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Property Rights and Externalities: The Uneasy Case of Knowledge*

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Abstract: Drawing from Coase’s methodological lesson, this article discusses the specific case of knowledge, which was for a long time chiefly governed by exchange mechanisms lying outside the market, and has only recently been brought into the market. Its recent, heavy “colonization” by the property paradigm has progressively elicited criticism from commentators who, for various reasons, believe that the market can play only a limited role in pursuing efficiency in the knowledge domain. The article agrees with the enounced thesis and tries to provide an explanation of it that relates to the fact that in specific circumstances property-rights can produce distinct market failures that affect the social cost and can consequently prevent attainment of social welfare.

In particular, the arguments set forth here concern three distinct externalities that arise when enforcing a property rights system over knowledge. First, the existence of a property right may itself alter individual preferences and social norms, thus causing specific changes in individuals’ behaviour. Second, the idiosyncratic nature of knowledge, as a collective and inherently indivisible entity, means that its full propertization can be expected to produce significant harm. Third, property rights can cause endogenous drifts in the market structure arising from the exclusive power granted to the right holder: though generally intended as a necessary mechanism for extracting a price from the consumer, in the knowledge domain property rights can become a device for extracting rents from the market.

Keywords: property rights, knowledge, invention, indivisibility, externalities, efficiency

JEL: D23, K11, O31, D62, O34

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1. Introduction

The Problem of Social Cost (1960) is a cornerstone of law and economics analysis. In this contribution, Coase disclosed the full economic function of property rights, showing them to be not merely a means for assigning private benefits to rightful owners, but also a powerful device for promoting social welfare.

This ability to align private and public interests has made property rights a valuable social tool. They have played--and continue to play--an important role in modern economies and democracies, eliciting justifiable enthusiasm among scholars and policymakers. However this support has in some cases tended to veer into a near-religious, dogmatic belief in property rights as somehow constituting a panacea for any kind of market failure (Porrini & Ramello, 2007).

This dogmatic attitude has often been used to justify the reflexive creation of new property rights or the extension of pre-existing ones, without regard for the fact that there is no single best way to stimulate efficiency, since much depends on exogenous variables such as transaction costs, among others.

Yet formulaic solutions are neither the usual remedy for market failures nor really in the spirit of Coase's message: after all, his pathbreaking essay was intended to challenge the blind enthusiasm surrounding Pigou's theoretical support for state intervention, reasserting a proper role for the market in promoting social welfare (Brian Simpson, 1996).

All in all, recognising the limitations of property rights in specific situations, far from being a challenge to Coase's achievement, is a manner of paying tribute to his work by extending our understanding of the property system's key features, and its weaknesses and strengths in promoting efficiency.

This article is intended to provide further insights into the specific case of property rights over knowledge, a distinctive social entity that deeply characterises human relationships and the semantic sphere of human groups. Though knowledge was for a long time chiefly governed by exchange mechanisms lying outside the market, it is now being increasingly assimilated to other commodified resources, and being made a target of specific property rights, labelled "intellectual"¹. This recent, heavy "colonization" by the property paradigm has progressively elicited criticism from commentators who, for various reasons, believe that the market can play only a limited role in pursuing efficiency in the knowledge domain.

The arguments set forth here concern three distinct problems that arise when enforcing a property rights system in the knowledge domain. First, the existence of a property right may itself shape individual preferences and social norms, thus causing specific changes in individuals' behaviour. Second, the idiosyncratic nature of knowledge, as a collective and inherently indivisible entity, means that its full propertization can be expected to produce significant harm. Third, property rights can produce endogenous drifts in the

¹ Whether intellectual property rights should be assimilated to tangible property is a question that has been hotly debated by scholars. See for instance, for patents, Bessen and Meurer (2009) and the references herein. However the rhetoric surrounding intellectual property, and the language which it employs, try to assimilate it to conventional property. What is more, many laws give IPRs the status of property; the British Copyright, Design and Patent Act (CDPA) 1988 in section 1(1) expressly asserts: "Copyright is a property right which subsists in accordance with this Part in the following descriptions of work [...]".

market structure arising from the exclusive power granted to the right holder: though generally intended as a necessary mechanism for extracting a price from the consumer, in the knowledge domain property rights can become a device for extracting rents from the market.

In all three of these cases, property-right dynamics produce distinct market failures that affect the social cost and can consequently prevent attainment of social welfare.

Although the aim of this article is to provide a positive rather than a normative analysis, some normative implications do indirectly emerge from the discussion.

The remainder of this paper is organized as follows: section 2 briefly reviews the meaning and the role of property rights, introducing the topic of property-right externalities in the knowledge domain; section 3 presents the first effects that a property regime can have on individual behaviour and on efficiency; sections 4 and 5 take this argument further by discussing, on the one hand, the social nature of knowledge, the collective dimension of its production, and the consequences of exclusive rights upon it, and on the other hand the rent-seeking incentives created by intellectual property rights and their impact on the market structure; finally section 6 presents the conclusions.

