Of Intellectual Property, Open Source and Innovation: Trends, and Some Opportunities for Italy

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This paper offers some reflections on the institutions for the governance of knowledge as an economic asset, and its management in firms. It then relies on a research based on a survey of a large number of patents (PatVal-EU) to discuss specific features of the invention system in Italy. The paper ends by suggesting that Italy is an interesting position to launch new policies that balance intellectual property rights and open source. It also flags the possibility of an Inventor Compensation Act like in Germany, which can motivate employees to launch new ideas and raise the Italian innovation rate. [JEL Classification: O31, O32, O34]

Key words: open source, patents, intellectual property rights, innovation.

1. - Introduction

Different factors of production have been central for economic growth in different epochs (land, capital, etc.). At the *firm-level*, this has been paralleled by the development of specific managerial techniques to govern these resources. At the

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system-level this has stimulated the formation of institutions for the development and exchange of the underlying assets. A classical example is the rise of the managerial corporation, based on the decentralization of activities in divisions (Chandler, 1990). This made it possible to govern large firms that exploited economies of scale associated to large investments in physical capital. Similarly, Rosenberg and Birdzell (1986) discuss the historical origin of several institutions of capitalism, like property rights on land, the bill of exchange, commercial law, double-entry book-keeping. They show that these institutions were prompted by the rise of new factors that could be best exploited by creating suitable institutions to handle them.

In this vein, it is widely argued that the past few decades have opened up a new epoch for capitalism. Knowledge and ideas have become a central factor in production, if not the central factor. As a result, we observe the rise of new managerial techniques to govern them, and the formation of the corresponding institutions.

This paper has two goals. First, it illustrates some recent trends in managerial techniques and institutions regarding knowledge and ideas. Second, it focuses on the Italian case, showing that Italy is lagging behind in the management of intangibles, and it is not part of the international debate on the formation of the new institutions that govern these assets.

The paper takes deliberately the form of an overview of these issues. This has the cost that some of the statements made here are suggestive and call for additional research. Yet, it can point out broad system- and firm-level policy issues. Moreover, it tries to provide an architectural perspective rather than focusing on one dimension of the problem. In particular, the world of intellectual property rights (IPRs) and that of open source do not normally communicate. The economic or managerial research on these matters is itself often separate. This paper discusses both phenomena along with their implications for firms or policy, and for one another.

2. - Trends

Some of the trends in the current economy of knowledge and ideas can be summarized as follows:

— the number of annual patent applications has increased significantly worldwide

— there is an equally significant growth of the so-called open-source approaches to the production of knowledge, which emphasize diffusion and non-appropriation of knowledge outcomes

— many companies are investing in new techniques for managing intellectual property, including the combined management of intellectual property and open source

— there is growing technology trade worldwide (the so-called “markets for technology”)

— the valuation of intellectual property has become a central issue, as we have little information on the economic values of patents or more generally of ideas

— there is a good deal of discussion about IPR policy that hinges on the reform of the patent system and on how to combine the benefits of intellectual property and open source

We shall discuss these trends one by one.

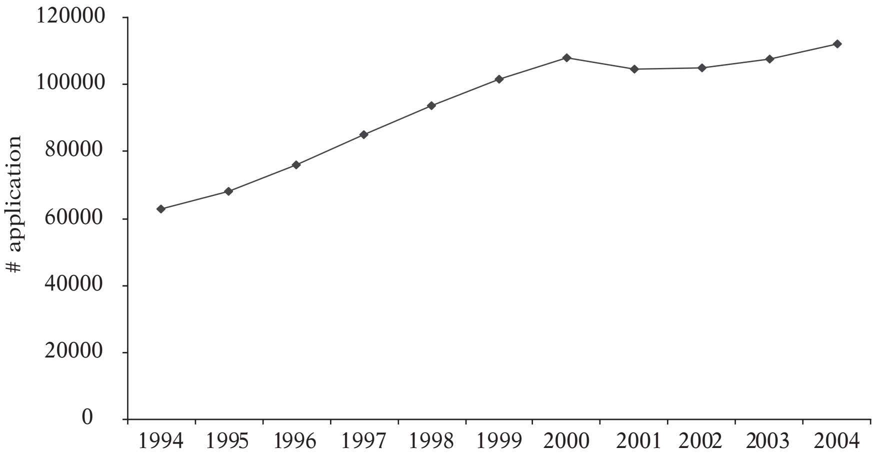
2.1 *Growth of Patents*

Graph 1 reports the growth in the number of patent applications to the European Patent Office (EPO) between 1994 and 2004. The trends are similar if one looks at the patents applied for at the US or Japanese patent office or at the World Intellectual Property Organization (WIPO).

The rise in the number of patents is both good and bad news. It stems from some genuine increase in innovation, as noted for instance by Kortum and Lerner (1999). Moreover, as again noted by Kortum and Lerner (1999), this corresponds in part to an increase in patenting by smaller firms or new applicants, which suggests that the rise is not produced only by established companies that may monopolize innovation. As we shall discuss,

GRAPH 1

NUMBER OF PATENT APPLICATIONS
TO THE EUROPEAN PATENT OFFICE (EPO), 1994-2004



(*) All European countries + US, Japan, Canada.
Source: EUROSTAT.

the increase in patenting also means that companies can establish property rights on inventions, which encourages, among other things, technology trade and then innovation and the diffusion of knowledge.

