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EUROPEAN PATENTING AND THE SIZE OF INVENTORS*

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Abstract

This paper presents the results of a survey on a regional sample of Italian inventors who, over the period 1991-2005, have submitted patent applications to the European Patent Office. The inventors' features and patenting activities are mainly examined according to the size of the firms they are working in. Compared to those coming from medium-large companies, 'small inventors' (encompassing employees or owners of small firms and independent inventors) have a lower educational level, ascribe less importance to codified sources of knowledge and are less productive in terms of patent applications. However, by using forward citations and other indicators, it emerges that there is no difference in the average quality of patented inventions of the two groups. Nevertheless, one third of small inventors evaluates negatively its patenting experience, while it is true for only a tiny fraction of larger patentees. On the basis of further interviews, we find that the inventors' assessments are particularly influenced by their different capabilities to enforce intellectual property rights.

Keywords: Inventors; European patents; Firm size; Patent quality; Intellectual property rights.

JEL Codes: O31; O34; L20.

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"If one patent is taken out, it is often necessary to "block" it, by patenting other methods of arriving at the same result; the patentee does not expect to use them himself, but he wants to prevent other from using them. All this involves worry and loss of time and money: and the large manufacturer prefers to keep his improvements to himself and get what benefits he can by using it. While if the small manufacturer takes out a patent, he is likely to be harassed by infringements: and even though he may win "with costs" the actions in which he tries to defend himself, he is sure to be ruined by them if they are numerous."
Alfred Marshall, *Principles of Economics* (1961 edition), Book IV, Chapter XI, footnote 1, p. 281.

"But yet every expansion in the general scale of an industry is likely to increase in some directions the advantage which an inventor who is also a capitalist, has over one whose means are narrow [It is true that, when an invention is complete, and a patent has been obtained for it, it may be sold, or taken up on some sharing plan, by a capitalist. But he is generally in a position to get the best of such a bargain]."
Alfred Marshall, *Industry and Trade*, Book II, Chapter IV, 1, p. 244 (footnote 1 included in squared brackets).

1. Introduction

A patent system should provide effective protection to valuable inventions, no matter the features of inventors or patentees. However, as stressed by some studies concerned with the US, the post-grant costs of patent protection reduce the small firms' propensity to invent. This paper aims at shedding some light on the role played by the size of inventors' firms in Europe. Although more robust evidence is provided for the impact of size on the number and quality of patents, we also try to asses to what extent European 'small inventors' are hampered by similar obstacles.

Our findings derive from a survey on Italian inventors - residing in the Marche region - who, over the period 1991-2005, have submitted patent applications to the European Patent Office (EPO). Small inventors (composed of the dependent workers or owners of small firms plus independent inventors) are found to be significantly different from those working in medium-sized and large companies: the former have a lower level of education, attribute a lower importance to codified sources of knowledge and are less productive in terms of patent applications. However, between the two groups, the average quality of patented inventions (proxied by forward citations and other indicators) is not different. In spite of that, one third of small inventors evaluates negatively its patenting experience while only a tiny fraction of larger patentees signals a similar discontent. On the basis of further interviews, we find that the inventors' assessments are particularly influenced by their different capabilities to enforce intellectual property rights.

The asymmetries in favour of large European companies should be substantially mitigated by the forthcoming London Agreement and, above all, the European Patent Litigation Agreement aimed at reducing, respectively, the translation costs required to validate EPO patents in specific countries and those associated with their legal enforcement. In the meantime, public subsides to sustain the patenting activities of small and medium-sized firms should be intensified.

The paper is structured as follows. Section 2 reviews the literature on the relationship between the size of inventors and the extent of patenting and patent protection. Section 3 illustrates the main features of Marche as compared to the most developed regions of the EU. Section 4 describes the population and sample of the Marche inventors. Section 5 compares their characteristics with those in the PatVal-EU survey that covers more than 9000 European inventors. Section 6 examines the features and patenting performances (both in terms of quantity and quality) of the Marche inventors distinguished according to their size. Section 7 analyses how the inventors of different size evaluate their patenting experiences; moreover, the findings of ten case studies concerned with very discontented and very satisfied inventors are presented. Finally, the changes in the European patent system and the policy interventions needed to sustain the patenting activity of small companies are discussed in section 8.

2. Patenting and patent enforcement by firm size

The patent system and, more generally, the protection of Intellectual Property Rights (IPRs) are mainly justified by the presence of positive externalities in the production of new ideas. (Nordhaus, 1969). Without the incentive of gaining a limited and temporary monopolistic position, private subjects and organizations will reduce inventive efforts (such as, costly R&D activities) and the overall rate of technological change - probably the main engine of economic progress in a market economy – will fall. The need of protection (such as the possibility to exclude others from using new products, processes and devices that have been patented) should apply to all the relevant inventions no matter who the inventors are. However, there are many reasons to protect small inventive firms and independent inventors. First, it is more difficult for them to rely on other forms of protection suitable for large established firms, such as first mover advantages, cumulativeness of technical change and learning economies. Secondly, due to the inherent financial constraints, it is harder for a small inventor to manufacture an entirely new product and, above all, find the market for it. The alternative is to sell or license the invention to a larger counterpart, but this can be done only in presence of an IPR that cannot be easily circumvented or infringed. Third, looking at the important innovations introduced in the US during the twentieth century, it emerges that many revolutionary breakthroughs originated from small firms and independent inventors: this finding, already emphasised by Jewek, Sawers and Stillerman (1958) in their seminal book, has been recently restated by Baumol (2004)[1]. As a consequence, in terms of innovation and growth policies, an effective protection of small inventors should be taken as a strong priority.

Unfortunately, the current system of IPRs protection is going in the opposite direction, i.e. the same highlighted by Alfred Marshall more than a century ago. This is what arises from a number of empirical studies concerned with patent litigation in the US. Within this strand of literature, one of the first contributions is by Lerner (1995) who showed that small firms do not invest in areas in which the threat of litigation from larger firms is higher. In the same vein, Lerner and Lanjouw (2001) find that the use of preliminary injunctions by large firms discourages small inventors. Merging the data from US district courts with that of the United States Patent and Trademark Office

[1] In the same chapter of *Industry and Trade* (from which the second beginning quote was taken), Marshall describes the assembly line of the Ford motor company and observes that "[…] the method is likely to put a large part of the industries that are most characteristic of the modern age, almost exclusively under the control of giant business. It is however relevant to note that Mr Ford himself began business on a small scale" (Marshall, 1919; p. 238). According to the US Small Business Administration, the assembly line is one the major innovations of the twentieth century introduced by US small firms (along with, for instance, personal, portable, large and super computers, vacuum tube, integrated circuit, microprocessor and DNA fingerprint; cf. Baumol, 2004).