2. Property rights, resources and production of externalities

Property rights are a universal feature of social interactions, albeit one that sometimes exhibits distinctive traits in different human groups. The social dimension and the attributes of goods are the natural elements which led to the spontaneous emergence of *de facto* property rights, even in the absence of a substantive law (Porrini & Ramello, 2007).

The need for strong, secure property rights later intensified with the evolution and development of economic activities, with their role in social contexts crucially driven by the concept of scarcity (Levmore, 2002). As pointed out by Demsetz (1967, p. 347) “[i]n the world of Robinson Crusoe property rights play no role”. The existence of a property right thus presupposes that a number of individuals are competing to access a given resource, thereby creating a need for a system for allotting that resource. In many cases, the proper solution is the market. Property rights thus arise out of certain attributes of private goods--i.e. rivalry and excludability--which call for a system for regulating the possible uses of a given subject matter. A person eating an apple, for example, automatically enforces a property right over it merely through use, even in the absence an explicit statutory arrangement, by the act of consuming the good and/or excluding others from doing so. Such an individual could equally decide to sell the apple, or to give it away as a present, and the previous assertion would remain valid; and this same rationale will continue to apply even in cases where technical change makes possible new uses, new goods and new markets.

We can thus see how *de facto* property rights predate any property law, and why any legal amendments to them would not ordinarily affect the valuation of the good or the behaviour of the owner. All in all, the rights were in most cases neutral with respect to

the resources: it was the subject matter which motivated the emergence of the property right, and not vice versa. Their proper statutory design then consisted in better defining the right, and internalizing externalities, to allow the market to work.

Empirical studies provide abundant evidence that strong property regimes have in many cases been central to promoting markets, investments, and economic growth. These results mostly apply to the domain of tangible property, and cannot be easily disputed. However, in other specific domains--such as knowledge--the positive evidence is not so robust, and it appears even that strong property rights can have a counterproductive outcome (Bessen & Meurer, 2008). This occurs according to the arguments raised in the next pages, when the system of property rights re-shapes the framework in which it is deployed, so that the mere fact of its introduction gives rise to new externalities which endemically affect welfare. Such externalities are not simply changes in allocation of the resource driven by the property system, which are of course part of the economic dynamics and beneficial in terms of efficiency; rather, they represent direct spillovers of the property regime that can provoke specific market failures. This can lead to the emergence of a new social cost, spawned by the property system itself, and possibly affecting the final welfare balance.

The above-described mechanisms seem particularly (though not solely) applicable to the knowledge domain, with a number of distinct consequences affecting social welfare. First, the property regime and its modifications may alter the attitudes and preferences of social agents, and hence their choices. Second, it may have consequences on the production of knowledge, by severely impairing its productive organization which is heavily reliant on the collective sphere. Third, it may cause rent-seeking drifts to arise, by creating opportunities for right holders to variously exploit the exclusive power arising from the property right, with repercussions on the market structure and on economic performance.

These three consequences represent distinct externalities produced by the property-rights regime, whose attendant social costs may partially or completely negate the ability of property to foster efficiency. Such a dysfunction may be countered either through ex-post regulatory intervention--such as access mandated by the government or court rulings--or through the ex-ante abandonment of the property rights system in favour of a different allocative solution--such as that discussed below for the case of collective invention. In either case, however, the insights of Coase and Pigou become complementary, rather than mutually exclusive. The three identified externalities of property rights over knowledge are discussed separately in the following three sections.

3. Dynamic effects of property on individual preferences and on social norms

The first externality arises from the ability of the property regime to alter individuals' attitudes to specific subject matters. Naturally, if the attitude change occurs because technological change has either created new goods or new opportunities for appropriation, or rendered already-existing resources valuable, it can be treated as the emergence of a new market, and readily justified on the usual efficiency grounds as

discussed by Demsetz (1967)². However, in certain circumstances individuals may change their behaviour merely because the emphasis created by the property system has altered their mindset toward a specific activity, which they previously engaged in with less regard to appropriation via property rights.

3.1 The example of property over science

A case in point is that of science, where the increasing prominence given to the patent system has substantially changed the attitude of many researchers, to the point of having tangible consequences on the organisation of the scientific community and its ‘openness’ regime, which have in turn affected the circulation and accessibility of scientific data (Nelson, 2004; Ramello, 2005a; Haeussler, 2010). One example is the widespread effect on academic institutions of the amendment of the Bayh-Dole Act (1980)³, aimed at strengthening university patenting, which produced a drift toward patenting or enforcing patents on discoveries that would formerly have been made widely accessible to the scientific community⁴.

Though the outcomes are in many respects somewhat puzzling, recent evidence suggests that increased patenting by academic researchers may slow and sometimes even halt innovation, due to the restrictions it places on the diffusion and use of upstream knowledge (Verspagen, 2006; Fabrizio, 2007). This is a vital question because, even though scientific achievements can sometimes benefit from the economic incentives provided to private individuals and firms by the patent system⁵, they rely greatly on the process of free sharing, and on the wide accessibility of a broad base of previously-created knowledge. This is the arrangement that has traditionally underpinned the scientific community, according to a paradigm of substantial openness that has been imaginatively termed the “Republic of Science” (Polanyi, 1962). It can be summarised as the form of organisation spontaneously emerging in science, which has characterised the production of scientific knowledge in such a way that--as we shall later discuss--it becomes itself part of the engine that makes possible the production of new knowledge (Nelson, 2004; Ramello, 2005a & 2005b).