Yet, the increase in patents also stems from the growth in "strategic" patents (*e.g.*, Von Graevenitz *et* al., 2007). They are patents produced not to implement an innovation but to block others from pursuing innovations in a given area. The issue has become significant because in some cases firms have flooded a field with their patents. This implies that nobody can invest in research without running a serious risk of infringing some other patents. Sometimes this is solved by cross-licensing agreements. Yet, in some cases it stifles innovation. In particular, even when the problem can be solved via cross-licensing, new entrants or firms that are not part of the recognized oligopolistic core may find it hard to enter into such agreements.

Another growing practice is the application of the so-called divisonals. Divisionals are patents that claim to be a continuation of an earlier patent application, and thus get the priority of the earlier invention. This gives an early priority to a late invention even when the link between them is weak. Strategic patenting has also prompted the rise of patent trolls, viz. applicants that patent minor inventions with the only goal of accusing others of infringement, and thus collecting licensing royalties. Finally, the growth in the number of patents is associated to an increase in the number of "trivial" patents, *i.e.*, innovations that do not satisfy the criterion of non-obviousness, but still pass the examination bar (*e.g.*, Jaffe and Lerner, 2004). Trivial patents create confusion, offer opportunities for trolling behavior, and consume examination time and resources of the patent offices.

Solutions to these problems are not easy, as they entail some reform of the patent system. An interesting mechanism in this respect is the opposition system in force at the EPO. Compared to the US patent system, the EPO features a grace period in which a patent is applied for but can be opposed by third parties before the patent is granted. The opposition is evaluated by the EPO and the patent is granted or not taking into account the oppositions. The advantage is that the patent office can collect information on potential limitations of the grant before the grant takes place. By contrast, in the US system, oppositions to the patent can only take place after the grant, which means that they can only be carried out in court, with litigation expenses.

Finally, the raise in applications is flooding the patent offices, whose resources have not increased at the pace of applications. Apart from delays in processing them, some of the problems raised above are a consequence of the pressures on the patent offices. Pressed with time, the patent examiners are more lenient towards acceptance than rejection. Rejecting an application requires more time and effort because one has to demonstrate why the application is unsatisfactory. By contrast, applicants do not press the patent office with questions or clarifications when the application is successful. Thus, trivial patents, or divisionals that should not be given an earlier priority date, slip into the system.

2.2 *Growth of Open Source*

The past decade has also witnessed a notable growth in the open-source system. Open source hinges on the idea that the developers of a software code diffuse it through the web and attach to the code a Generalized Public License or GPL[1]. This is a licensing right whereby anyone can use the code and make improvements provided that she attaches the same licensing right to her innovations — that is, the modified code or the innovation has to be diffused openly through a GPL. The open-source system is most diffused in the development of software. However, the institutions and the open-source mechanisms are being explored in other fields (*e.g.* biotechnology). Moreover, there are variants of the GPL, like the less restrictive BDL (Berkeley Development License), which allows for the privatization of some improvements.

The important point for our purposes is that the GPL is an institution that can ensure that an entire trajectory of research remains public. One way to think about it is that while patents establish that a certain piece of research is privatized, the initiator of a GPL project can establish that the entire project has to stay in the public domain. We do not enter here in the mechanisms, the motivations, or the sustainability of open source and particularly of the GPL system (see, *e.g.* Lerner and Tirole, 2002). What is most important for our discussion is the nature of the institution and the fact that it has implications for the production and diffusion of knowledge. In particular, it can balance the negative implications of the patent system. A proper policy architecture can then define which types of knowledge are to be made public and which ones can be privatized.

Broadly speaking, only narrow ideas or knowledge should be allowed to become private. General knowledge or technologies with many potential applications should not be made private as this may forestall innovation in areas that the patent owner does not pursue, or in which he deliberately blocks others. By contrast,

[1] For details on the rise and characteristics of the open-source system, see for example Lerner J. - Tirole J. (2002).

patent and patent rights should be clear and crisp on specific and well defined innovations. The experience so far is that the patent system may be unable to fully ensure such limits to the privatization of knowledge, or it cannot prevent confusions and undesired consequences. An enforceable GPL system could then play an important role in an architectural policy with these goals.

However, a central problem is how to enforce the GPL system. Within the communities of software developers it is enforced via reputation and sociological factors. If the system has to spread beyond these communities one needs other sources of enforcements, particularly with respect to agents — and primarily the industrial system — that are not motivated by the same rules. At the same time, we need to understand how a GPL system can be implemented beyond software. As noted, open source is diffusing to other contexts, though the diffusion is slow, as software offers ideal conditions (easy exchange of the programs or communication through the web, established communities of developers, etc.). However, the implementation of the mechanism simply requires that the institution of the GPL (or its variants) is made enforceable through the legal system. In short, the hard task is creating the enforcement. If so, a GPL could apply in principle to software, biotech or any other technology.

2.3 *Management of Intellectual Property, Open Source and Spinoffs*

Companies are increasingly paying attention to the management of intellectual property. This implies greater attention to opportunities of both selling their intellectual property (*e.g.*, Rivette and Kline, 2000) and buying it from others. Since the 1990s this has implied the creation of special units inside the firms for managing licensing (both buy and sell), and more generally it has led to view intellectual property as a strategic asset to manage (*e.g.* Grindley and Teece, 1997).

