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Intellectual Property Regimes: a Comparative Institutional Framework

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Abstract

This paper aims to provide a unified framework for the analysis of the *governance* of intellectual property resources, starting from methodological assumptions drawing on both New Institutional Economics *strictu sensu* and a broader institutional approach that allows to encompass the analysis of private orderings along with that of markets and formal and informal institutions. The analysis highlights the main characteristics and trade-offs involved by the adoption of different intellectual property regimes linking them to the relevant features of knowledge/technology domains.

1. Introduction

In this paper, we construct a framework for understanding the multiplicity of institutional arrangements that shapes the governance of intellectual property resources – what we call IP regimes. Our notion of IP regime is rather broad and includes not only relevant state-designed laws and institutions but also the private arrangements that contribute to defining the social relationships pertaining to the use of intangible resources. The object of our analysis thus includes not only patent, copyright and trade secret laws but also private institutions such as open source and creative commons communities, collective copyrights organizations and patent pools. Indeed, while substantial attention has been paid in the literature to the design of IP laws, and especially patent laws, and – to some extent – to formal intellectual property institutions such as specialized courts and administrative procedures, scant attention has been devoted to exploring in a unified framework the range of institutional arrangements that contribute to the governance of intellectual property resources.

We rely on comparative institutional analysis to explore the properties of different intellectual property regimes and assess the trade-offs involved in the relevant organizational choices. Rather than being concerned with identifying the conditions for implementing an efficient “ideal” IP system, as most of the IP literature, we are concerned with the concrete organizational arrangements that shape the management of intangible resources and aim at comparing their salient properties. In so doing, we adhere to the main methodological statements of New Institutional Economics (NIE), and in particular to the working proposition that all institutional arrangements are imperfect and that therefore it is pointless to seek comparisons with ideal reference points in evaluating their properties.

According to us restricting the analytical focus on state-backed IP laws and institutions greatly limits the understanding of the characteristics of the intellectual property system, as it is widely held to be the case as regards institutions relating to tangible resources. The economic analysis of property rights over tangibles, and in particular the contributions by North and Barzel, have highlighted the inherent indefiniteness of property rights regimes, pointing to the role of private arrangements in the ex-post redefinition of property rights relationships. This understanding has allowed refining the analysis of property institutions but seems to be latent or entirely absent when it comes to understanding intellectual property institutions. We thus deem it worthwhile to make a first step in this direction.

The paper is organized as follows. In section 2, the rationale for an approach that goes beyond formal IP institutions and towards issues of governance will be explored. In section 3 the characterization of intellectual property regimes we propose will be introduced so as to highlight its relevant dimensions and trade-offs. In section 4 the characteristics of the knowledge/technology domain we deem salient will be described. Section 5 links the latter to the previously identified features of IP regimes so as to identify the nature of the IP regime best suited to the different knowledge/technology domains.

2. From Intellectual Property Law to Intellectual Property Governance

The analysis of intellectual property rights and intellectual property systems has become prominent in recent years with the advent of the so-called “knowledge-based economy” but has undoubtedly a longstanding tradition in economics. Of crucial importance in this analysis is the identification of a well-known instance of market failure: knowledge resources possess public-good characteristics that limit private parties’ ability to profit from them so that the divergence between their private and social value induces the sub-optimality of incentives to invest in their production (see, e.g., Arrow, 1962). This, in turn, justifies the creation of appropriability mechanisms in the form of legal rights to the exclusive enjoyment of the benefits from knowledge objects, i.e. intellectual property rights. However, the establishment of IP rights comes at a cost in terms of reduced diffusion of resources whose non-rival nature would call for the widest possible degree of diffusion.

Starting from these basic insights, a substantial body of literature that goes under the label of “economics of knowledge” or “economics of IP” has developed. This literature emphasizes the characteristics of knowledge as determinants of the optimal properties of appropriability regimes focusing, by and large, on the trade-off between ex-ante incentives to innovate and ex-post diffusion problems. What is important for our purposes is that the nature of the appropriability regimes that constitute the object of the analysis is generally implicitly assumed to be public, i.e. the analytical focus is generally on determining normative prescriptions as regards the design of the law, and more specifically of the IP system. Relevant questions in this regard concern the determination of the optimal scope and duration of patents, the rationale for various limitations to the extent of copyright protection such as the fair use doctrine and various other issues related to the economic analysis of the formal and legally sanctioned features of IP protection.