That is not to say that science has ever been totally extraneous to propertization; there have been a number of solutions permitting (partial) appropriation by researchers in order to extract some private benefit from their activity. Secrecy was--and still is--one way to enforce some exclusion; but it has the weakness that secrets are difficult to keep and can in some cases be reverse engineered. Also, they cannot assure very strong exclusive

² Consider for instance a new mining technique that makes it possible to exploit previously inaccessible resources, or a novel use of a previously unexploited factor for producing a good. A similar dynamics can take place when there are externalities between new and pre-existing goods so that preferences changes can be ascribed to the choice set changes. But of course in this case the property rights is neutral, the changes depend on innovation and the subsequent substitution between old and new goods.

³ Among other things, it strengthened US universities' control over internal inventions and other intellectual property rights that resulted from such funding. Sponsored by the senators Bayh and Dole, the act was amended by the US Congress on December 12, 1980.

⁴ Although science provides a good example, it is not the only case. Another example is copyright, with many religions having recently decided to strengthen the protection and the enforcement of already-existing copyrights on various religious texts in order to extract rents (Marchese & Ramello, 2010).

⁵ Especially in the case of applied and directly market-oriented research (David & Dasgupta, 1994; Nelson, 2004).

rights, since nothing prevents separate individuals from unwittingly owning the same secret (Samuelson, 2000). All in all, a multitude of spillovers are likely to occur (Frischmann & Lemley, 2007).

Reputation has provided another powerful means for researchers to capture some benefits (in many cases even pecuniary benefits) from their work without restricting others' access to new data, thereby preserving the Republic of Science⁶. The prompt availability to the scientific community of newly created knowledge and its ensuing validation, e.g. through publication in peer-reviewed journals, has been a crucial reputation building mechanism that perfectly aligns (from a Coasean perspective) the private incentives for scientists with the public interest of society and the community, while at the same time enhancing the circulation of new ideas (Spier, 2002; Ramello, 2010)⁷.

What is more, up until recently, even though patents were available and exploited to provide an extra incentive for fostering inventions and discoveries, a suitable balance between openness and enclosure was generally struck through adherence to a social norm, so that the peculiar productive organization of the scientific community was not disrupted. Indeed, according to empirical investigations the propensity of researchers to actively participate in the community and share information can be affected by changes in the social norms that govern their activity and it further explains the changes affecting individual preferences (Haeussler, 2010).

3.2 Laws, social norms and individual behaviour

The past three decades have seen a progressive erosion of openness in favour of enclosure, often driven by an unquestioning reliance on the dogmatic (and thus, it must be emphasised, non Coasean) tenet that property rights are always beneficial in terms of efficiency.

This drift in the norm-based relationships of the scientific community may change the attitude of individuals, and what they are willing to produce for the existing incentives, so that the possibility of extracting new benefits causes a shift in their behaviour. Since this will essentially involve exercising the exclusive power provided by patent law, it will in turn affect the accessibility of previous knowledge.

It should be emphasised once again that the described behavioural shift does not arise out of any new opportunities for appropriation, but only from transformations in the prevailing social norms of the scientific community (Haeussler, 2010)⁸. We can thus regard this outcome as an externality of the property regime affecting the social norms

⁶ The same holds true in many creative and efficient milieus in which a “democratic” structure prevails without the market, and even in the absence of any direct monetary reward. A well known example is provided by the open source community where “[...] though some participants do focus on long-term appropriation through money-oriented activities, like consulting or service contracts [...] the critical mass of participation in projects cannot be explained by the direct presence of a price or even a future monetary return” (Benkler, 2006, p. 60).

⁷ The same also characterises different productive domains such as, for instance, open source software (Benkler, 2006).

⁸ The assertion can be extended to other creative domains. For copyright and software see, for instance, Benkler (2006, chap. 4), who discusses in depth the social relations within the programmers' community and the consequences upon it of the price system.

governing researchers, which had formed part of the system of incentives and governance of the scientific community.

Many scientist have now begun to patent--or to more strictly enforce already-existing patents--in situations where access would formerly have been kept open, pursuing a strategy of securing ex-ante any possible additional revenues accruing from their work. However the goal of this new behaviour is not to reward inventive activity through property, but merely to exploit the possibility of gaining some ex-post extra monetary benefits. It is thus a rent-seeking attitude, in the event that some good will shows up, and of course has the added consequence of slowing the circulation of newly created knowledge, by postponing the publication of results.

Surveys conducted in the life-sciences community have shown, for instance, that the modern patenting strategy, directed at assuring better appropriation, has delayed the disclosure of scientific outcomes by at least six months on average⁹. What is more, approximately half of the respondents said they had in many cases been unable to pursue specific incremental research and/or verify results reported by others, because access to the necessary details or data was denied (Blumenthal et al, 1997; Campbell et al., 2002).