Interestingly, this has been paralleled by greater attention to open source as well, especially in the information technology and software business. As noted by Lerner and Tirole (2002), tapping into the open-source networks can have advantages for firms: they can access talented programmers, or they can use and improve software programs that are relevant for their purposes, or the distribution of open-source products may increase the demand for complementary products that the firm sells on a proprietary basis.

However, the interesting twist here is that, as shown by Fosfuri *et* al. (2008), companies are more likely to access open source and exchange information openly with open-source communities when they can secure complementary products or technologies with IPR. This is natural as on the one hand they can benefit from open source and at the same time participate in these activities, while on the other hand they remove potential preoccupations about intellectual property that they want instead to keep proprietary.

Finally, companies are increasingly using spinoffs as a means of exploring technological areas that they may want to tap in the future. Most often, they leave a good deal of autonomy to these firms (*e.g.*, Chesbruogh, 2003). When and if these firms become successful they try to establish new relationships with them. In many cases they do not reintegrate these companies when they are successful. They develop links in the form of strategic alliances, licensing or cross-licensing deals, or they keep supporting them by offering complementary assets like downstream production or commercial activities or complementary R&D (*e.g.*, Allen, 1998).

2.4 *Growth in Technology Trade*

A notable trend in recent years is the growth in technology trade among independent parties. This takes the form of licensing, strategic alliances and other forms of collaboration on the production of innovations, which we lump under the general label of technology markets (Arora *et* al., 2001*a*). At the aggregate level, OECD data show that in the G8 countries, from 1980 to 2003, technology royalty payments and receipts have increased by an average annual factor of 10.7%, reaching a volume of about USD 190,000 million in 2003 (OECD, 2006).

The growth of technology trade, and the underlying markets, has some important implications. First, they create efficiency advantages due to the fact that the producer of an innovation is not necessarily the best organization to carry out its further development or commercialization. For example, many innovative ideas come from smaller firms that do not have the proper large scale assets for efficient downstream processes. Technology markets then produce two advantages. First, the producer of technology may be able to gain a higher revenue from licensing the technology *vis-à-vis* developing it internally. For example, the larger scale operations of the technology buyer may produce economies that the upstream technology specialist firm is unable to attain, which produces gains from trade. Second, at the system level, this creates the typical advantages of specialization and division of labor. Smaller firms are most often better environments for producing innovative ideas, while larger firms are relatively more effective in developing them. To the extent that there can be specialization according to comparative advantages, this division of labor between large and small firms in innovation can generate efficiency gains at the system level (*e.g.*, Arrow, 1983).

A related advantage is that when technology markets function properly smaller innovative firms can invest in innovation even if they do not own the downstream assets to carry out the development and commercialization stages. If technology markets did not exist, or they had high transaction costs, small innovative firms would not invest in innovation unless they own the assets for carrying out the full innovation development and commercialization process. But as noted, many small firms may have comparative advantages upstream, without owning such downstream assets. Thus, with no technology markets they will not carry out the investments in innovation in the first place, which reduces the innovation rate of the economy. In addition, innovation is most often an uncertain process, and the development of successful innovations may require exploration of different opportunities. Technology markets enable the upstream technology specialist firms to focus on the upstream investments for innovation. To the extent that this does not require large capital investments upfront, they can then explore innovation opportunities at relatively low risk, as they do not have to sink large assets in the process. By contrast, if the returns from innovation only came from the full integrated investment in both upstream and downstream assets, they would not engage in exploration, as failures entail a larger capital loss. Thus, technology trade produces more exploration.

Technology markets have other advantages. First, many patents are "sleeping" patents, in the sense that they are not exploited economically by the patent owner. There could be many reasons. For instance, research produces internal spillovers. Firms then patent by-products of the main innovations that they seek, even if they do not intend to exploit them. Sometimes, they patent mainly to provide inventors with incentives and recognition. Whatever the reasons, technology trade enables the firms to profit from their sleeping patents, as they can license them to other firms that may instead profit from their economic exploitation. At present, there is evidence that large firms are important reservoirs of sleeping patents that can be licensed (Rivette and Kline, 2000; Gambardella *et* al., 2007). Apart from revenue advantages at the firm level, this raises the rate of exploitation of patents at the system level.

Finally, technology markets can have implications for downstream competition. The presence of specialized technology suppliers, or more generally of firms that are willing to license their technologies, means that downstream firms that do not have upstream technological capabilities can acquire the technology in any case. This raises competition as it favors firms that may not enter the product market because of their inability to produce technologies internally, but that nonetheless have valuable downstream capabilities. Arora *et* al. (2001*b*) show these patterns in the context of the chemical processing industry. By using data on chemical plants in developing countries they show that the domestic producers in the less advanced economies are more likely to invest when there are engineering firms from the First World that license the process technologies. At the same time, multinational firms are not affected by the presence of these technology suppliers, as they are more likely to be able to produce the technologies internally. Thus, when technology suppliers are present, competition downstream increases as inframarginal firms have better opportunities to enter.

2.5 *The Economic Value of Patents*

But what is the economic value of patents or intellectual property more generally? The question is important because in order to set the present discussion in the right perspective we need to understand the orders of magnitude involved.