Thus, this literature pays scant attention to (a) the role of institutions other than formal and public institutions; and (b) the effects of governance strategies of IP resources as opposed to exclusion strategies. It is our contention in this paper that both of these aspects and a number of other related aspects on which more will be said below deserve much greater attention in the analysis of intellectual property rights. The main reason why this is so is that the formal features of an IP system are far from being the sole determinants of the efficiency and functioning of the system. Moreover, while attention is usually focused on the two extremes of free access and private property, intermediary strategies of governance that turn knowledge commons into something different from both an entirely open-access and an entirely closed-access resource constitute the norm rather than the exception. This has been clearly shown by the New-Institutional Economics literature with reference to systems of property rights over tangible resources.

This literature therefore constitutes an important reference point for the analysis of IP regimes, although it has so far said relatively little about intellectual property rights. The NIE literature has contributed to highlight the important function of property rights systems as the fabric of the institutional structure of any society. Yoram Barzel (1989) and Douglass North (1990), in particular, have pointed out the fact that a necessary precondition for the efficient use of resources is the definition of exclusive rights over them and have stressed the role of the institutional framework in ensuring the existence of a formal set of rules that satisfies this objective. Indeed, in order for agents to be able to organize their economic activities it is necessary that incompatible overlaps among uses of scarce resources be resolved, to the extent it is possible, by

delimiting the rights different holders may enjoy to such resources and that the rights be attributed to individuals or groups.

The stage of definition of the formal rules inherent to the uses of scarce resources does not exhaust the range of functions performed by a property rights regime. As Barzel (1989) has made clear, in addition to the definition and allocation of the rights – i.e. the *measurement* of the rights in Barzel’s terms – for the efficiency effects to be achieved it is necessary to ensure their *enforcement*. In other words, it is necessary to ensure that right-holders control the resources over which property rights are defined to an extent sufficient to capture most of the actual value of the stream of benefits associated to them by excluding unauthorized agents from access to the resource. Enforcement entails a range of activities including the control of access, the identification of authorized and unauthorized uses and the sanctioning of violations.

The most relevant aspect for our purposes is that Barzel’s framework calls attention on the fact that, in a world of positive transaction costs, property rights are never perfectly defined ex-ante so that definition necessarily occurs in part also ex-post and entails costs for the agents that engage in it. Ex-post definition may be accomplished through multiple institutions that entail different costs and are chosen by agents on the basis of their relative costs and benefits. This implies that the analysis of the efficiency properties of property rights systems necessarily involves the consideration of institutions other than formal ones. These may have different characteristics in terms of their composition and nature, be private or public, perform highly specialized or general functions etc.

Thus, by taking as a starting point the insights offered by the Barzel/North framework and applying them to the intellectual property realm it is possible to significantly broaden the analytical perspective, moving from the economic analysis of intellectual property law to the economic analysis of intellectual property governance. In so doing, the object of analysis becomes the “intellectual property regime”, broadly defined as the combination of the entire set of institutions that contributes to defining, both ex-ante and ex-post, the nature and extent of the bundle of rights to intangible resources attributed to right-holders and to enforce the defined specification. Thus, within the definition of the elements making up an intellectual property regime fall the legal rules sanctioned through public enforcement in court as well as various contractual and organizational arrangements that, though not usually interpreted as part of the conventional notion of intellectual property system, play a crucial role in determining the conditions of access to and use of valuable intangible resources.

3. The Characterization of Intellectual Property Regimes: Relevant Dimensions and Trade-offs

The previous section has introduced the three useful functions that, in accordance with the Barzel/North framework briefly recalled above, we deem essential to the functioning of an IP regime: definition, allocation and enforcement of property rights. The way in which an IP regime implements these functions can be described – we submit – by making recourse to two fundamental dimensions: (1) the *intrinsic properties* of the regime; and (2) the *organizational dimension*.

The first dimension provides an answer to the question: “what is the scope of rights the regime attributes to owners and non-owners?” It thus allows to describe (a) the extent to which right-holders may choose among different uses related to given

property bundles (this is captured by the bundled/unbundled dimension); and (b) the extent to which third parties may choose among different uses associated to IP-holders' property bundles (the open/close dimension). The second dimension provides an answer to the question: "how is the chosen specification of rights implemented?" The organizational dimension thus captures other two key aspects of an IP regime: (a) the degree of centralization of the definition/enforcement tasks; and (b) the extent to which the tasks are performed by an institution characterized as public in the sense that it is endowed by citizens with a constitutional delegation to define the relevant notion of public/collective interest and ensure its implementation and it can rely on the legitimate use of the force within a territorial community.