This situation represents the other side of the coin: the reduced accessibility of knowledge determined by stronger property rights makes the life of subsequent researchers more difficult, by increasing the cost of inputs and of sequential knowledge development. In a world of perfect information, this would not be a problem since ex-post profitability would make it possible to recover the ex-ante access costs. However scientific research-- and especially basic research--often follows the erratic dynamics of a random walk, i.e. of advancement through trial and error, which can blur any economic prospecting (Merton,1973). That is why the social norms governing the community were originally preferred over a market mechanism.

Furthermore, the need for firms to obtain near-immediate returns on investments--e.g. within the managers' mandate for having their appointments renewed--makes them unable to sustain a high level of risk, and orients them toward specific short-run profitable research that does not permit path-breaking discoveries, due to market-imposed limitations (Dasgupta and David, 1994).

Many researchers and scientific institutions (e.g. NIH) in the medical field have reported that broad basic patents have actually made their work more difficult, by raising the costs of inputs and in some cases substantially impairing their ability to undertake sequential development of knowledge (Mertz et al., 2002; Williams 2010).

The above trends, taken together, are affecting the performance of the Republic of Science as a social productive technology. The interesting point to note is that the extension of property rights in the science domain has been somewhat blurred in its effects, since it interferes with the productive ability of other researchers and thus impairs the productive role of the scientific community intended as a collective productive technology. This is a different kind of externality that will be tackled in the next section.

4. The collective dimension of knowledge production

⁹ A current routine of university patent boards, as experienced by the author himself as a member of his University's patent committee, is to remind researchers to carefully avoid any presentation or publication of results before having successfully filed a patent request, as otherwise the attribute of "novelty" would no longer hold true for the would-be patented idea.

The connection between knowledge and the social structure is not one that arises by chance: they are in fact intrinsically related, because knowledge is a social entity pertaining to human relationships and the semantic sphere of human groups¹⁰. Knowledge belongs to the collective contexts in which it is created. It is brought to fruition in the symbolic sphere defined by society and renewed through sharing, which is thus an indispensable prerequisite for individuals' creative activities (Ramello, 2005b & 2008). Even though the creation of knowledge can be partially ascribed to individual efforts, it cannot be fully understood and explained outside the social dimension. Its existence and production necessarily rely upon communities, in a decentralized system whereby inputs and outputs are shared, freely or conditionally. Knowledge production thus has a pervasively decentralized organisation in which--though individual agents do play a role--the total output depends upon the collective effort¹¹. In other words, even though we can zoom in to perceive individual contributions at the micro level, the process and its output can only fully be understood from a macro perspective which reveals their interdependent actions (Weitzmann, 1998).

4.1 *Idiosyncratic features of a social technology*

The point to be taken here is that knowledge does not fit into the standard representation of commodities and goods, since it exhibits idiosyncratic features connected with its inherently social nature.

Our understanding of knowledge has been growing clearer as various contributions from different social sciences have identified the characteristics of this elusive entity, that is at the same time both a resource and a process marked by complex dynamics. The best definition formulated thus far by economists is that given by Martin Weitzman (1998), who in an imaginative essay, inspired by Schumpeter's (1934) insight, argued against modelling knowledge advances as if they were comparable to other manufacturing activities, or to prospecting for natural resources. "[...S]omething fundamentally different is involved here. When research effort is applied, new ideas arise out of existing ideas in some kind of *cumulative interactive* process that intuitively seems somewhat different from prospecting petroleum." (Weitzmann, 1998, p. 332; the italics are mine)¹².

This process, labelled "recombinant innovation", is cumulative, interactive, and hence inextricably social, despite relying upon a sum of individual contributions.

A good analogy for understanding what is involved here is Aristotle's explanation of the peculiar and seminal features of democracy, whose overall accomplishments far exceed the sum of the abilities and virtues of its individual participants:

¹⁰ For an in depth discussion of the idiosyncratic nature of knowledge as a social entity see Ramello (2008) and the references therein.

¹¹ Ref. for example to Benkler (2006) for the software domain. However it is also valid in general for the production of knowledge. The economics literature provides a number of examples of innovation outcomes in the case of collective invention, that will be discussed further on. See for instance Allen (1983), McGaw (1987), von Hippel (2005).

¹² A similar dynamic was earlier set forth and adopted by Boulding (1955, p. 103-104): " We cannot regard knowledge as simply the accumulation of information in a stockpile, even though all the messages that are received by the brain may leave some sort of deposit here. Knowledge must itself be regarded as a structure, a very complex and quite loose pattern with its parts connected in various ways by ties of varying degrees of strength."

“For it is possible that the many, though not individually good men, yet when they come together may be better, not individually but collectively, than those who are so, just as public dinners to which many contribute are better than those supplied at one man's cost [...]” Aristotle (1944, book 3 1281b) .

Such an outcome emanates from the special features of the collective dimension, and exhibits a phenomenon similar to what economists would term economies of scale, with respect to the number of individuals involved in the process.

While we are accustomed to seeing a similar dynamic in consumption, with demand network externalities occurring when the value of a consumed good is dependent on positive externalities created by others' consumption (Katz & Shapiro, 1985), the same may well also apply to the production of certain resources, susceptible to what we might term supply network externalities.