(USPTO), Lanjow and Shankermann (2001) examine the subsequent phases of the legal protection path and highlight the high cost of engaging in a patent suit as a powerful disincentive to innovate. Moreover, by linking the patent features with the risk of litigation, these authors find that there are two types of patentees overexposed to litigation threats: small firms and independent inventors with patents in new or high-tech sectors. Lanjouw and Shankermann (2004) calculate the probability of litigation by firms' typology. They show that the overexposed patents are those of firms with a relatively undersized patent portfolio, i.e. with a limit ability to prevent legal disputes either by recurring to cross-licensing or credible threats of retaliation. These patent holders are usually small firms and independent inventors rather than large listed companies.

Is the uneven system of IPRs protection a peculiar feature of the United States? Unfortunately, lack of data does not permit to test whether European small inventors face the same disadvantages as their US counterparts. In fact, thanks to the unique jurisdictional system of Federal Courts, data on the extent, duration and outcomes of patent litigations have been extensively collected and examined only in the United States. Similar information cannot be found for European patents for the simple reason that each country, albeit adhering to the European Patent Convention, has its own jurisdiction. Thus, at present, the verdict of, say, a German court on a litigated patent can be reversed by a French or British court and national databases will be of little use. Aside from the data issue, a system of multiple jurisdictions implies that a single patent granted by the EPO can be challenged in different states or to fight infringements the inventor has to file multiple lawsuits. For both kinds of litigation there is no certainty that the outcomes will be similar. As a consequence, it is reasonable to assume that, for small inventors, the potential costs of patent litigation are much higher in Europe than in the United States.

Empirical studies on European patents have been limited to analyse the probability of an EPO opposition (Haroff and Reitzig, 2004) with a parallel analysis for USPTO re-examinations (Graham et al., 2002). The common findings are that the opposition's probability is not significantly affected by the inventor status (i.e., independent patent holders versus companies) while it varies across technological fields. Moreover, together with other features, it depends positively on the quality of patents (proxied by forward citations). The results concerned with the size of patent portfolios are mixed, so that there is not clear evidence that the patents held by small inventors are more likely to be opposed.

However, the above conclusions refer exclusively to the last phase of the EPO granting process, while nothing can be said on the legal disputes that European patentees had to cope with. According to the experience of a limited number of inventors, this paper attempts to shed some light also on these issues by stressing that litigation threats and infringements can start well before a

patent is ultimately granted. This may discourage small inventors up the point of withdrawing their applications. In terms of individual economic rationality such a choice can be extremely wise but, from a social point of view, the economic consequences of many choices of this kind are extremely negative.

Along with the effectiveness of patent protection, the size of firms also influences the very motives to patent. The dramatic surge of patenting activities experienced during the last fifteen years is due a variety of causes, such as the emergence of new fields of technology (Kortum and Lerner, 1999), less rigorous examination procedures and a jurisdiction more favourable to patent holders no matter the value of their inventions (Jaffe and Lerner, 2004). However, a more convincing explanation has to do with the mounting role of strategic patenting (Hall and Ziedonis, 2001). Firms tend to patent a wide range of new technical solutions not with a view to exploit them internally, but for blocking competitors as well as for avoiding to be blocked by them (Bureth et al. 2005; Blind et al., 2006). In the second case (defensive blockade), the ultimate aim may be that of preventing patent litigations (by means of credible threats of retaliation), favouring cross-licensing agreements with competitors and improving the contractual power of the company. To be effective, strategic patenting requires large patent portfolios and, accordingly, its use should increase with the companies' size.

The above hypothesis is confirmed by the findings of the PatVal-EU survey (Giuri et al., 2007) on the European inventors who contributed to 9017 patents granted by the EPO from 1993 to 1997. By looking at the patent use, it emerges that almost 22% of the patents held by large firms (with more than 249 employees) has been exploited for strategic reasons (i.e. to block competitors) while the same occurs to less than 10% of the patents held by small companies (with fewer than 100 employees). The internal use is mainly signalled by medium-sized firms (but the differences between size classes are modest) while the share of small firms' patents used for licensing (15%) is three times higher than that reported by larger companies. The latter finding (confirmed by Gambardella et al., 2007) supports the idea that for small firms it is often more convenient to commercialise their inventions rather than exploit them internally.

It should be stressed that the PatVal-EU is the first comprehensive survey on European inventors. Accordingly, this paper will make an extensive use of it as a sort of benchmark. A prosecution of the above survey has been performed by Mariani and Romanelli (2007) who considered 793 European inventors contributing to 4376 patens granted or applied to the EPO over the period 1988-1998. Providing additional and useful information on both the inventors' features and the quantity and quality of their patents, also the findings of this study will be employed for comparative purposes. One important result of Mariani and Romanelli is that the productivity of

inventors (in terms of number of patents) is significantly affected by individual and firms' characteristics - including company size - while the quality of their patents (measured through a composite indicator) is not correlated with any of the above factors. Thus, the average quality of the few patents (or patent applications) usually held by small inventors is not significantly different form that of very 'productive' inventors who, very often, are employed in large companies. The relevant finding that the inventions coming from independent inventors or employees/owners of small firms are not less valuable than those of their larger counterparts is confirmed by our survey concerned with the inventors residing in the Marche region of Italy. Before describing the survey's features and results, a brief characterisation of this region is provided in the next section, also for showing that our findings could be extended (albeit with caution) to other European regions with similar features

3. The Marche in the EU context

The Marche region is located in the east side of Central Italy, hosts 1.48 million people and, compared to other European regions, has a low patent propensity: in 2002, 55 EPO applications per million inhabitants were recorded in the region while the figures for Italy and the whole EU15 were, respectively, 75 and 160[2]. In spite of its low performance in terms of international patenting, Marche has a per capita GDP equal or higher than 75% of the EU25 average and, accordingly, is currently classified by the European Commission as a relatively developed region. Table 1 reports some indicators for 164 NUTSII regions of the EU15 which, on the basis of the above criterion, can be defined as 'developed'.