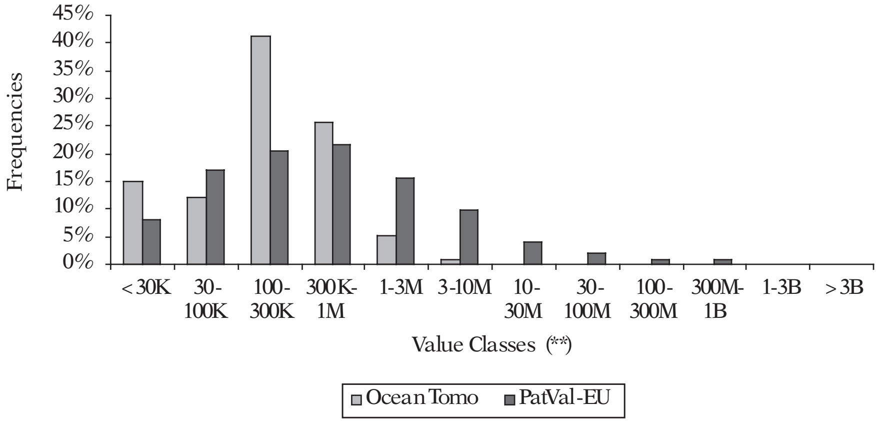
Unfortunately we have little information on the economic value of patents. To be sure, we first need to clarify what we mean by the value of patents. Particularly, we distinguish between the value of a patent as an asset *vs.* the value of the licensing right. The former is the value of the patent when the property of the patent is transferred to the buyer. In this case, the buyer inherits the right to exclude others from using the technology protected by the patent. The latter is the value of the right to use the patent when the suppliers keep the property of the patent. Clearly, the former is higher than the latter.

Today, some information has become available thanks to the disclosure of the prices paid by the licensees of the patent auctions held by a patent intermediating company, Ocean Tomo (*www.oceantomo.com*). In addition, a research on the value of European patents (PatVal-EU) has retrieved information on the value of patents from interviews with the patent inventors (see Giuri *et* al., 2007). Both the Ocean Tomo and PatVal-EU data measure the value of the patent as an asset.

Graph 2 reports the frequency distribution of the Ocean Tomo and PatVal-EU data. The Ocean Tomo data are actual prices, while the PatVal-EU survey asked the inventors to cast the value of the patent in classes, which are the ones used in Graph 2. Another difference is that the Ocean Tomo values refer to lots composed of one or more patents, while PatVal-EU refers to one specific patent. However, most of the Ocean Tomo patents in a lot are "equivalents" of the US patent (which is the focal patent for Ocean Tomo), that is they are the same patent granted by a different

GRAPH 2

FREQUENCY DISTRIBUTION OF PATENT VALUES, PATVAL-EU *VS*. OCEAN TOMO (*)



(*) PatVal-EU and Ocean Tomo estimates based, respectively, on 8220 and 133 observations.
(**) Values in Euro for PatVal-EU, USD for Ocean Tomo.
Source: PatVal-EU and Ocean Tomo (*www.oceantomo.com*)

patent office in a different country. The PatVal-EU patents are European Patent Office (EPO) patents. Since EPO patents cover all the European countries in which the applicant asked for coverage, they can be thought of as including the equivalent patents within Europe. Also, in evaluating the PatVal-EU patents, inventors probably had in mind the full set of equivalent and complementary patents protecting a given invention. The difference between Ocean Tomo's patent lots and PatVal-EU individual patents may then not be that critical. Finally, the value classes in PatVal-EU are in euro, while the Ocean Tomo data are in US dollars. Since there is only primitive information on patent values, and even discussing orders of magnitude is informative, we treat Euros and dollars at 1:1.

There are some differences between the two distributions. The frequency distribution of the Ocean Tomo values is more volatile. This is expected as actual transactions are affected by factors and sources of heterogeneity (*e.g.*, in the bargaining process, in the actual evaluation of the patent) that do not affect an expectation of the patent value as formulated by the inventors. Moreover, the Ocean Tomo distribution is based only on 133 observations *vs.* 8220 PatVal-EU patents. With fewer observations one can only expect a more volatile picture. But the most important difference is probably that there are PatVal-EU responses in the very right tail of the distribution, and not for Ocean Tomo. We also compared the two distributions by only looking at the PatVal-EU patents that were licensed to account for the fact that very valuable patents may not be licensed. We still find some PatVal-EU patents in the very right tail of the distribution. While this stems in part from the fact that inventors may exaggerate the assessment of their patents, it can also stem from the far fewer observations of the Ocean Tomo distribution. With asymmetric distributions, values in the right tail are rare, and hence they can only be observed when the sample is large. Moreover, the Ocean Tomo patents are typically in electronics and information technology. Unlike PatVal-EU, they exclude for example the pharmaceutical patents, some of which can be very valuable. All in all, while I think that the subjective assessment of the inventors may shift the PatVal-EU distribution to the right compared to the true distribution of patent values, the Ocean Tomo distribution may not make justice of the fact that some patents can fall in the very right tail.