This hypothesis is borne out by much factual evidence relating to knowledge. There are examples from ancient times of many spectacular achievements that were made possible by a social “cumulative interactive” productive organisation. The Maya, for example, were able to devise an accurate system for measuring time and excelled in astronomy thanks to a collective intelligence built up over the course of successive generations by a number of individuals, all of whom were able to abundantly access the previously-produced knowledge, thus making it possible to refine and improve upon it (Thompson, 1961).

More recently, even in the history of western industry, there have likewise been many examples in which the social structure and the sharing of knowledge have fostered important achievements. Indeed, the wide accessibility of knowledge and a cooperative, decentralised structure are at the root of the many instances of what Allen (1983) terms “collective invention”, in which the collective intelligence provided by a widely participative and non-proprietary structure of individuals or firms has made possible notable achievements, including among others the development of efficient blast furnaces, the mechanisation of paper manufacture, and more recently the development of the techniques and equipment of high-performance windsurfing (Allen, 1983; McGaw, 1987; von Hippel, 2005). Even the production of legal precedents, which represent a by-product of dispute resolution, can be regarded as a form of collective invention which, for reasons connected with the specific needs of judicial decision-making and economic efficiency, has rejected the market analogy and preferred that of social production although by a community of specialists (Harnay & Marciano, 2007).

There is also evidence in support of the counterfactual, demonstrating how the property system has directly hampered innovation, and how dismissing the property paradigm has actually reversed that failure. For example, analysing the dynamics of technological change in the Cornish mining district, Nuvolari (2004) shows how establishing a collective invention setting proved crucial for resuming innovation, following the expiration of the Watt and Boulton patent on the steam engine. The free sharing among firms of detailed information about the design and performance of the newly introduced technologies, which provided voluntary knowledge spillovers to anyone willing to access to them (even outside the Cornish district), was the main driver for overcoming the slow pace of technological change impressed by aggressive exploitation of the Watt and

Boulton patent. The decision to shift inventive activity out of the proprietary system was decisive for dramatically accelerating the pace of development of the steam engine.

Another more recent illustration of the potential of collective invention is provided by free software. In this case the property right implicated is chiefly copyright, although patents have also sometimes entered the scene. There is extensive evidence that this collective, non-proprietary productive structure has led to the development of many important products widely used today, especially in the Internet domain¹³.

The most celebrated case of course is that of open source software, which is developed through a non-market and non-hierarchical productive organisation. According to various commentators, many of its achievements would not have been possible in a proprietary regime (Benkler,2006). However it is worth noting that in order to allow the social domain to re-enter a scene heavily colonised by the market and copyright, some additional costs have to be borne. In practice, this is accomplished through contractual agreements, informally known as “copyleft”, designed to collapse the exclusive power associated with property rights by obliging follow-on creators to preserve the full accessibility of the material accessed and further developed¹⁴.

In other words, a bizarre contractual arrangement by the first copyright holder is needed to neutralise the subsequent temptations to propertize the subject matter and its incremental developments. Here again, the aim is to preserve the cumulative interactive production.

4.2 *The puzzle of knowledge indivisibility and propertization*

In all the cited cases, a pattern emerges in which the property regime is unable to maximise social welfare, due to a fundamental divergence between the sum of individual private benefits and the collective dimension. In this case, there is a failure of the property system, and the atomisation entailed by the appropriation mechanism is likely to produce externalities. These might be avoided if a single property right could encompass and fully internalize the entire resource, thus allowing the Coasean paradigm to function properly. However this is impossible in the case of knowledge, which has an intrinsically social nature which full private appropriation would inevitably hamper¹⁵.

In describing the peculiar situation of knowledge, we earlier introduced the concept of economies of scale with respect to the number of individuals involved. This seems to be an apt representation of the knowledge-production function, and also yields some clues as to why property rights might cause--rather than resolve--market failures in the knowledge domain.

To address this question we must refer back to a well-known problem in economics: that of indivisibility, which arises--among others--in the case of economies of scale (or

¹³ Just a couple of examples: the famous Linux operating system is installed on many computers -- including those of Amazon, Google and CNN.com -- and is additionally an important learning tool for developers and students because of its accessible open source structure; what is more today about 70% of web servers also run another opens source product, the free Apache software (Benkler, 2006).

¹⁴ For a general reference see: <http://www.gnu.org/copyleft/>

¹⁵ The same solution is put forward by Liebowitz & Margolis (1994) for overcoming the demand-side market failure arising from network externalities. This work includes an interesting short reference concerning non-propertizable resources: in such a case the authors propose a solution which is social -- and non market based -- in its essence.

scope), and makes it impossible to rely on the competitive market for optimal allocation of resources (Edwards & Starr, 1984). Furthermore, the essence of economies of scale consists in “the presence of large and significant indivisibilities in production” (Scarf, 1994, p. 115) since otherwise—i.e. with continual returns to scale—there would be no need to employ a large productive hierarchy.