It is important to stress that, keeping up with the premises of the previous paragraph, our underlying hypothesis is that the two dimensions are strictly intertwined and jointly determine the overall properties of IP regimes: the organizational dimension helps to shape the intrinsic properties of the system and vice-versa. Moreover, each of the dimensions we identify entails different trade-offs for the agents. Identifying these trade-offs may allow deepening our understanding of the institutions that shape the governance of intellectual property rights.

3.1 The Intrinsic Properties Dimension

Any property rights regime must be able to specify, at a minimum, the nature and extent of the rights that belong to an owner's property bundle and the conditions of access to the objects of property by third parties. In order to do so, at least two kinds of choices have to be performed. The first choice relates to the extent to which non-owners may exercise access to given property rights (the open/close dimension)¹. This dimension captures the fact that both the stage of definition and that of enforcement of property rights may involve, to a certain extent, access to the resource over which property rights are defined by third parties. This may be the unintended consequence of the fact that transaction costs prevent a complete specification of the right or may be the outcome of a voluntary choice identifying a specific answer to the incentive/diffusion trade-off (on which more below). Note that focusing on this dimension calls the attention on the fact that there are many intermediary positions between the two extremes of complete openness and complete exclusion: while the IPRs literature often traces a sharp contrast between IP, intended as a strategy of absolute exclusion, and open access, we think it important to focus the attention on the intermediary governance strategies that lie between the two extremes.

The main trade-off inherent to this dimension corresponds to that identified by the literature on the economics of knowledge as its primary object of analysis, namely the diffusion/incentive trade-off. On one side, increased closeness entails a more effective ability of owners to appropriate the benefits from the intangibles over which they hold rights. This, in turn, generally translates into increased ex-ante incentives to invest in the production of such intangibles as it allows narrowing the gap between their social value and their privately appropriable value. However, as it is well-known, increased incentives come at the cost of a loss in static efficiency, as closeness increases the probability of incurring deadweight losses associated to monopolistic exploitation of

¹ Note, however, that the dimension bundled/unbundled also relates to the rights of uses of third parties, but in a different sense, namely it relates to the ability of proprietors to choose which rights of access to grant to third parties.

knowledge, although this need not necessarily be the case (Kitch, 2000). Moreover, increased closeness also means that a diminished extent of spillovers is enjoyed by non-owners, which adversely affects their incentives.

The second choice relates to the degree of unbundling of the rights (the bundled/unbundled dimension) and concerns the degree of precision and completeness with which the rights over the multiple uses associated to a given asset are specified ex-ante and thus the extent to which owners may choose which sorts of rights they may exercise. At one extreme, “bundled” property rights are not clearly and completely defined ex-ante, in the sense that they imply residual rights to control an unspecified set of uses. At the other extreme, to “unbundle” property rights entails achieving a greater degree of specification so as to assign variously assorted collections of rights of use inherent to the uses of a resource to different agents.

The bundled/unbundled dimension captures an important trade-offs. Indeed, the choice of the degree of unbundling of IPRs affects the identity of the party that bears the costs of definition (or “measurement”, in Barzel’s terms) of IPRs and the extent of costs incurred. The more “bundled” is the IPR, the more limited are the costs of definition incurred ex-ante by public authorities, and the greater are the ex-post costs of definition borne by right-holders. In particular, the higher the degree of bundling, the higher are the costs of contractualization, namely the costs incurred in exploiting the resource by contractual means. If the rights are bundled, the right-holders have to bear the costs of contractually specifying the admissible forms of exploitation of the resource protected by property rights.

