitely if they so wish in return for the payment of a renewal fee. The existence of an applicable trademark register makes it possible to solve disputes over trademark infringement without any ambiguity, whether the counterfeiting is intentional or not. For all these reasons, trademarks represent an indicator of the product innovation and marketing activity of the companies concerned. Playing a significant role in launching marketing campaigns and establishing the companies' reputation, they are also part of their most valued intangible assets, especially in cases of mergers and acquisitions [GRE 10].

1.2.3. *Industrial design right*

Taking into consideration that the innovation effort often involves designs to a large extent – namely, the esthetic aspects of products – there is a form of protection inherent to ornamental creations: industrial design right. It plays a fundamental role in the so-called creative industries, especially in fashion. However, it also sometimes plays a major part in manufacturing. For example, this is true for a company like Michelin, which uses this right to protect the treads of its tires to counteract the emergence of counterfeit tires from China. This also holds true for robotics, where the most used intellectual property formal tools are patents and industrial design right, even if the appropriation strategies that employ these formal tools or other means are still being developed [WIP 15]. Industrial design right is also increasingly used in information and communication technology (ICT), in particular to protect the emergence of new smartphones.

1.2.4. *Other technological creations (utility patents, plant variety rights, etc.)*

In the industrial field, some technological creations may be protected with other legal tools more or less specific to certain sectors.

Utility patents, for example, are used in several countries, but not in the United States or the United Kingdom, and are similar to patents, despite involving fewer requirements. They are mostly designed for small-size companies and individual inventors to protect inventions with a relatively short lifespan. In France, their term of validity is of six years. They generally involve an examination process, but their granting requires a lower inventiveness threshold than patents. Similarly, they are also more precarious in cases of court litigation.

Let us consider another example. Plant variety rights (PVR) protects seeds whose selected variety meets the required conditions (novelty, homogeneity and stability). It has been implemented internationally since 1961 and in the European Union since 1994; on the other side of the Atlantic, it has a counterpart which was established by law in 1970. According to the plant variety, the maximum term of protection is of 25 to 30 years in Europe and 20 to 25 years in the United States. PVRs are especially important for France, which represents the second seed exporter in the world and where companies in the seed sector engaging in R&D activities devote on average around 13% of their turnovers to R&D.

1.2.5. *Copyright and neighboring rights*

Apart from the aforementioned tools, which concern industrial property rights, another set of instruments involves copyright and neighboring rights. They are part of what is traditionally called literary and artistic property, but are now *de facto* being applied to different fields of activities that are *a priori* quite unrelated with fine arts or cultural industries such as the software industry. This group of rights, however, has several specific features that distinguish it from patents in particular. Thus, copyright does not cover technological solutions but only the expression of ideas. Consequently, in most cases it provides a less effective protection than patents. Nonetheless, it offers

a longer term of legal protection, which generally lasts 70 years after the author's death. Similarly, it provides automatic coverage without filing formalities or fees and delaying each work that meets a simple originality requirement. This helps us explain how copyright and neighboring rights have become very widespread internationally and are applied to a great variety of objects in a large number of sectors: databases, in some cases videogames, package inserts, etc.

In any case, a recent document issued by the WIPO points out the increased power of copyright in several hi-tech fields. In the semiconductor industry, for example, copyright has now become a significant tool for the protection of net lists, which are the graphical descriptions of all the devices and the connections between these devices or, in other terms, a set that represents concepts related to chips and involves texts, software, libraries or databases. In robotics, similarly, copyright can protect different elements, especially the software source code that controls a robot – provided that this element is considered unique and original. Some robots, which are thought to have a distinct character and persona, may also be covered by some forms of protection through copyright, for example, for a specific design, a component or a soundtrack. The increasingly significant role of copyright especially affects other emerging sectors such as nanotechnologies and 3D printing. It is partially dependent on the growing role played by software in innovation processes in fields such as 3D printing or robotics. Copyright may *a priori* protect any form of original expression with a digital component, including the design of 3D objects [WIP 15].

1.3. Informal means of protection

Other forms of appropriation involve informal means of protection. The main difference between these informal means of protection and the formal tools of intellectual property lies in the nature of the rights available to the company concerned in case of violation of its intellectual property [HAL 17].

1.3.1. *Trade secrets*

Trade secrets may benefit from legal protection in certain cases. The European Commission's Directive on the Protection of Trade Secrets, adopted in June 2016, defines trade secrets as undisclosed information whose business value derives from this confidential aspect and whose holder makes an effort to keep secret by appropriate provisions. In legal terms, moreover, thus defined trade secrets belong to the legal framework of intellectual property even if they do not entitle one to any exclusive rights on the object covered. It is in any case acknowledged in the TRIPS agreements (Agreement on Trade-Related Aspects of Intellectual Property Rights) introduced by the WTO (World Trade Organization) in 1995. Despite being less demanding and costly than patents, trade secrets are often more precarious, especially when the company in question sees high levels of staff turnover. This is also true when the company stores its most precious data on remote servers (cloud computing) without encrypting it beforehand. It is possible to resort to trade secrets in different ways, for example with non-disclosure agreements, restrictions on publication, non-competition clauses in employment contracts, etc.

1.3.2. *Lead time*

The fact of having lead time on competitors or being the first mover on the market gives, among other things, a cost advantage, whereas the production costs decrease over time and in relation to the effect of the learning curve. The fact of being able to quickly go down this learning curve with practice may allow a pioneering company to leave behind its competitor-followers.

1.3.3. *The control of complementary assets*

The ability to profit from an innovation effort may also be heavily dependent on the control of complementary assets, whether in marketing – for example, with distribution and after-sales service networks – or through manufacturing capacity, particular skills or expertise, or even complementary technologies [TEE 86].

1.3.4. *Design complexity*

Finally, appropriation may be facilitated by technological complexity. Nevertheless, some experts – among whom Cohen *et al.* [COH 00] – do not take it into consideration, as they think that complexity, despite being undoubtedly a characteristic of the products or processes that can affect appropriability, is not something that companies can choose to exploit deliberately.