Therefore, indivisibilities play a prominent part in understanding the industrial organization, and of course likewise affect the market structure. Now, an important stream of economics literature, including the influential essays by Coase himself (1937) and those of his student and Nobel laureate Oliver Williamson (1985), has devoted much effort to explaining the evolving nature of the boundaries between the firm and the market, showing that fully internalizing externalities may in some cases require shifting the productive activity out of the market and into the hierarchy of the firm.

Yet the arguments set forth previously show that in some cases neither the firm nor the market can fully internalise the externalities arising from the social dimension; when this happens, only the collective organization can provide a solution. The main cause of such a situation arising has to do with the imperfect appropriability associated with the problem of indivisibility. Though knowledge can to some extent be appropriated through specific objects or embodiments (in the case of copyright, expressions of ideas such as literary texts, written music, written software codes etc.), these are imperfect entities because they contain much more than a clearly-delimited and indivisible “piece” of knowledge. Just as conventional economies of scale prevent the fragmentation of technology into smaller units, economies of scale relating to the number of individuals do not allow knowledge to be split into elementary units the sum of which will give back the original entity. Furthermore, this division will inhibit the social productive technology.

Consequently, the legal technology for the demarcation of knowledge is imperfect: it may appropriate something less, producing positive spillovers for society, but it may also appropriate something more, producing negative externalities for society. This imprecision itself tends to work against efficiency, as land demarcation has taught us¹⁶.

Interestingly, this is an issue that was already well known at least as far back as the 19th century, when Coase’s fellow citizen, the English copyright scholar Augustin Birrell, observed that the claim that “a particular leg of mutton is mine is capable of easy proof or disproof, but how much of my book is mine is a nice question” (Goldstein, 1994, p. 4). Aside from the problem of possible legal disputes, the point here is that the legacy of previous knowledge is impossible to neatly excise, and anyhow amounts to much more than a mere sum of its inputs. If knowledge production can be thought of in terms of economies of scale arising from the number of individuals taking part in the process, then the indivisibility of knowledge must characterise both the process and the resource, so that any attempts to break it down into fragments and make these the subject of property rights will necessarily be imperfect.

The literature on economics of innovation has, to date, focused chiefly on knowledge spillovers, that is to say on the positive externalities affecting the circulation of knowledge, which represent a valuable non-market exchange that, for example, accounts for the localisation of production and the emergence of industrial clusters (Breschi &

¹⁶ Empirical evidence shows that the comparative limitations of certain land demarcation systems seem to have negative long-term effects on land values and economic activity in the area concerned (Libecap & Lueck, 2009).

Lissoni, 2001; Frischmann & Lemley, 2007). This in itself testifies to the inability of property to internalise the social value of innovation, so that some additional governance is called for. However, since the boundaries of property rights in the knowledge domain are elastic and somewhat blurred due to the indivisibility problem, they can likewise be stretched in the direction of appropriating more than the socially optimal value. Full appropriation, where it is possible, must necessarily extend beyond the subject matter, thereby implying over-appropriation¹⁷.

Because knowledge exists and is produced through a technology reliant on economies of scale in its contributors, internalising it so that ownership can be assigned to a single individual is by definition impossible without damaging the technology itself and its productivity—consequences which would then constitute a new social cost.

To summarise, in certain circumstances the market or the hierarchy may provide the best solution for fostering efficiency; however there are cases where neither the former nor the latter respond properly. When this happens, though some role for the market remains possible, there is also a need to broadly protect the social dimension intended as a productive technology which is complementary to the market. This in essence implies regulation, so that in the knowledge domain Coase to some extent meets Pigou.

5. Property rights and market structure

The property paradigm of intellectual property is essentially exclusionary. Such rights are in fact designed to give inventors/creators--or most often licensors—the power to ask a positive price to pay back production cost and to obtain a reward for their work. In this respect, intellectual property rights treat knowledge as a commodity that mimics the conventional, tangible, ones (Ramello, 2008).

However, unlike for many other goods where the exclusive right generally affects the demand side, by excluding consumers who are not willing to pay the price, for property in the knowledge domain the exclusionary power somewhat overlaps the supply side, because it can in many circumstances be leveraged to produce rents.

5.1 Knowledge and market power

The associated behavioural changes arise directly from the possibility of affecting the competitive process and the market structure via property rights. Though such an opportunity is not restricted to knowledge, it is more easily exploitable for this particular commodity by reason of its flexible boundaries, which can in a sense can be stretched beyond the subject matter to also gain control of the market or at least of significant part of it. In the knowledge domain, property rights can be more easily directed to extracting the additional benefits arising from the strategic uses engendered by the exclusive right. Such profits can be extracted in a variety of ways, all somewhat related to the degree of market power provided by a successful intellectual property right.

¹⁷ There is only one situation in which property rights will produce an efficient market solution, and namely that where the boundaries of property correspond to the total resource. This case has been discussed by Coase (1974) with the example of the lighthouse. However that situation cannot be mapped onto the knowledge domain, where contributions necessarily come from different individuals, so that a monopoly cannot be envisaged.