By jointly considering the intensity of EPO applications, the employment share in manufacturing and the per capita GDP, three groups of regions can be distinguished. The first is composed of 12 regions only, characterized by a very low propensity to patent, a lower GDP and a presence of manufacturing employment far below the average. The third group includes the large majority of developed regions (125) which record above average figures for EPO applications and per capita GDP while they are slightly below the average in terms of manufacturing employment. The intermediate group is composed of 27 regions and comprises Marche (see, for the list of included regions, table A.1 in the appendix). Both the share of EPO applications and the per capita GDP are below the average but the patenting performance is much worse. At the same time, these 'intermediate' regions share the common feature of having an above average percentage of people employed in manufacturing. To be stressed is that this strong presence of manufacturing activities is concentrated in low and medium-tech industries, as witnessed by the below average share of

manufacturing employment attributable to high-tech industries (half of that recorded by the third group of more advanced regions). This pattern of specialization contributes to explain the relatively low level of patenting activities performed by these regions.

Table 1 – Patenting activities and other economic indicators for the developed regions of the EU15

	Very low patenting regions with a below-average manufacturing presence (1)	Low patenting regions with an above-average manufacturing presence (2)	High patenting regions with a manufacturing presence on the average (3)	Total	Marche [included in group (2)]
Number of EU15 developed regions	12	27	125	164	
Share of total EPO applications of developed regions (1995-2000)	0.18	7.55	92.28	100.00	0.16
EPO applications per million inhabitants (1995-2000)	7.30	62.43	188.02	157.24	52.27
Share of employment in manufacturing (2000-03)	13.45	24.56	19.23	20.02	33.79
Share. of manufacturing employment in high-tech industries (1995-2003)	3.64	4.32	8.89	7.69	2.37
Per capita GDP in PPS (2000-02)	19530	21146	25196	24210	22423
Share of EU15 population (2000-02)	3.11	15.48	62.86	81.46	0.39

The above explanation applies to a greater extent to the Marche region since it ranks first in terms of manufacturing employment while recording a very low presence of high-tech industries (cf. table A.1). To be added is that this sectoral specialization is coupled with a strong presence of small firms. As a consequence, this region is particularly suitable for analyzing the international patenting activities of 'small' inventors. Although regional data on the average size of manufacturing firms are not available, one can reasonably assume that the prevalence of small firms (and inventors) is shared by the other intermediate regions of Europe. Accordingly, such a feature can be taken as an additional (structural) factor responsible for their low propensity to patent.

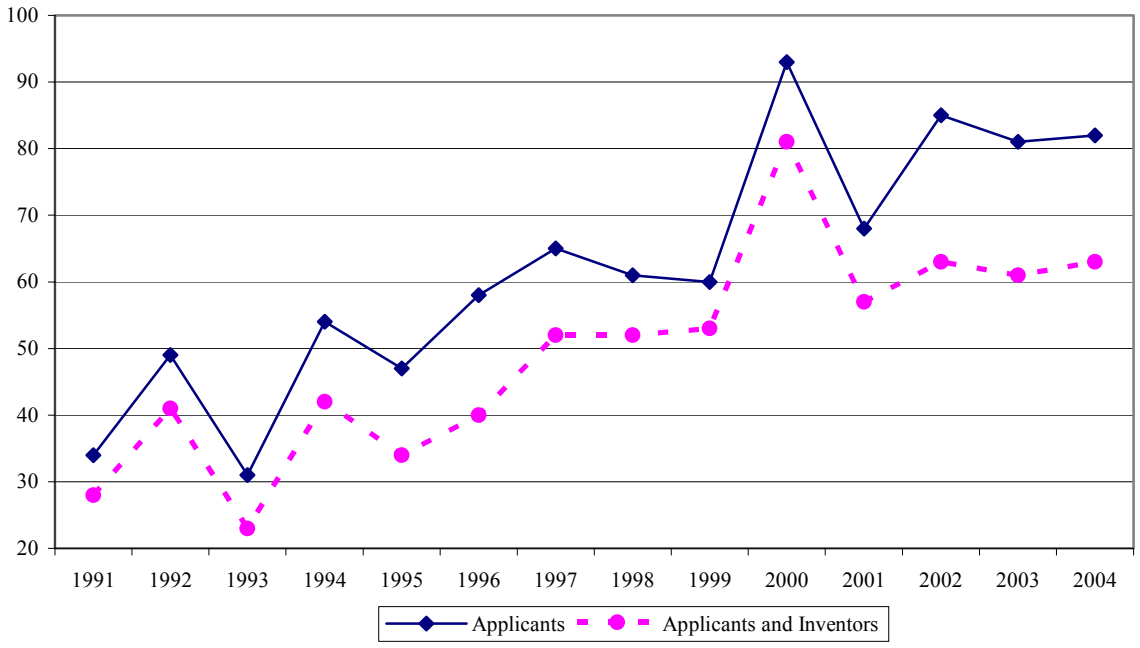
As a final remark, it must be stressed that the low patenting regions of the EU that can be assimilated to Marche account for only 7.6% of the EPO applications attributable to developed regions but their share of the entire EU15 population amounts to 15.5%. Thus, as far as Marche provides a good representation of the inventive activities performed by the group of intermediate

[2] An analysis of EPO applications over time and across EU countries is provided in Lotti and Schivardi (2005).

regions, the results of the present study could be extended (albeit with cautions) to a non negligible portion of the EU.

Figure 1 provides a dynamic representation of the Marche propensity to apply for EPO patents: the upper line describes the EPO patents requested by applicants residing in Marche while the lower one indicates the cases in which both the applicant and, at least, one inventor are resident in the region.

Figure 1 – EPO applications in the Marche



From 1991 to 2004 the number of patent applications submitted by Marche holders has increased from 35 to 82, i.e. by 147%, and the same trend applies to the (lower) figures in which also the presence of regional inventors is taken into account. During the same period, the EPO applications from European countries rose from about 36000 to 70000 with an increase of 110%. Thus, although the absolute and relative figures are not remarkable, Marche inventors, in line with those residing in other regions and countries, have ascribed an increasing importance to international patenting.

4. The Marche inventors: population and sample

The population of inventors considered in the present study is extracted from 743 EPO applications - filed during the period 1991-2005 and published in December 2006[3] - in which both the applicant and at least one inventor reside in the Marche region[4]. Thus, since we wanted to consider also the features of patent holders, the regional inventors who contributed to the patents of extra-regional assignees are not taken into account. In sum, our population comprises 509 individuals. Without taking into account the cases of multiple inventors, on average each inventor contributed to 1.5 patents. Such a low figure highlights probably the most important and unique feature of our reference population composed, in its overwhelming majority, of patentees and inventors who applied only once or twice for an EPO patent in a time span of 15 years.