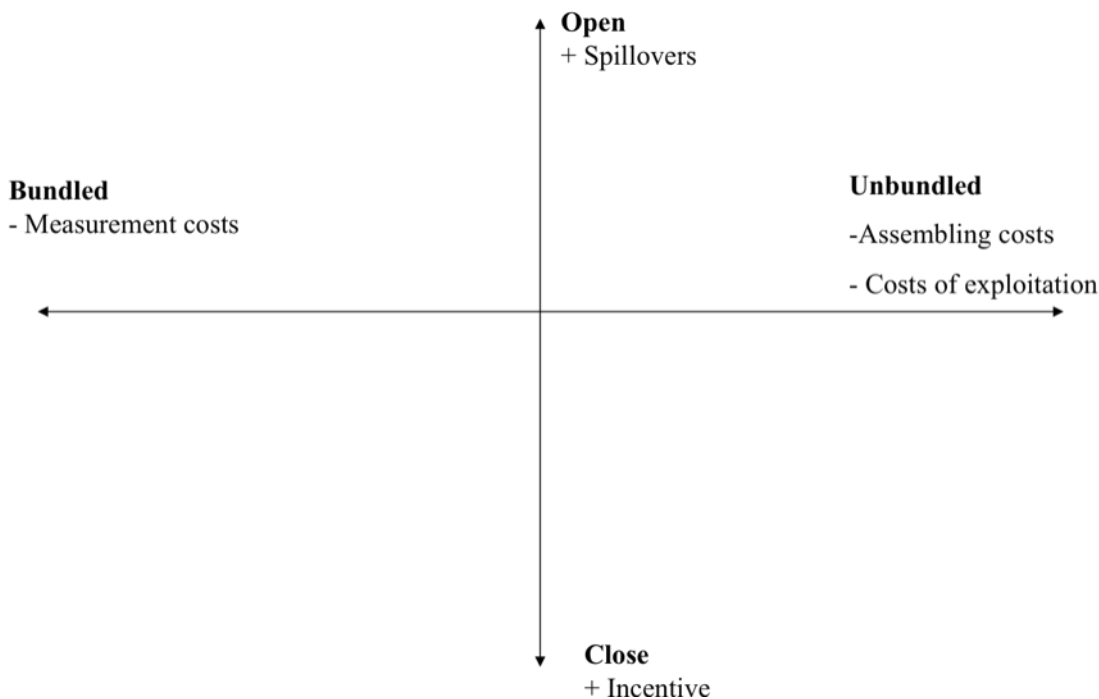
By contrast, the more unbundled are the IPRs, the more precisely alternative contractible uses are specified ex-ante (before contracting takes place) by parties other than the owners. This has at least two sorts of implications in terms of the costs incurred in combining multiple rights for productive purposes, i.e. the costs of assembling. On the one hand, the more unbundled is the right, the open tend to be the transaction system to combine various rights of use to form a service of value for the users. On the other hand, in spite of the eventual increase in the number of transactions, the more unbundled are the rights, the lower the average cost of assembling them. This is due both to the fact that economic agents bear less ex post transaction costs (since the costs of definition are borne ex ante), which entails that transparent and competitive exchange systems can more easily develop, and to the fact that unbundling makes it easier for potential acquirers of rights to “cherry-pick” and buy only those rights that best suit their objectives. In other words, with unbundled rights, buyers do not need to bear the costs of acquiring rights on uses in which they do not have an interest. They therefore do not need to eventually disentangle them contractually or to eventually resell some rights of use.

Thus, unbundling reduces the costs of creating a market for the exchange of intellectual assets. This, however, comes at a cost in terms of overall measurement costs. Indeed, the choice of a high degree of bundling tends to save the costs of establishing rights over uses of not private and collective value. When IPRs are bundled the costs of definition of rights over uses are incurred only when the benefits outweigh the costs to right-holders. Moreover, since users are generally those best placed to evaluate the costs and benefits from contracting, this might be considered efficient relative to a full ex-ante definition (and unbundling) of the uses included in the IPR bundle because it allows to save the costs of definition of the uses for which benefits never happen to outweigh the costs.

Unbundling impacts on the degree of exploitation of the resource. Increased bundling tends to induce under-exploitation of the resource. This is because, in presence of high transaction costs, the larger the scope of the IPR, the higher is the probability of obstacles to the flow of each of the relevant uses of the resource object of IPR protection towards the agents that can exploit them appropriately and therefore value them most highly. In the intellectual property realm, costs of transacting tend to be particularly high for a variety of reasons that include the risk of misappropriation experienced by the seller (that may not be able to delimit clearly the range of admissible uses granted to the buyer, given the incomplete ex-ante definition of the IPR itself and the incomplete nature of contracts). IPRs holders have therefore incentives to imperfectly reveal information, which has to impacts. Ex-ante, the other parties might miss information about the exact characteristic of the knowledge traded. It result in non-transparent market on which dealing opportunities might be missed both because default in matching and because adverse selection occurs. Also, the high level of transaction costs reduces the number of profitable deals. On transaction costs for the exchange of intellectual assets see also Merges, 2001).

The trade-offs identified in this section can be visualized in figure 1.

Figure 1. Characterization of IP regimes: intrinsic properties.



3.2 The Organizational Dimension

The definition of the intrinsic properties of the system (the “measuring” of property rights, in Barzel’s terms) as well as the enforcement of the chosen property rights specification may be implemented through various organizational forms, whose properties may be captured along two principal dimensions. The first – the centralized/decentralized dimension – relates to the organizational level at which the ex-post definition and enforcement of property rights is performed by a given institution.