As shown in Gambardella *et* al. (2008), after controlling for some upward bias of the PatVal-EU patent distribution, the mean of the PatVal-EU patents is about 3 million Euros. Gambardella *et* al. (2008) note that the German inventors are likely to make more precise estimates of the value of their patents. This is because the German Inventor Compensation Act establishes that inventors are to be compensated by their employers for their patented inventions in relation to the value of the patent (Harhoff and Hoisl, 2007). Thus, they are probably aware of some actual estimate of the value of patents. Regressions in Gambardella *et* al. (2008) find that other things being equal a dummy for German inventors reduces the value of the patent to about 43%. This measure was applied as a rule of thumb to obtain the mean of 3 million euro discussed above.

Gambardella *et* al. (2008) also estimate that the median of the PatVal-EU distribution is 380K Euros and the mode is 6K Euros. These are typical parameters of very asymmetric distributions (very high mean, high median, low mode). By contrast, the mean of the Ocean Tomo patents is only 300K dollars, and its median is 165K. It is interesting because the two medians are similar, while the difference between the two means clearly depends on the fact that the Ocean Tomo distribution does not exhibit a long right tail, which in asymmetric distributions is the main culprit for the high mean. Previous literature estimated skewed distributions of patent values, more similar to PatVal-EU than Ocean Tomo (*e.g.*, Scherer and Harhoff, 2000). This suggests that, even though the inventors may give inflated responses, the true mean of the distribution of patent values is probably between that of Ocean Tomo and PatVal-EU since Ocean Tomo does not take into account the possibility of a long right tail. Be that as may, the bottom line of this discussion is that patent values can be significant, even though they are quite skewed, with many patents that are not worth much, and a few that are worth a lot.

2.6 *Reform of the Patent and IPR System*

To conclude our discussion, today there is a considerable debate on reforming the patent- and IPR-system more generally. This is prompted by some of the problems discussed earlier, as well as by the recognition that, as shown in the previous section, the economic values involved may not be trivial.

The reform of the patent system hinges on some key issues. How to limit blocking and strategic patenting? How to increase patenting for genuine reasons (*e.g.*, by smaller firms, or to enhance markets for technology)? Some discussions suggest the use of renewal fees or other instruments to create different incentives to patent, and particularly to discriminate between good and bad intensions for patenting (*e.g.*, François and Van Potellsberghe, 2009). As noted earlier, there is a growing discussion on how to extend and perfect the European opposition system, including a discussion about its introduction in the US, to reduce the extent of post-grant patent litigations and to create more diffused mechanisms for checking the grant of patents (see, *e.g.*, Gambardella, 2005; Hall, 2007). Finally, an important issue is how to reduce the burden of examination of the patent offices in light of the acceleration of patent applications. One question is whether increases in the resources of the patent offices may produce higher quality evaluations because of the lower number of applications to be evaluated *per* examiner. There is evidence that the problem may be more severe in the US than in the European Patent Office, where the number of examiners *per* patent is higher (Guellec and Van Pottelsberghe, 2007).

Another question regards the exemptions to patent infringements. As noted, some fields are flooded with patents, which makes it hard to launch a new project without infringing some right. This may forestall innovation because of the risks of infringement when starting a new research. The problem is especially severe for academic and scientific research. A system of exemptions from patent infringement could allow research conducted for non-commercial reasons — particularly academic research — not to be liable when it is clearly conducted for scientific purposes or broadly defined goals.

Of course, this is an area where an open-source system hinging on the GPL can help. The GPL system cannot do much if the field is already filled with patents. In this case, policy has to act through the research exemptions to open up the field. When the soil is more virgin, a combination of GPL and patents offer the possibility of privatizing some innovations, while leaving entire trajectories, and thus parts of the field, public. As discussed earlier, the ideal outcome is that narrow innovations are protected by clear and crisp patents, while more general fields and outputs are left public. This is clearly easier to say than to do. But policy should create the right institutions and conditions to get as close as possible to this goal.

At the same time, to achieve this objective it is crucial that policy finds ways to ensure the enforcement of the GPL. This is a serious problem. In the US patents are strongly enforced in courts. In Europe patent enforcement is weakened by the fragmentation of national patent jurisdictions. While some countries may have stronger enforcements (*e.g.*, Germany), the need to enforce patents through separate interventions in the other countries not only means that the costs of enforcement can be high, but also that there may be different outcomes according to the positions of the different countries or courts. In the emerging economies the enforcement of patents is even weaker. All these problems are more severe in the case of the GPL. Being a new institution, there is no tradition of enforcing it in courts. There is evidence that this is changing, though the change is not yet widespread. As noted earlier, the possibility of enforcing the GPL in courts is the only way to diffuse this institution beyond the set of communities that abide by it for sociological or other reasons, and to make it a proper instrument of a broader policy for the development and diffusion of knowledge. Once this step is made, the GPL can become an institution that enforces public knowledge, and contributes to a policy architecture that balances the different forces that push for public or private knowledge. The combination of IPR and open source is probably the most important challenge of a policy for knowledge in the next few years.

3. - Implications for Italy

The Italian system is at the margin of the international debate on IPR, open source and the economics of knowledge more generally. First and foremost, Table 1 shows that in Italy the number of patents *per* millions of inhabitants is well lower than other advanced countries. There has been an upward trend since the mid-1990s. However, the Italian acceleration has been roughly similar to the other advanced nations, with the result that there is no catching up, in spite of the fact that Italy starts from a lower basis of patents.