Table 2 – Percentages of EPO applications by number of patents per inventor

	Marche	EU4[a]
1-2 patents	85.07	43.63
3-6 patents	10.41	30.64
7 and more patents	4.52	25.72

a= Source: Mariani and Romanelli (2007); EU4= Germany, Italy, Netherlands, United Kingdom.

As shown in table 2, only 15% of our inventors took part to more than two patents and only 4.5% to more than six[5]. For a comparison, the same table reports the findings of Mariani and Romanelli (2006) arising from a survey on 793 European inventors (cf. section 2). In this case, those with more than two patents represent 56% of the sample, i.e. 41 percentage points above the share of our sample. Although the European survey is concerned with applications and patents belonging to a limited number of technological classes in which the Marche applicants are not specialised (see below), the difference is striking.

As it will be emphasised in the rest of the paper, the prevalence, in our region, of 'occasional' or 'low-productive' inventors is mainly due to the small size of patent holders (who often coincide

[3] The time lag between the filing date and that in which the application is officially published by the EPO can last a maximum of 18 months. As a consequence, the data referring to 2005 are incomplete (in fact, only 55 applications were observed, while they amounted to 85 in 2004).

[4] The applications of Marche inventors were extracted from the EP-CESPRI database on the patenting activity at the EPO. We are grateful to Gianluca Tarasconi for his prompt assistance.

[5] The extremely low presence of more prolific inventors suggests that the typical skewed distribution of inventive productivity observed by some scholars (Lotka, 1926; de Solla Price, 1963; Narin and Brezmann, 1984) could also emerge for geographical areas.

with the inventors). Then, an important issue that shall be addressed in the following sections is whether the patent quality of 'small inventors' is different from that of their larger counterparts.

With respect to the technological classification, the majority of EPO applications examined in the present study (64%) are in the field of 'Mechanical Engineering' which comprises a number of miscellaneous branches, including consumer goods (see table A.2 in the Appendix). The second technological class is that of 'Process engineering' recording 20% of applications. Compared with the patenting activity of Italy and that of the six countries considered in the PatVal-EU survey, the presence in the field of 'Electrical engineering' (which includes semiconductors, IT and TLC apparatus) is significantly lower and that in 'Chemistry and Pharmaceuticals' is extremely low (less than 2% of applications). This peculiar technological distribution of patents is consistent with the sectoral specialization of the regional economy characterised by a very low presence of high-tech industries (cf. the previous section).

Looking at their full name we found that 25 out of the 509 inventors were females. At a first sight, a 4.9% share of female inventors seems very low; however, at least in relative terms, this is not the case because, according to the PatVal-EU survey, the average percentage of females arising for six EU countries is 2.8. As it will be shown in section 6, an interesting finding is that the majority of these females can be classified as 'small inventors'.

Table 3 – Population and sample of Marche inventors by number of patents per inventor

	Population		Sample		
Patents per inventor	Absolute values	Percentages	Absolute values	Percentages	Sample/ Population (%)
1-2 patents	433	85.07	66	62.26	15.24
3-6 patents	53	10.41	26	24.53	49.06
7 and more patents	23	4.52	14	13.21	60.87
Total	509	100.0	106	100.0	20.83

To investigate the features of the Marche inventors, we carried out a telephone survey on a sample of 106 individuals accounting for 21% of total inventors and 42% of total EPO applications. To select the sample, we applied three criteria. First, to not alter the regional innovative specialization, we choose a sample with a technological distribution of patents similar to that of the population[6]. The second criterion, instead, altered substantially the distribution of patents per

[6] The Kolmogorov-Smirnov test accepted the hypothesis of equality between the (non-parametric) patents' distribution (across 30 technological classes) of the population and that of the sample.

inventor: in fact, we selected the sample with a view to over-represent the more productive inventors (see table 3). In this way, we got a number of observations adequate for testing the presence of (statistically) significant differences among the less and more prolific inventors (and, possibly, among those with a small and a relatively larger size). Moreover, we obtained information on a higher number of patents since the questionnaire was concerned with the total inventive activity of each individual rather than focussed on a single invention. Third, without changing the sample distribution resulting from the application of the previous criteria, the inventors whose EPO applications were filed after 1997 were preferred to those contributing to older applications. Thus, in our sample the more recent inventions are slightly over-represented.

5. Comparing Marche and European inventors

In predisposing the questionnaire administered to the inventors included in our sample we took care of obtaining information consistent with those collected by the PatVal-EU survey with a view of using its findings as benchmarks. Along with those comparable with the European survey we collected other information that will be examined in the next sections.

Table 4 illustrates the main features of inventors and highlights the strong peculiarities of those residing in Marche. First, on average, our inventors are significantly older than the European ones: none is younger than 30 while the PatVal survey identifies at least 5% of very young inventors (Giuri et al., 2007). More striking is the difference in terms of level of education. Only 35% of the Marche inventors have a tertiary education (university degrees and PhDs) while for the EU inventors the share is 77%. From the European survey it emerges that 89% of inventors are dependent workers while in Marche less than 60% have the same employment position: this is due to the fact that, in our sample, 36% of inventors are firms' owners.

Another strong peculiarity of Marche inventors is that only one third of them is occupied in large firms while the same occurs to more than 70% of European inventors. In fact, the majority of Marche inventors can be classified as 'small' in that they work either in a small firm (45%) or are independent inventors (13%). To be stressed is that the latter case applies when the name of inventor and applicant coincides and, on the basis of our survey, the individual is neither a firm owner nor an employee (or, at least, is not occupied in an organization that has something to do with her/his inventive activity).

Table 4 – Inventors' characteristics

	Marche	EU6*
Age (mean)	53.8	45.4
Tertiary education (%)	35.0	76.9
Dependent workers (%)	57.4	89.2
Inventors' working places (%):		
Small firms[a]	45.2	13.7
Medium-sized firms[b]	10.4	8.8
Large firms[c]	30.2	70.6
Others[d]	14.2	6.9
of which: Independent inventors	13.2	n.a.