Performance of such tasks may occur in a markedly centralized fashion, as when they are attributed to specialized institutions whose main function is to deal with IP enforcement issues, or in a more decentralized way, as it is the case when responsibility for enforcement is attributed to private agents acting on their own.

The centralized/decentralized dimension involves a number of relevant trade-offs (Brousseau & Raynaud, 2008). Centralized management of measurement and enforcement undoubtedly involves some benefits relative to decentralized enforcement in terms of (a) economies of scale; (b) economies of scope in enforcement; (c) learning; (d) internalization of externalities; and (e) reduction of negotiation costs. Let us consider each of these benefits from centralization in turn.

Economies of scale arise because the measurement and enforcement tasks both involve set-up costs and fixed investments in the form of the accumulation of relevant expertise and specific knowledge that come into play in the performance of such tasks irrespective of the specific characteristics of the resource object of IPR protection and because centralization enables a more effective division of labor. Specialization and effective division of labor also create benefits in terms of enhanced learning, which is also favored by the fact that many tasks inherent to measurement and enforcement are performed repeatedly within a centralized organization. Economies of scope in enforcement take the form of an extension of the number and types of markets/domains over which control and enforcement may be cost-effectively exercised. By centralizing the performance of enforcement tasks, indeed, it is possible to target markets/domains that individual owners would find too costly to exploit commercially or to monitor for possible infringements. Centralization also provides advantages in terms of internalization of externalities in enforcement, especially as regards the detection of infringements: any single effort expended at detection may involve positive externalities for other right-holders, especially if what is at stake is the identification of outright copies, and these externalities would not be taken into account if enforcement were performed in a decentralized fashion. Finally, centralization may allow reducing significantly negotiation costs incurred in establishing the conditions of access to IPR-protected resources. This may occur through various means, such as by devising standard-form contracts, and by building languages and interfaces to facilitate transactions, interoperability and integration. Note, in particular, that achievement of some form of interoperability necessarily relies on centralized coordination of some sort.

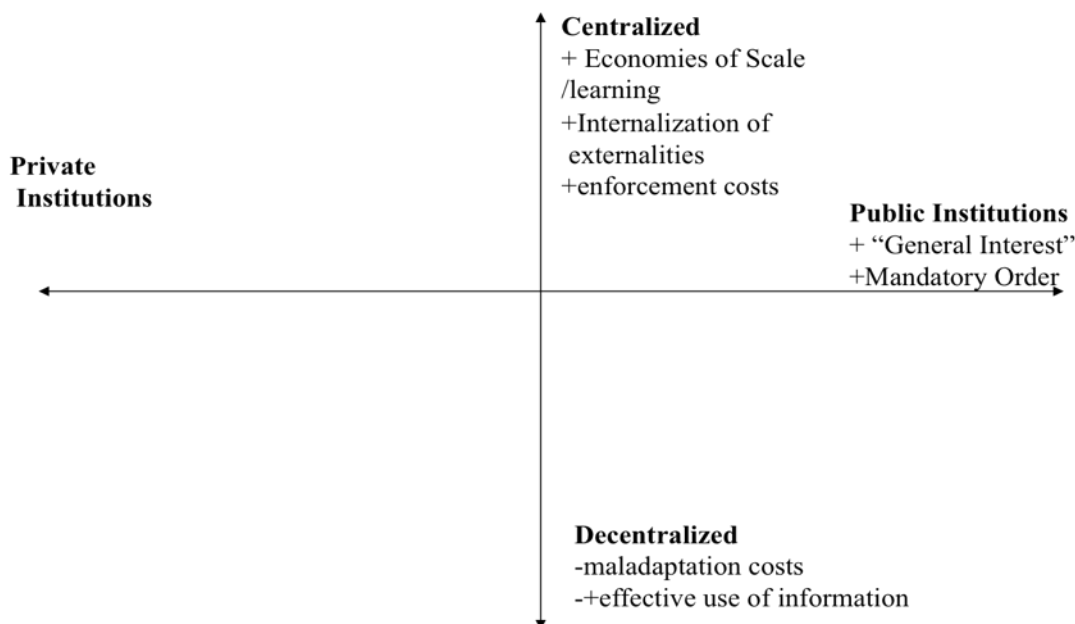
On the other side, however, centralization also involves some costs that suggest that, in some circumstances, decentralized management might be preferred to centralized organization, which explains why we do not observe the emergence of centralized solutions for each and every measurement/enforcement task. In particular, decentralization allows reducing the mal-adaptation costs (Williamson, 1985) that arise as a consequence of the fact that centralization allows only a limited degree of customization of solutions to individual needs. The higher the degree of centralization, the lower is, of course, the flexibility in dealing with individual cases, given that centralized solutions are designed to deal with those issues that occur with higher probability and are, therefore, more common. This may impose costs in circumstances that involve a limited number of subjects and/or occur with lower probability and therefore require a high degree of customization. An additional advantage of decentralization – strictly related to the previous one – is that it allows to make more effective use of private information because it places decision-making power in the