At the same time, while there is no systematic data on the matter, Italy shows a good deal of activity in open source. Apparently, there are a fair number of software communities, and

TABLE 1

EPO PATENTS PER MILLION INHABITANTS

Countries	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
EU (27 countries)	62.5	65.5	75.3	84.9	93.8	101.4	106.1	104.7	103.0	104.9	108.4
Denmark	92.5	95.2	117.4	116.4	146.1	157.9	175.5	166.3	170.1	184.6	181.1
Germany	154.2	160.5	190.6	213.2	239.8	255.8	268.0	263.8	259.0	261.1	270.5
Spain	10.0	9.9	10.8	14.7	15.9	18.4	19.7	21.2	22.5	22.2	27.0
France	84.4	86.7	92.8	104.1	114.6	119.4	119.8	118.7	118.5	125.9	130.2
Italy	41.1	43.7	50.4	55.1	59.7	65.4	70.0	69.4	72.6	74.8	77.0
Hungary	4.3	5.3	5.8	7.5	5.6	11.3	11.8	9.5	11.7	12.4	14.4
Netherlands	99.6	113.5	135.7	152.1	167.2	185.6	215.5	240.4	210.7	210.0	215.7
Finland	134.7	139.8	162.2	198.1	228.7	271.9	269.4	262.3	237.7	239.7	253.4
Sweden	153.2	172.6	204.3	230.0	235.2	247.4	256.1	234.2	221.2	217.3	236.4
United Kingdom	63.4	65.7	72.1	78.3	88.0	97.7	100.6	93.4	90.9	89.4	86.1
Norway	42.6	54.9	61.6	70.5	74.0	83.4	88.2	78.1	82.4	74.0	79.1
Switzerland	247.8	241.5	266.0	302.3	339.6	346.3	376.1	381.1	358.7	367.4	394.2
United States	75.2	83.0	85.9	96.3	105.0	110.4	108.0	103.8	105.7	106.4	108.8
Japan	87.8	99.9	113.3	121.8	127.2	146.2	168.4	153.3	154.7	162.9	168.8
Canada	24.7	28.2	30.5	40.8	46.1	51.8	52.6	53.0	54.1	55.6	64.2

Source: EUROSTAT.

there is attention to open source, including demand of open-source systems from the Public Administration. The Italian system may then be better positioned than other countries, *e.g.*, the US or other European countries, to combine IPR and open source in an architectural policy framework, as discussed in the previous sections. In fact, Italy may face a problem opposite to the US, Germany or Japan. In these countries, relatively strong IPR may produce an excessive privatization of knowledge, along with the problems of strategic patents and the other limitations discussed earlier. By contrast, in Italy a disproportionate attention to open source, or a strong push from the open-source communities, which can be quite ideological on these matters, may lead to an excessive extension of public knowledge. Even IPR on relatively narrow and genuinely patentable innovations may become hard to obtain or to enforce. As noted in the previous section, the broad policy solution is to allow for crisp and clear patents on well defined innovations, while keeping the more generic knowledge public. The lack of patenting opportunities for specific innovations may forestall the markets for technology, technological exploration, the division of innovative labor, and all the potential benefits associated with a well functioning IPR system.

The PatVal-EU survey offers the opportunity to dig into the characteristics of the invention process in Italy. PatVal-EU surveyed the first inventor, or other inventors if the first one could not be found, listed in nearly 10,000 patents with priority date 1993-1997 applied to the European Patent Office (EPO). The Italian patents (first inventor located in Italy) are 1,250. By the same criterion, the other patents are from Denmark, France, Germany, Hungary, the Netherlands, Spain, and the UK. The PatVal-EU distribution of patents by country reflects the country distribution in the universe of EPO patents (see Giuri *et* al., 2007, for details). Table 2 summarizes the similarities and differences between Italy and the other PatVal-EU European countries discussed below.[2]

[2] Unless stated otherwise, the data discussed below can be found in the Final PatVal-EU Report, which is cited in Giuri P. *et al.* (2007), and downloadable at *www.alfonsogambardella.it/PATVALFinalReport.pdf*. Both Giuri P. *et al.* (2007) and

TABLE 2

ITALIAN INVENTORS AND INVENTION PROCESSES, SIMILARITIES AND DIFFERENCES WITH OTHER EUROPEAN COUNTRIES FROM THE PATVAL-EU RESEARCH

Similarities	Differences
– Gender, age profile and motivation of inventors – Economic value of patents – Rate of economic utilization of patents – Share of patents used to create new firms	– Lower education of Italian inventors and higher share employed in small-medium firms – Fewer external interactions of Italian inventors in the invention process – Italian inventions less likely to be the outcome of planned R&D activities – The previous two points suggest lack of attention to management of innovation and intellectual property – Less developed technology markets

Source: PATVAL-EU (final report and GIURI P. *et* AL., 2007).