*Sources: Giuri et al. (2007). For the EU share of dependent workers: Gambardella et al. (2005).
EU6= Denmark, Germany, Italy, Netherlands, Spain, United Kingdom.
a= firms with less than 100 employed persons; b= firms with 100-249 employed persons; c= firms with 250 employed persons and more; d= Government, independent inventors and others; n.a.= not available.

The peculiar features of our sample of inventors are consistent with those of the regional economy (cf. section 2), characterized by a relatively low propensity to patent and a low presence of large firms and high-tech industries. Having said that, an immediate question that arises is whether the above characteristics affect the quantity and, above all, the quality of patented inventions.

Looking at the average number of patents, table 5 shows that Marche inventors are less productive than their European counterparts. This confirms the finding presented in the previous section (cf. table 2) which was not concerned with the sample but the entire population. However, comparing the standard deviations and the maximum values per inventor, it is likely that a non negligible part of the productivity differential is due to the fact that, among the 793 inventors considered by Mariani and Romanelli (2007), there is a small group of very outstanding individuals.

To compare patent quality we use, as it is customary in the literature, the number of forward citations. Mariani and Romanelli examine 4376 EPO patents or applications over 1988-98 and collect the number of citations received within five years of the publication date. In this way, they circumvent the problem of 'time truncation', that is the fact that more recent patents have, by definition, a lower probability to be cited. Our patent applications refer to 1991-2005 so that, in order to apply the same procedure, we truncated the sample at 2002 and collected the citations received by each application up to June 2007. In this way 72 inventors and 234 applications are considered (accounting for, respectively, 68% and 70% of the whole sample).

Table 5 – Inventors' productivity and patent quality

	Marche			EU4*		
	Mean (St. Dev.)	Min	Max	Mean (St. Dev.)	Min	Max
Patent per inventor	3.37 (4.31)	1	34	5.51 (7.40)	1	87
Forward citations per patent	1.14 (1.47)	0	8	1.40 (1.75)	0	24

* Source: Mariani and Romanelli (2007).

Table 5 shows that the average quality of the patents involving European inventors is only 23% higher than that of the applications concerned with Marche inventors. Considering that, on average, the latter have a lower level of education, work for smaller organizations and are less productive in terms of EPO applications, it can be said that their inventions, at least in terms of forward citations, are not less valuable than those of European inventors.

Another issue for which a comparison can be performed is that of the sources of knowledge used by the inventors in developing their inventions. As in the PatVal-EU survey, we asked the inventors to rank some sources of knowledge in a Likert scale ranging from 1 (not important) to 5 (very important). Table 6 reports the average score obtained by each item. For both Marche and European inventors the most important source of knowledge comes from customers: this confirms the crucial role that, in the innovation process, is played by producer-user interactions and the understanding of user needs. However, while European inventors rank high also the recourse to patent and scientific literature, the Marche inventors ascribe a relatively greater importance to suppliers and, to a lesser extent, competitors.

Table 6 – Inventors' sources of knowledge

	Marche	EU6*
Customers/Users	3.47	2.95
Suppliers	2.47	1.62
Competitors	2.88	2.24
Patent literature	2.17	2.69
Scientific literature	2.27	2.63
Technical conferences & workshops	1.89	1.74
University laboratories	1.81	1.40

* Source: Giuri et al. (2007).

The result concerned with suppliers is consistent with the strong specialization of Marche inventors in the fields of mechanical engineering and consumer goods (see the previous section): in these industries, especially in Italy, there are seldom vertically integrated firms whilst the productive system is mainly based on networks of firms and subcontracting relationships. A further significant difference between Marche and EU inventors, is that the former attribute a lower importance to the use of searches in patent databases.

Moving from the sources to the final stage of the inventive process, table 7 focuses on the use of patents according to the size of the firms in which the inventors are occupied. Starting from the last column of the table, it emerges that almost 70% of the Marche inventions are exploited within the firms while in the EU the same share reduces to 50%. Thus, the main purpose of Marche patentees is simply to protect their inventions from imitation and this contributes to explain, along with other important factors, the low propensity to patent recorded in this region. In Europe, instead, remarkable shares of patents are used for strategic reasons (blocking patents) and commercial or exchange purposes (licensing and cross-licensing). As expected (cf. section 2), the importance of blocking patents raises with firm size. On the contrary, both in Marche and the EU, the commercial use of patents is higher among small firms. This is in line with Gambardella et al. (2007) who examine the PatVal-EU patents owned by firms (8207 observations) and, by means of a probit analysis, find that those with a smaller size are more involved in licensing.

Table 7 – Patent use by the size of inventors' working places*

		Small firms	Medium-sized firms	Large firms	Total
Internal use	Marche	61.36	96.77	71.65	69.83
	EU6**	55.80	65.60	50.00	50.50
Sleeping patents	Marche	21.97	3.23	17.53	19.55
	EU6**	8.80	10.30	19.10	17.50
Licensing and cross-licensing	Marche	8.33	0.00	4.64	4.47
	EU6**	25.80	10.02	9.20	13.20
Blocking patents	Marche	0.00	0.00	6.19	3.07
	EU6**	9.60	13.90	21.70	18.80

*Independent inventors resident in Marche are ascribed to small firms. However, their answers did not match completely with those included in the table; as a consequence, the sum of the column percentages of the small firms located in Marche is lower than 100. **Source: Giuri et al. (2007).

Looking at the main differences by size class, another peculiar result of our survey is that the highest share of sleeping patents is found in small firms: since the latter also include independent

inventors, this means that small patent holders are often unable to exploit their inventions either internally (by raising productive capacity and finding a market for their new products) or externally (by selling or licensing their IPRs). In the EU, on the contrary, the highest percentage of sleeping patents pertains to large firms, probably because their expected benefits from licensing do not compensate for the risk of giving technological advantages to potential competitors (Gambardella et al., 2007).

6. Small and medium-large inventors: characteristics and patenting performances

This section deals with the central issue addressed in this paper, that is whether and how the size of inventors affects both the number and quality of their patents. As anticipated in the previous section, some inventors may act independently from any kind of organisation and apply individually for an EPO patent. According to their status of independent inventors, these individuals are mainly interested in selling or licensing their patented ideas rather than exploiting them directly for productive purposes (only a few of them, in fact, decided to start a new business). Most of the inventors, however, are dependent workers or owners of an extant firm, which results as the patent holder. Moreover, as the size of the firms rises, it is less likely that only one inventor will appear in the patent document. In medium-sized and large firms there is usually a team of inventors albeit centred on the figure of an 'inventive leader' (see Narin and Brezmann, 1984). Sometimes, in our sample, the firm owner results as the unique inventor and, when the firm is not a small one, this probably means that the 'boss' does not even recognise the 'moral rights' of his employees. Although it occurs in a few cases, this conduct is unfair and must be condemned.