hands of those in possession of the relevant information as regards the uses and value of the resources protected by IPR. This is particularly relevant when IP-specific knowledge is necessary to detect infringements, and especially when it is a matter of detecting acts of plagiarism rather than servile copies (Brousseau and Bessy, 2005). It is also relevant when deals have to be settled. Inventors and users have the most relevant knowledge and information to decide best deals and best contractual conditions.

The second relevant dimension is the Public/Private dimension. We define as “public” arrangements those relying on the broader “social contract” between a territorially defined State and its citizens, by which the former provide public goods to the later — and in particular an institutional infrastructure — who grants him with an extended authority in exchange of checks and balance and constitutional guarantees (see Brousseau, Schemeil, Sgard, 2008). This constitutional pact between the citizens and the ruler provide the later with an extended enforcement capability (limited a territorial community) and with an ability to establish the collective interest; which is also a responsibility. “Private” arrangements, by contrast, result from the convergence of wills of agents acting to benefit of club goods to the exclusive benefits of the member of the coalition who share easily aligned interests.

The main trade-off involved by the public/private dimension is between a form of measurement/enforcement that promotes the general interest and one that privilege only the private interests of IPRs holders. Costs and efficiency issues also matter. The burden of public action is born by all citizens, which might result in cross-subsidies in favor of those who benefit the most of the provision of public goods². Also, public authorities are the monopoly users of legitimate violence, which endow them with extended enforcement capabilities and therefore credibility.

Figure 2. Characterization of IP regimes: organizational dimension.



² This is obviously depending upon the distribution of taxes within the population.

4. The Characterization of the Knowledge/Technological Domain

The analysis of intellectual property regimes cannot dispense with an analysis of the characteristics of the knowledge/technological domain. Indeed, it is only with reference to such domain that the comparative properties of alternative intellectual property regimes can be assessed. We distinguish between knowledge and technology by interpreting technology to refer to the application of scientific knowledge for practical purposes. We thus use a rather conventional distinction between knowledge and technology, although we interpret the latter narrowly by assuming that technology is valuable only as a final good (i.e., not as an input into a cumulative innovation process). This implies that the essential elements of the technology domain can be captured from a static viewpoint with reference to its network characteristics and that the main criterion for performance of an IP regime with respect to technology is given by conventional static efficiency measures such as aggregate welfare. The dynamic dimension is captured, by contrast, by the notion of knowledge, which is by essence cumulative and evolving. In the case of knowledge, the relevant criteria of performance are well identified by the economics of growth and development and are given by the speed and sustainability of the development process.

To try to characterize the alternative knowledge/technological domains, we rely on a vision inspired by network theory. The literature of knowledge often insists on the idea that knowledge result from the combination and re-combination of existing pieces of knowledge. In the same line, we see technological domains as collection of available solutions that can be combined and recombined to result in services/functionalities provided to the final users of the technology. We represent therefore knowledge/technological domains as collection of individual pieces that can be localized in a space characterizing their proximity in terms of differentiations and that are or can be connected together to produce new ideas or new uses. We then characterize knowledge/technological domains along four dimensions aimed at characterizing the very nature of (potential) combination needs among individual pieces of knowledge/technology.

The principal features of the knowledge/technological domain can be captured with reference to a micro dimension – the properties of individual pieces of knowledge/technology – and a macro dimension – the network properties of knowledge/technology, namely the properties of knowledge/technology as a system.

The main characteristics of the micro dimension are (a) the degree of generality/specificity of individual pieces of knowledge/technology; and (b) the degree of complementarity among individual pieces of knowledge/technology. These characteristics may be best understood with reference to the notions of “star” vs. “meshed” networks in network theory. A “star” network represents a topology whereby all the nodes of the network (called peripheral nodes) are connected to a single central node. In a “meshed” network, by contrast, no node is in a central position.