PatVal-EU finds that the Italian inventors are not different from the inventors of the other countries in terms of gender, age profile, and motivations. The typical inventor is male (more than 90%) and between 40 and 50 years old. He is motivated in part by monetary goals, but largely also by the satisfaction to solve technical problems, by reputation, and by the possibility of advancing knowledge and technologies. In this respect, the motivations of the inventors listed in the European patents look more similar to academic scientists than to company managers. PatVal-EU also finds that the average and median inventor response about the economic value of their patents is not different from the other countries. Since there are no reasons to believe that the vagaries of these estimates differ across countries (apart

the Final PatVal-EU report do not include the data on Denmark and Hungary, which were added at a later stage. The content of the discussion below does not change when we take into account the data for Denmark and Hungary.

from Germany, see earlier), the Italian patents seem to be in line with the values of other European countries. PatVal-EU also finds that only two-thirds of the patents are used for some specific economic or industrial purposes (internally, licensing, or else). Again, the Italian share is not different from the other countries, which suggests that Italy is not relatively less active in making use of its patents.

Finally, about 5% of the surveyed PatVal-EU patents are used to create new firms. This can be thought of as a proxy for the degree of technological entrepreneurship. The PatVal-EU data show clearly that there is a UK-model, where almost 10% of the patents are used to form new firms, and a German model, where less then 3% of the patents are employed for this purpose. This reflects a well known difference between the two models of capitalism (*e.g.*, Hall and Soskice, 2001). Innovation mirrors this pattern, viz. the UK is a more conducive environment for technological entrepreneurship, whereas in Germany technological opportunities are pursued mostly within established firms. Italy lays between these two models, with a fair share of new companies from patents, almost 6%. This suggests that the well known entrepreneurial spirit of the Italian traditional sectors does not disappear in technology-based activities. Given the importance of new firm creation for economic growth, this is an interesting signal about our country that is worth understanding further.

At the same time, there are differences between Italy and the other European countries. First, the PatVal-EU data indicate that the Italian inventors differ from the inventors in the other European countries in two dimensions: *a)* lower share of inventors holding a PhD or university education; *b)* higher share of inventors in small-medium firms. This reflects structural features of the Italian system. The share of Italian population with a tertiary degree is lower than other advanced countries, let alone the share of PhDs, and the Italian industry structure exhibits a relatively high presence of small and medium enterprises. These characteristics also affect the innovation process.

A second set of differences regards the invention activity. According to the PatVal-EU data, Italy shows less intensive collaborations at the inventor level. First, there is a lower share of patents in which at least one co-inventor listed in the patent is employed in other organizations. Second, the interactions with people other than the co-inventors are less important than in the other countries. Third, external sources of knowledge for the innovation (universities, customers, etc.) are less important in Italy then elsewhere. Since we are dealing with patented innovations, these findings may not extend to innovations that are not patented, which are important in the Italian system. This may explain the puzzle, as Italian firms are known for being active in their interactions with customers, suppliers, or networks of external parties, often inside industrial districts or local territories. Patented innovations can be different, as they depend on more formal innovation processes within structured organizations. In the case of patented innovations Italy may not abide as much as other countries by the rules of "open innovation".

This result may be combined with the earlier ones that inventors are relatively less educated and operate in smaller firms. This suggests that, compared to other European countries, Italian innovations are to a greater extent the result of individual efforts or those of small groups within firm boundaries. An old study by Gibbons and Johnston (1974) shows that employees with university education are more open to relationships outside their firms. This view of the Italian inventors being part of small closed groups within firm boundaries is reinforced by another PatVal-EU finding. Compared to the other European countries, fewer inventions in Italy are the outcomes of targeted and planned R&D projects, and they are more likely to be by-products of research aimed at other goals, or of non-research activities, or they are the result of pure inspiration or creativity. This may reflect differences in the industrial composition across countries. In Italy there may be a larger share of industries where pure creativity or less-intensive R&D processes are more important. Yet, this is also consistent with the previous results. The relatively lower importance of formal R&D processes means that inventors do not deliberately plan relationships with outside parties, which are often organized as part of formal R&D activities. Similarly, formal

R&D processes are more likely to occur in larger firms, which typically hire employees with university degrees or PhDs.

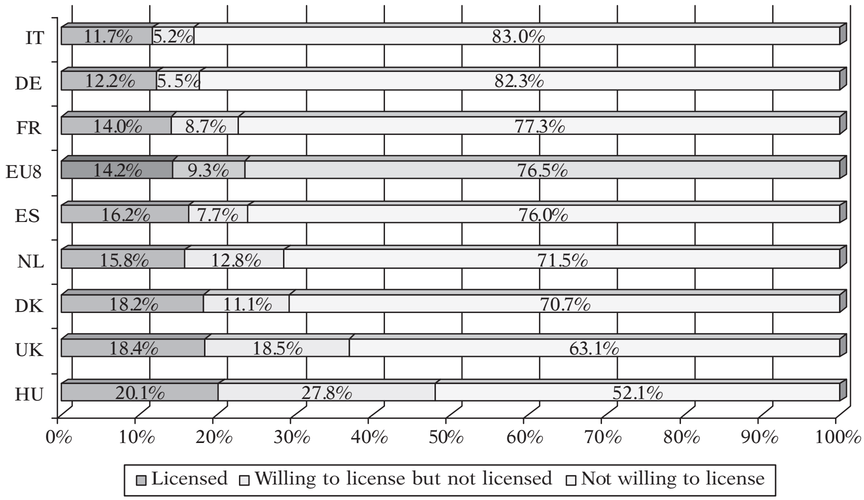
In sum, open innovation needs planning, and the conclusion that R&D in Italian firms does not appear to be planned as much as in other countries, may explain why open innovation is less advanced than elsewhere. These results also suggest that in Italian firms the management of IPR (including licensing strategies), let alone an effective combination of IPR and open source, is probably still at a primitive stage. This is also consistent with a final result of the PatVal-EU survey that we want to discuss here. One of the PatVal-EU questions asked whether the firm was willing to license the patent in question, and if so whether the patent was actually licensed or not. This offers a picture of the willingness to license as well as of the effective licensing of patents. Gambardella *et* al. (2007) study these processes through a detailed econometric exercise, and discuss the determinants of both the willingness to license and actual licensing.