In order to distinguish the inventors by size, we had to choose the 'right' type and number of size classes. As table 8 reports, from our questionnaire we collected information for six groups, one for independent inventors (labelled *a*) and five for the firms with different numbers of occupied persons (micro, small, two medium-sized classes, and large, labelled from *b* to *f*). By using a set of individual characteristics (see below), we tested the presence of statistically significant differences among the means of the inventors' groups and compared the results arising from different aggregations of size classes. First, we found that independent inventors are not statistically different from those employed in or owners of micro firms (label *b*). So, we grouped the first two classes and compared them with a 'medium' (*c* + *d*) and a 'large' class (*e* + *f*). This grouping, however, gave rise to mixed results since, according to some features, medium-sized inventors had to be assimilated to small inventors while, according to others, they were not significantly different from large inventors.

Table 8 – The size distribution of Marche inventors

	Size class' label	Number	Percentage
Small inventors		50	47.1
Independent	*a*	*15*	*14.1*
Firms with 1 to 9 employed persons	*b*	*10*	*9.4*
Firms 10-49	*c*	*25*	*23.6*
Medium and large inventors		56	52.9
Firms 50-99	*d*	*13*	*12.3*
Firms 100-249	*e*	*11*	*10.4*
Firms 250 and more	*f*	*32*	*30.2*
Total		106	100.0

In the end, as shown in table 8, we decided to break down the inventors into two groups:

1. small inventors (i.e. independent inventors plus those employed in or owners of firms with less than 50 occupied persons) accounting for 47% of the sample;
2. medium-large inventors (i.e. those occupied in or owners of firms with 50 employed persons and more) representing 53% of the sample.

From such a separation, a number of significant differences arise. Table 9 reports, for the individual characteristics resulting from our survey[7], the main statistics by the size of inventors and the P-values of the T-tests for the equality of means. Along with the gender and age, the level of education is expressed in a four-point scale (1=primary school; 2=secondary school; 3=diplomas; 4=tertiary education and PhD). Then, we consider the recourse to patent attorneys and consultants: this variable takes the value of one if the inventor relies exclusively on attorneys and IPR consulting firms located in Marche and zero when also or only extra-regional consultants are used. Finally, five variables for the importance ascribed to different sources of knowledge[8] (see the previous section) are included.

Looking at the cases in which the hypothesis of equal means is refused at a 5% level of confidence, it can be stressed that small inventors record a higher presence of women, have a lower

[7] Along with those reported in table 9, we also used five dummies for the technological classes in which the inventors' patents are classified (cf. section 4 and table A.2 in the appendix). For these variables, however, the differences of means between small and medium-large inventors were not statistically significant.

[8] The sources labelled 'technical conferences' and 'university labs' are neglected for two reasons. First, they were ranked very low as compared to other sources of knowledge (cf. table 6, previous section). Secondly, they do not significantly discriminate between small and medium-large inventors.

level of education and ascribe a lower importance to competitors and patent literature as sources of knowledge.

Table 9 – Inventors' characteristics: means, standard deviations (in brackets) and equality test

	Small inventors	Medium and large inventors	P-value of the T-test for the equality of means[a]
Gender (male=1)	0.880 (0.328)	0.982 (0.134)	0.044**
Age (years)	55.040 (13.087)	52.607 (9.099)	0.275
Education (1=elementary; 4=tertiary and PhD)	2.780 (0.910)	3.339 (0.721)	0.001**
Patent attorneys and consultants (only regional=1)	0.480 (0.505)	0.304 (0.464)	0.065*
Source: (1=not important; 5=very important): customers/users[b]	0.378 (1.222)	0.327 (1.243)	0.056*
Source: suppliers[b]	2.278 (1.323)	2.589 (1.058)	0.239
Source: competitors[b]	2.528 (1.404)	3.107 (1.216)	0.046**
Source: patent literature	1.680 (1.058)	2.607 (1.485)	0.000**
Source: scientific literature	2.160 (1.361)	2.375 (1.259)	0.402

a= Equal variances are not assumed. b= this variable was not collected for independent inventors; as a consequence, it refers to 35 rather than 50 small inventors. *= Significant at a 0.10 level of confidence. **= Significant at a 0.05 level of confidence.

The finding concerned with gender is simply due to the fact that 6 out of the 7 women included in our sample are classified as small inventors: in particular, there are four owners of small firms and two independent inventors. Thus, the presence of female inventors among dependent workers is rare suggesting that, to be formally involved in inventive activities, women have to possess entrepreneurial attitudes or responsibilities.

The entrepreneurial requirement is also important to explain why small inventors have a lower level of education. In fact, half of small inventors are firm owners, another 30% is composed of independent inventors and only 20% are dependent workers; on the contrary, the share of employees among medium-large inventors is almost 75%. Within their relatively large organizations, the latter accomplish the task of carrying out inventive activities (mainly performed in research labs or technical departments) and have been selected for such a task also on the basis of

their type and level of education. Instead, no formal education is needed for small entrepreneurs or independent inventors to have bright ideas that are worth to be patented.

Somewhat linked with the finding for education, is the fact that small inventors do ascribe a significantly lower importance to patent literature since it confirms that, for their inventive activity, they do not rely on codified knowledge to the same extent of larger inventors. The latter rank higher also the scientific literature but, in this case, the gap between inventors' groups is not statistically significant.

Remarkable differences arise also for other sources of knowledge since small inventors rely more on customers while medium-large inventors attribute a greater importance to competitors. It should be pointed out that, for obvious reasons, independent inventors did not take part in these assessments. As expected, small firms devote more attention to user needs while their larger counterparts are more aware of the technological developments undertaken by competitors and, then, able to exploit these information in their own inventive activity.

Although at a 10% level of confidence, the exclusive usage of local patent attorneys and consultants is significantly higher for small inventors suggesting that those with a medium-large size, thanks to their greater financial means and patenting experience, do search for better or more specific competencies and are able to select among a larger pool of patent consultants.