The degree of generality (a) of a given piece of knowledge/technology will be highest if the piece of knowledge/technology can be conceptualized as the central node of a star network. More precisely, the relevant metric for capturing the degree of generality/specificity is given, in the case of a piece of knowledge, by the number of ideas that can be derived from it and, in the case of technology, by its position in the network. Defined in this way, the degree of generality captures, in the case of knowledge, the level of spillovers generated by a single piece of knowledge. This notion

thus encompasses both the distinction between upstream and downstream knowledge and that between general and specific knowledge. The degree of generality/specificity of technology indicates the degree of asymmetry of the network effects the given technology generates. A general technology is a technology likely to generate wide network effects, while this is not the case for a specific technology.

The second characteristic – the degree of complementarity of individual pieces of knowledge (b) – indicates the average number of nodes of the topology with which the piece of knowledge is connected. In particular, in the case of knowledge the degree of complementarity captures the number of individual ideas with which direct recombinations are viable, whereas in the case of technology it captures the number of interoperability relationships. The degree of complementarity indicates the level of networks effects a particular piece of knowledge is concerned with.

As for the macro dimension, it refers to the properties of knowledge/technology as a system and its main characteristics are (a) the degree of heterogeneity/differentiation of the pieces of knowledge/technology composing the system and (b) the degree of clusterization. The first characteristic refers to the degree of substitutability among the pieces of knowledge/technology. The degree of heterogeneity/differentiation, in other words, can be captured by the number of characteristics that the pieces of knowledge composing that system have in common. The degree of clusterization indicates the intensity of complementarities within the elements composing a knowledge/technology system coupled to independence among groups and identifies, in the case of technology, the existence of clusters of interoperability requirements and, in the case of knowledge, the existence of clusters of affine disciplines and knowledge domains. The degree of clusterization can be measured by the standard deviation of the distance among individual pieces of knowledge/technology in a system. It indicates the “localization” of potential spillovers/networks effects.

5. Knowledge/Technology Domains, IP Regimes and Modes of Governance

In this section the characterization of the knowledge/technology domains offered in the previous section will be used to create a mapping from the characteristics of knowledge/technology to those of IP regimes. This will allow defining the governance arrangements the best suit different knowledge/technology features.

Consider the degree of generality/specificity of knowledge/technology first. A high degree of generality, which implies a high degree of potential spillovers, calls for a high degree of openness along the intrinsic properties dimension. A high degree of openness allows, indeed, maximizing the extent of spillovers that benefit the economy at large and therefore to increase the extent of cross-fertilization among different pieces of knowledge, ultimately promoting economic growth. This, however, comes at a cost in terms of incentives of those producing general knowledge: the loss in incentives is most pronounced the most general is the knowledge and thus the greater its social value.

A similar trade-off emerges with respect to the degree of bundling of the rights to general knowledge: the more general is the knowledge, the more unbundled should be the rights defined over it in order to minimize/socialize the transaction costs of contractualization, namely the costs for the right-holders of drafting contractual agreements for the exploitation of the knowledge/technology. To choose a high degree of bundling, in presence of a high degree of generality of knowledge, would imply an

increase in the costs of exploitation of a piece of knowledge that, by its very nature, has a wide range of possible applications and would thus increase the risk of under-exploitation of such knowledge. To unbundle the rights to general knowledge, in other words, amounts to “socialize” the costs of measurement of the rights in the sense that they are sustained ex ante, rather than ex post and by right-holders, at the stage of the contracts definition. Yet the more unbundled are the rights, the lower the incentives to produce such knowledge. This is, of course, because the extent of incentives depends positively on the scope of the residual rights of control the knowledge producer expects to be able to enjoy.

With regard to the features of the organizational arrangements, it should be noted that, along the centralization axis, a high degree of generality of knowledge tends to require the adoption of centralized arrangements so as to exploit economies of scale in the predisposition of unified solutions. Centralization, in presence of general knowledge, also allows reducing the transaction costs involved by the predisposition of standards drawing on general knowledge assets or platforms for the integration of multiple ideas/technological assets. Moreover, it can be argued that along the public/private axis, a high degree of generality renders opportune recourse to Public implementation so as to implement a system balancing the interests of the most productive innovators with those of society.