Here we show instead the country shares of licensed patents and of the patents that the firms are willing to license. They are in Graph 3. The Graph corroborates our earlier remark about the UK *vs*. German model. In the UK firms are willing to license more than one-third of the patents, with about half of them actually licensed. In Germany, the share is half of the UK share. This suggests that in Germany patents are more likely to be exploited internally by the firm that owns them, while in the UK one is more likely to observe an open model in which patents are licensed to others in technology markets. Note also that compared to Germany, in the UK there is a higher share of patents that the firms are willing to license but that are not licensed. This suggests that in Germany licensing is itself part of a more deliberate and planned strategy, and thus firms are more likely to end up licensing if they decide to do so. By contrast, the UK is more likely to feature potential technology suppliers that hinge on licensing business models, and this prompts them to be more explorative in their search for potential licensees.

The other countries range between the UK and the German model. In particular, Italy and France are closer to the German

GRAPH 3

TECHNOLOGY MARKETS IN EUROPE



Source: PATVAL-EU.

shares. Though it has few patents, Hungary is largely betting on licensing. Italy has the lowest shares of patent licensed. In part, this may stem from the fact that it may be closer to the German or Continental European model. In part, however, this may stem from our earlier remarks. There is less intentionality in the Italian invention process. Particularly, there is less planning of inventions than in other economies, and this includes little attention to patent licensing (whether in or out) as a profitable opportunity. Thus, technology markets in Italy are underdeveloped. Similarly, this provides evidence of the lack of attention to the management of intellectual property. As noted, the formation of specialized units for managing intellectual property entails strategic attention on what should be patented and how, as well as on the uses of patents. Apart from internal use, this includes licensing out as a source of revenue or for other purposes (see, *e.g.,* Lichtenthaler, 2007), and licensing in. In sum, the weak market for technology in Italy may reflects this limited focus on intellectual property and the need for raising managerial attention on this matter.

4. - Conclusions

This paper has tried to discuss trends and opportunities associated with the rise of IPR, the combination of IPR and open source, and the management of intellectual property and of knowledge more generally.

The diagnosis of the Italian system suggests that Italy, which has fewer patents than other advanced economies, is not part of the international debate on IPR and related institutions, and the Italian firms are not active in the management of their intellectual property. There are clearly exceptions, both at the level of firms and policy institutions. Also, some Italian open-source communities are active internationally. Yet, by and large, Italy as a system does not seem to be well entrenched into the debate about the institutions and the management of knowledge assets. One remark of this paper is that the Italian system is less active in pursuing open innovation opportunities, as implied by the fact the inventors of the Italian patents show fewer external interactions in the invention process, and by the primitive stages of the Italian market for technology.

Therapies are hard to design, and in this respect the purpose of this paper may simply be to flag that Italian firms should start investing in the management of their intellectual assets, including a greater strategic focus on licensing in and out, the creation of spinoffs, or technology-based alliances. For policy institutions, we need greater participation in the international debate that is shaping the institutions for knowledge of the XXI century.

Two specific remarks can serve as a conclusion. The first one is a proposal to launch an Italian Inventor Compensation Act like in Germany. The German Act compensates inventors for their patented inventions according to the returns that the invention produces for the employers. According to Hoisl and Harhooff (2007), it has pros and cons. Thus, one has to take the German experience into account. Yet, the Act could motivate Italian employees to pay greater attention to the innovation processes, to launch and disclose new ideas, and other such factors. Given that in the end this amounts to rewarding people in relation to the value of their invention, one can think of it as a mechanism for creating spinoffs based on ideas, or for sponsoring ideas whose costs are incurred only if the idea is potentially successful. Today, many leading companies worldwide have launched programs to encourage the inventiveness of their employees (*e.g.*, Shell). Moreover, Gambardella *et* al. (2008) show that the two major determinants of the value of patented inventions are the resources invested in the process and the talent and experience of the inventors. Encouraging these talents can then be a major opportunity for stimulating the Italian innovation system.

The second remark is that, as noted earlier in this paper, Italy is in a good position to propose an institutional model that balances the forces that push for private or public knowledge. The country could design a system in which both IPR and GPL are enforced. The aim is an architectural policy in which narrower innovations are patented, and more generic knowledge remains public. As noted, other countries - and the US in particular - have gone too much in the direction of privatizing knowledge. Today there is discussion about the undesired consequences of this process, and about the remedies to problems like strategic patenting or trolls. A similar debate is in course in Europe. Since Italy is greenfield in this area, it could test a model in which different elements are combined, and policy goals are defined according to the different benefits of privatizing knowledge *vs*. keeping it public. Italy could then contribute to the international debate both with practical experience within the country, and by proposing new mechanisms and policy instruments. This can have far-reaching implications for firm management, industry structure, and ultimately for economic growth.

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