The above assertion is of course not obvious, and should be at least briefly clarified. In fact, though the mere existence of an intellectual property right, does not necessarily confer any significant market power to the right-holder, the success on the market of a given subject matter (such as a best selling book or a blockbuster drug) and its exclusive exploitation are likely to produce some market power¹⁸. Hence, in the knowledge domain, the legal monopoly created by the property right can potentially be leveraged into an economic monopoly, or something close to it (Ramello, 2005b & 2008). This is at least a possibility for those intellectual property rights that have behavioural consequences: whenever some market power is put in the hands of right-holders, it may result in rent-seeking behaviours, which are thus specific spillovers of the property regime and, as is well known, detract from efficiency.

One way of rent-seeking through property consists of using the right as a sort of veto power aimed solely at extracting rents from the market. In this case, the exclusive right associated with property becomes merely a private taxation system, which neither promotes efficiency nor encourages the innovative effort, but only serves to produce rents by exploiting the shortcomings within the market itself (Marchese & Ramello, 2010). This type of taxation becomes a social cost when it influences the allocation of resources. A recent example of the above is provided by patent trolls. These are firms that legally hold a portfolio of patents, essentially for the sole purpose of exploiting the attendant exclusive rights over knowledge to gain monetary benefits. Patent troll firms have no interest in actually using the patents themselves, which they generally simply purchase on the market, but only in reaping large sums of money from litigation, which thus becomes their productive activity (Bilton, 2010).

The chief activity of the patent trolls thus consists of filing, or threatening to file, frivolous lawsuits for patent infringement against major players, who have much to lose from these and are accordingly apt to settle out of court, producing stream of rents for the plaintiff. A good example of this was the Blackberry case, in which the producer, Canada's Research in Motion, agreed to settle and pay the plaintiff, patent-holding firm NTP, over US \$ 612 million to avoid the cost of shutting down its communication system whilst awaiting the judicial decision (Gregory, 2007).

The paradox here is that the property rights owned by the patent troll are legal, and the claim against the defendant is non-trivial, because the boundaries of patent, though they should be sharply defined by the Patent Office, are always partially blurred to some extent, due to the afore-mentioned problems of demarcation. This makes almost any threat of a lawsuit credible (Gilbert, 2010).

Such behaviour is essentially made possible, on one hand, by the role of knowledge as an input for ensuing activities, and on the other hand by the potential degree of market power created by the intellectual property right, which entitles the owner to exclude downstream or competing firms if they do not pay a price.

5.2 Industry regularities: foreclosure and concentration

¹⁸ Several arguments support this assertion and are extensively discussed in Ramello (2008). Among others, the problem is connected with the uniqueness of successful subject matters, which is also the reason why they are deemed to merit a specific property right. In fact, envisaging a competitive market would imply perfect substitutability among subject matters, at which point it would make no sense to invent a complex legal apparatus for fostering innovation, since it would be more efficient to directly finance an individual inventor.

Another possibility is for this price selectively to be raised infinitely high. In such a case the outcome of exploiting the exclusive right will be foreclosure of the market to competitors, and the permission to comfortably extract rents from consumers¹⁹. Property over knowledge becomes thus a somewhat plastic market device that can be endogenously manipulated to exploit and extend market power.

There is abundant factual evidence of this, from a wide spectrum of industries. Thomas Alva Edison, a prolific creator of inventions and profitable business strategies, appears to have shown the way in pursuing rent-seeking through leveraging and aggregation of intellectual property rights. In the case of the electric lamp industry, he undertook an aggressive campaign—which was later continued by his successors--of heavily exploiting patents. This included “vigorous acquisition of other inventors’ key patents, restrictive cross-licensing of patents when outright acquisition was not possible, mergers with competing companies producing electric lamps and ancillary equipment and leveraging a powerful patent position to organize both national and international cartels” (Scherer, 2005, p. 298). By 1896, in just a few decades, Edison’s Company General Electric and its cross-licensees thus comfortably dominated more than 75% of the US market.

A recapitulation of General Electric’s conduct would provide sufficient material for nearly a complete course on antitrust, in addition to demonstrating the inexhaustible and multifaceted richness of Edison’s creative vein even from the anti-competitive perspective. However such a discussion would be well outside the scope of this article. Suffice to say that this example clearly shows how property rights over knowledge can be used to influence competition in many ways.

The example of the Cornish steam engine cited earlier showed how, for the duration of its validity, the Watt and Boulton patent blocked the entry of competitors (Nuvolari, 2004); the electric lamp example further shows how such power can be consciously leveraged to transform competition *in* the market into competition *for* the market, leaving the winner in a very comfortable position for extracting rents—albeit at a cost to society.

Experiences in the pharmaceutical industry likewise indicate that patents have sometimes been used to restrain competition and delay the entry of competing products such as generic drugs (Correa, 2004). It is furthermore worth noting that concentration is a salient characteristic of the pharmaceutical industry, and that this feature is seen to recur very often today in industries governed by intellectual property.

In fact, turning now for example to another sphere governed by copyright, and one which is more familiar to academics, we find a very similar situation. Today’s journal publishing industry is characterised by a complex strategy of reputation inertia, bundling and exclusion, which has over the past two decades led to dramatic price increases—from 3 to 8 times the rise in the consumer price index over the same period, depending on the field—and a remarkably rapid concentration of the industry into the hands of a few commercial players, at the expense of small competitors even when the latter charged lower subscription rates (Ramello, 2010).