Consider now the degree of complementarity among the individual pieces of knowledge. The higher the degree of complementarity, the more the IP regime should be characterized by openness. In presence of complementary knowledge/technology assets, openness reduces the costs of spillovers and allows maximizing the opportunities for the productive combination of the individual pieces of knowledge. In this case, the usual trade-off between maximization of the benefits from positive spillovers and incentives might, in some circumstances, be a less serious concern. This would be the case if the complementary knowledge pieces were all characterized by a similar degree of generality. If this were the case, openness would imply symmetric effects on all knowledge producers, meaning that, although each knowledge producer would be less able to appropriate the benefits from her creative investment, each would equally benefit from the positive spillovers of other producers’ complementary knowledge. By contrast, in a less homogeneous environment characterized by knowledge pieces of a different degree of generality, there is no guarantee that those producing the most general knowledge would have the expectation to benefit, on average, from an amount of spillovers comparable to that generated by their own creations. In this case, forms of governance that allow preserving the incentives of those producing the most general knowledge become particularly important (see below).

A similar argument holds for the degree of unbundling of the rights. To maximize the exploitation of spillovers, the higher the degree of complementarity, the higher should be the degree of unbundling. The negative incentives effects of unbundling might be attenuated in circumstances in which the complementary pieces of knowledge have the same degree of generality so that there is an overall symmetry of the effects of openness. Finally, needless to say, the higher is the degree of complementarity, the greater is the need for a technology of interoperability provided by a central management of uses rights over knowledge and technology.

Looking at the features of the governance arrangements that allow the implementation of the desired intrinsic properties of the IP regime, it appears that centralized governance might allow to reduce the costs of implementation and use of a

regime characterized by the properties we have identified, namely a high degree of openness and unbundling of the rights. As previously pointed out, centralized governance might also facilitate the creation of various sorts of standards and integrating platforms that allow to address problems of interoperability emerging in presence of complementary technologies.

To the extent that the benefits of an open and unbundled system are symmetric as described above, such a system can be implemented indifferently through public or private means. The higher the asymmetry in terms of generality of the complementary intellectual assets, the higher is the likelihood that a public system of implementation is required. Indeed, in presence of strong asymmetries, a private arrangement for the sharing of the benefits among right-holders is rather unlikely to emerge, while public implementation enjoys an advantage over private implementation in terms of the ability to impose a mandatory system of sharing through authority. In other words, a system of compensation à la Kaldor-Hicks, which would allow preserving the incentives of the producers of the most valuable knowledge, can more easily be devised by a public rather than a private authority.

As for the degree of differentiation, in constructing a mapping from knowledge/technology to the intrinsic properties of IP regimes, it is necessary to consider jointly the choices along the openness axis and along the bundling axis. In other words, the choice of the degree of openness needed for a given degree of differentiation of knowledge/technology goes hand in hand with the choice of the degree of bundling. A low degree of differentiation should be associated to a high degree of unbundling, if closeness is accompanied by a high degree of closeness. Conversely, a low degree of differentiation should be associated to relatively open rights to the extent that the latter are also characterized by a high degree of bundling.

Indeed, if a high degree of closeness is chosen, in presence of scarcely differentiated technologies, bundled rights would generate significant risks of overlap and consequently would substantially increase the costs of enforcement of the rights due to the increase in the amount of controversies involving the rights. The low degree of differentiation of knowledge/technology, if associated to closed and bundled rights could, in other words, give rise to so-called “anti-commons” problems. The coupling of closeness and unbundling, by contrast, guarantees adequate protection of inventors’ investment even in presence of innovations of a very incremental nature. Indeed, in presence of unbundling, closeness is necessary to counteract the negative effect on incentives of unbundling.

Note that, by calling attention to the degree of knowledge differentiation, we are stressing an aspect of the anti-commons problem that is not generally stressed in the literature dealing with the phenomenon. The emergence of anti-commons problems is usually cast in terms of complementarities only, i.e. anti-commons arise in presence of variously motivated bargaining breakdowns when bargaining would allow to combine productively complementary knowledge inputs. What we are underlining here is that a precondition for the emergence of an anti-common is not only the complementarity of the pieces of knowledge, but may also be their low degree of differentiation.

Finally, the degree of clusterization does not seem to exert significant influence on the desirable properties of the IP regime, except for the influence it might have on the choice of the degree of centralization of the governance arrangement. A high degree of clusterization makes it opportune the recourse to an intermediate governance mode, neither completely centralized nor completely decentralized.

6. Conclusions

One important outcome of our analysis is to point out the potential complementarity between the management of bundling and the management of openness. Indeed, the unbundling of IPRs can be a good way to alleviate the closeness of IPRs. Indeed unbundling decreases transaction post and favor therefore diffusion. Moreover, the combination of closeness and unbundling favors the development of efficient market exchange for the more valuable uses of the knowledge/technology, which provide the rights incentives for inventors.