All the above findings point to the conclusion that larger inventors are endowed with better characteristics and, thanks to the size of the organizations they are working in, have further advantages over small inventors. Accordingly, both the patent quantity and quality of the latter should be lower. However, as shown by table 10, medium-large inventors significantly outperform the smaller ones only in terms of per-capita patents[9]. Instead, by considering a number of proxies for the quality of patented inventions, there are no significant differences.

The first indicator considered is the row (i.e. not adjusted for time truncation) number of forward citations per patent: this is higher for larger inventors, but the T-test does not refuse the hypothesis of the means' equality. For the second one, the number of citations is adjusted for truncation by adopting the 'fixed-effects' approach suggested by Hall et al. (2001): accordingly, the number of citations received by a patent in a given year is divided by the average number of citations received, in the same year, by all the patents of Marche inventors. With respect to that applied in the previous section, this method has the advantage of preserving all the available observations and gives rise, for the whole sample, to an almost identical result (1.20 citations per patent versus 1.14; see table 5 in the previous section). However, such a procedure determines a

[9] Nevertheless, the number of patents seems to rise less than proportionally with firm size. This is consistent with Lotti and Schivardi (2005) who find that, among EU countries, the size of firms exerts a positive impact on the likelihood to patent but not on the number of patents per employee.

staggering increase of citations for the few recent applications that have been cited. As a consequence, by dividing the sample into two groups with a limited number of observations, the comparison could be biased by the above over-estimation. To avoid it, we attributed a maximum of 8 citations to the most recent applications that have been already cited, which corresponds to the maximum number of actual (i.e. not adjusted) citations received in our entire sample. Table 10 shows that for the adjusted number of forward citations per patent the hypothesis of equality between small and larger inventors is not refused with a level of confidence higher that that arising for the row number of citations.

Table 10 – Inventor's performances: means, standard deviations (in brackets) and equality test

	Small inventors	Medium and large inventors	P-value of the T-test for the equality of means[a]
Patent per inventor	2.140 (1.808)	4.464 (5.477)	0.004**
Forward citations per patent	0.663 (1.319)	0.991 (1.149)	0.178
Adjusted forward citations per patent	0.991 (1.692)	1.145 (1.617)	0.633
Claims per patent	10.790 (10.610)	10.421 (7.627)	0.939
Early withdrawals per patent	0.163 (0.317)	0.148 (0.253)	0.788
Late withdrawals per patent	0.175 (0.306)	0.137 (0.248)	0.487
Oppositions per patent	0.003 (0.018)	0.015 (0.069)	0.119
Refutations per patent	0.025 (0.145)	0.023 (0.097)	0.932

a= Equal variances are not assumed. ** = significant at a 0.05 level of confidence.

The third variable that has been used is the number of claims per patent application, which turns out to be almost identical between the two groups of inventors. The next two proxies of patent quality are the shares of 'early' and 'late' withdrawals. A patent application can be explicitly withdrawn by the applicant or, according to the EPO procedure, is *de facto* withdrawn when the applicant: i) does not pay the fees that, step by step, are required to complete the granting process; ii) does not reply to the communications of EPO examiners. We term 'early' withdrawals those occurring after the search report and the patent application are published (within 18 months from

the application date); at this point, if the applicant does not ask and pay the fees for the examination, her/his application is deemed to be withdrawn. 'Late' withdrawals, instead, occur during or after the examination, which can be a quite long process (lasting from two to three years). The application can be withdrawn even at the end of the examination, when the intention to grant is announced. However, this happens in a few cases since, according to Lazaridis and van Pottelsberghe de la Potterie (2007), late withdrawals are mainly induced by the communications of EPO examiners. The same authors show that, over 1995-2004, about 33% of total EPO applications have been withdrawn while, for the whole sample of Marche inventors, the share of withdrawals is lower (around 29%). Having said that and assuming that less valuable applications are more likely to be withdrawn[10], the findings for both early and late withdrawals provide a further support to the conclusion that the patent quality is not significantly affected by the inventors' size.

Finally, the last two rows of table 10 indicate that also by looking at the shares of opposed and refused patents the differences between small and larger inventors are not statistically significant. According to the relevant literature (cf. section 2), opposed patents are usually more valuable (i.e. receive more citations) and this is consistent with the finding that, albeit not significantly so, the share of oppositions is higher for the patents of medium-large inventors. The percentages of refused patent are instead almost identical between the two groups and lower than that found for total EPO applications (about 5%; cf. Lazaridis and van Pottelsberghe de la Potterie, ibid.)

7. Is patent protection worth to be sought?

Having established that small inventors are significantly different from those of larger size, do apply for a lower number of EPO patents but yet their patented inventions are not less valuable, this section examines how the Marche inventors evaluate their patenting experience. For this purpose, we asked them to perform a sort of cost-benefit analysis of their overall patenting activity and provide a qualitative evaluation based on a five point scale: from 'strongly negative' to 'strongly positive'. Since many inventors with the position of dependent workers were not able to perform such an assessment, the question was exclusively posed to independent inventors, firm owners and employees with managerial responsibilities (usually, the heads of R&D or technical departments). As a consequence, the above evaluation refers to patent assignees rather than inventors: in total we

[10] It should be stressed that an application can be withdrawn for a variety of 'rational' motives, some of which have little to do with the patent quality. Some applicants may decide to withdraw their applications on the basis of a more accurate evaluation of the costs and benefits associated with IPRs (cf. Iversen and Kaloudis, 2006). Others may be content to publish their applications because, in this way, they create prior art and prevent that the invention will be patented by competitors: the diffusion of such a strategy, termed 'defensive publishing', is analysed by Henkel and Pangerl (2007).

got 56 answers, 39 for independent inventors and small firms and 17 for medium-sized and large firms. Since some companies - and especially the largest ones - employ two or more inventors that are included in our sample, the patenting activities concerned with the evaluation exercise refer to a larger number of inventors: 41 for small firms and 30 for those with a medium and large size. In any case, the number of observations is significantly lower than that employed for previous analyses so that the findings provided in this section must be taken with more caution.

Table 11 – Evaluation of the patenting experience by size of patent assignees (row percentages in brackets)

	Number of cases	Strongly positive evaluation	Intermediate evaluations	Strongly negative evaluation
Independent inventors and small firms (41 inventors)	39	13 (33%)	13 (33%)	13 (33%)
Medium and large firms (30 inventors)	17	12 (71%)	4 (23%)	1 (6%)
Total (71 inventors)	56	25 (45%)	17 (30%)	14 (25%)

Breaking down the answers into three possible outcomes (the two extreme evaluations and the sum of the intermediate ones; i.e. moderately positive and negative, plus neutral or undecided answers), table 11 shows that independent inventors and small firms are equally distributed among them. Thus, looking at their patenting experience, one third of small patentees reports a strongly negative assessment. On the contrary, the same occurs to only one out of the 17 medium-large companies, while for the overwhelming majority of them (71%) a very high level of satisfaction arises.