Here again, as in the cases of the electric lamp and pharmaceutical industries, we see a similar pattern of aggregation of property. Indeed, aggregation of a large number of

¹⁹ The argument made here concerns exclusionary pricing. In point of fact, monopolistic pricing cannot generally be infinitely high; accordingly, such pricing should not be considered a genuine profit-maximizing choice, but rather a way for engendering market foreclosure with inherently welfare-reducing consequences.

intellectual property rights can represent a strategy for controlling the market, a hypothesis supported by theory in both the patent and copyright domains. For example certain practices, such as the systematic acquisition of unexploited patents--commonly known as "sleeping patents"--have had in a number of cases the true purpose of restricting competition from newcomers (Gilbert and Newbery, 1982). Occasionally, in a similar vein an incumbent might choose to work around a principal patent rather than paying--a practice known as "inventing around"--thus making unproductive investments with the sole purpose of producing sleeping patents and thereby locking out the competition.

In the case of copyright, a correspondent situation has arisen in several industries where a few incumbents own very large catalogues of copyrighted works (e.g. recording, film, publishing and other industry sectors). These situations are best understood in terms of a defensive leveraging strategy, specifically aimed at preserving and extending the incumbent's market power by increasing the asymmetry of costs and benefits between incumbents and new entrants (Nicita and Ramello, 2007).

The final outcome of the aggregation of rights described above is to create a highly concentrated industry, in which a handful of players control the market; and since the investments made to achieve this market structure are non-productive, they constitute not just a dissipation of rents but also an additional social cost associated to market power.

All in all, the examples of rent-seeking drifts connected with property over knowledge are too numerous not to be correlated with the legal framework upon which the industry relies, namely intellectual property rights. In observing the real economic life of these property rights within specific markets, an interesting feature emerges: they provide incentives that far exceed simply rewarding creative activities, and affect rent-seeking. Very often, the net resultant of these forces is a tendency toward concentration within the industry, and a weakening of competition with repercussions on efficiency. This of course opens the door to a wider discussion of the dynamic effects of intellectual property rights on the innovation race, on rent-seeking behaviour and on the structure of the market. This question is very complex, and would require a much more detailed analysis. However, there is no doubt that the exclusive rights connected with intellectual property have in some cases been used to achieve or extend market power, to the detriment of the collective welfare. Such occurrences raise a new issue concerning property rights and knowledge, and namely the problem of the social cost of induced market power in these industries. This induced market power represents yet another new externality, engendered by the opportunities created by the property regime, and which in its turn affects efficiency.

In many cases, regulatory arrangements can be adopted to overcome the attendant social costs, such as compulsory licensing, or strong antitrust interventions.

6. Concluding remarks

Property rights play a crucial role in economic activities: that much is out of the question. They are a keystone of the market, which undeniably could not exist without them, to the point that much of what we term 'economy' could not happen in their absence, or at least not as we currently know it.

However they are much more than simply a tool for making an economy and exchanges workable: they are also a formidable device for broadly serving society by fostering efficiency through the alignment of private benefits with the public interest. In pursuing their profits, right-holders also accomplish the efficient allocation of a resource, thereby serving social welfare in a manner very much aligned with the totemic paradigm of economic theory: the invisible hand. This is an insight that greatly furthered our understanding of this legal institution, and represents a milestone in the economics literature of the past century. However it is only one among the many merits of Ronald Coase.

The English Nobel Laureate in fact also taught us a great deal more: for example to look in general at all laws and institutions as potentially powerful devices for promoting efficiency and welfare, and equally to distrust blind recipes and formulaic policies for enhancing welfare.

Drawing from these lessons, this article has examined the limitations of the property regime within the knowledge domain. The route taken has been essentially that of a positive rather than a normative analysis, though some aspects of the latter do also emerge as a consequence of many of the points discussed herein. Property rights are “genetically” designed for managing economic resources where excludability plays a significant role in regulating use of the resource or avoiding its depletion. Accordingly, the central feature of the property system is to permit internalisation of the externalities, so as to make the market the better solution for fostering social welfare in accordance with the laissez-faire tradition. The market, with its integrity thus restored, will then be able to allocate the resources to those who value them most, thereby attaining a socially optimal outcome.

However, in certain situations the workings of the property-rights system may produce a new kind of externality, one which itself entails a social cost and requires a specific remedy. This happens in the knowledge domain, where the property regime can give rise to three kinds of externalities, pertaining to: the consequences on the social norms and individual preferences which characterise creative and inventive milieus; the collective framework of knowledge production, whose idiosyncratic economies of scale and indivisibilities may be damaged by atomisation through property rights; and, finally, the behavioural changes prompted by the creation of opportunities for distorting the competitive process and the market structure.

On the whole, the problem described has a self-referential character, since the property regime's attempt to remedy a market failure itself produces a new market failure, thus creating a vicious circle that is difficult to break. In a sense, we find that to some extent Coase meets Pigou, since a pure property-rights system cannot be envisaged without some state/regulatory intervention.

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