Table 11 compares the characteristics and patenting performances between the most dissatisfied inventors and all the others. Starting from the inventors' features, it emerges that the patentees reporting a negative evaluation are only smaller, while there are no significant differences in terms of gender, age and level of education. Being smaller, the patentees with a strong discontent record a lower number of patents per inventor. However, looking at the shares of citations, claims, late withdrawals and refutations, the quality of their patent applications is not significantly different from that of the patentees with less or no discontent. The only indicator for which the former outperform the latter is the percentage of early withdrawals. In fact, almost 42% of the applications submitted by the inventors who, ex-post, evaluate negatively their patenting experience have been withdrawn at an early stage of the granting process. Because this high share of withdrawals cannot

be attributed to a lower quality of their patented inventions, the reasons that have induced these inventors to stop the granting process and, more generally, the motives of their deep dissatisfaction are worth of further investigations.

Table 12 – Inventors' characteristics and performances by types of evaluation: means, standard deviations (in brackets) and equality test

	Strongly negative evaluation	Positive or intermediate evaluation	P-value of the T-test for the equality of means[a]
Gender (male=1)	0.867 (0.352)	0.929 (0.260)	0.532
Age (years)	56.133 (8.774)	56.054 (11.401)	0.977
Education (1=elementary; 4=tertiary and PhD)	3.067 (0.799)	2.946 (0.923)	0.621
Size (small inventor=1)	0.933 (0.258)	0.482 (0.504)	0.000**
Patent per inventor	1.667 (1.047)	4.464 (5.537)	0.001**
Forward citations per patent	1.417 (2.195)	0.772 (0.979)	0.285
Adjusted forward citations per patent	1.687 (2.057)	1.024 (1.490	0.258
Claims per patent	14.100 (15.782)	9.923 (7.258)	0.334
Early withdrawals per patent	0.417 (0.460)	0.108 (0.202)	0.022**
Late withdrawals per patent	0.283 (0.410)	0.164 (0.256)	0.300
Refutations per patent	0.017 (0.065)	0.014 (0.072)	0.890

a= Equal variances are not assumed. ** = significant at a 0.05 level of confidence.

For a better understanding of the different evaluations arising from our survey, we carried out ten direct interviews concerned with, respectively, five small patentees who declared to be very dissatisfied and five owners or chief-executives of medium-large companies who, instead, reported a very high level of satisfaction. The above were open interviews in which we asked the patent holders to recount their own experiences and the lessons they have learned.

All the most dissatisfied inventors that we interviewed were owners of micro enterprises, employing fewer than 10 workers. In commencing the interview, these small inventors complained about the high costs of European patents: in particular, they pointed out the weight of the renewal fees that must be paid yearly during the granting process for each country where the patent protection is sought. Anyway, being aware of such costs at the outset, this was not the main difficulty they had to face. In fact, the big problems aroused when the inventors realised the need of sustaining additional costs as, after their applications were published, their patented inventions became targets of litigation threats and infringements. The inventors' applications were mainly attacked or infringed by large companies, most of them located in foreign countries. The interviewees, albeit sure to be 'in the right', were scared to suit larger companies or defend themselves in a court and, especially, in foreign jurisdictions. First, they should have had to bear remarkable legal costs, without any guarantee of success. Secondly, during the legal dispute, they should have had to stop producing and/or commercialising their invention. To avoid that and with a view to attain some (though limited) economic benefits, they attempted, in some cases, to reach an agreement with the companies attacking their inventions but, probably due to their limited bargaining power, they did not to succeed. Eventually, all these inventors decided to withdraw their patent applications, as the costs were increasing too much with respect to the expected benefits. On the basis of their negative experience, most of them took the decision of not seeking any more for international patent protection. Although it cannot be denied that also small inventors can be successful (in effect, our survey reveals that one third of them are very satisfied), the above stories are not exceptional. The EPO has recently published in its web site the case studies of eleven SMEs involved, often to a great extent, in international patenting: most of them are medium-sized firms and, for obvious reasons, no 'losers' were interviewed. Yet, a crucial issue for all the respondents is that of patent enforcement, a very expensive and time-consuming activity that, sometimes, small firms cannot afford. As stressed by the owner of a medical equipment firm employing 20 people, "The cost of litigation is high and the process is complex. Small companies are in a very difficult situation especially when their patents are infringed by large companies" (cf. European Patent Office, 2007; MIPM case study, pages 2-3).

Moving to the five larger patentees who reported a very positive assessment, we found that, albeit with opposite outcomes, their main motives of satisfaction were always concerned with IPRs enforcements. This means that medium-sized and large firms were able, even though with some difficulties and remarkable costs, to provide enough protection to their inventions. All of them recorded, at least, a successful legal dispute. One company, by threatening to suit the local importer, was able to block the German imports of a product made in China that infringed one of its patents.

Another attacked with success a German patent granted to a big competitor; moreover, it won a suit for infringement in Turkey and is still involved in a similar litigation in the same country. A third medium-sized firm decided to invest in international patenting after being suited for infringement by a competitor: in that episode the firm risked to go bankrupt and, consequently, it radically changed attitude with respect to IPRs protection. To summarise, a factor that all the successful patentees have in common is that of devoting substantial resources to legal protection. Obviously, in the words of one entrepreneur, they are "not happy to spend all this money for lawyers" but this is an inescapable condition to sustain their inventions. The costs are high but the economic benefits are remarkable too; it should be added that the latter are not easily quantifiable especially because, as another respondent said, "I don't know how many potential imitators I discouraged by bringing one of them to court". This sentence is quite illuminating since it highlights that business people are fully aware of the strategic role played by credible threats of patent litigation.

In conclusion, the high costs of legal disputes whit highly unpredictable outcomes should be included among the most important obstacles that small inventors have to face. To say that they should ponder that before seeking patent protection does not amount to a solution. One of the key recommendations arising from the SMEs case studies presented in the EPO web site (see above) is the following: "Be sure of your case: if you are planning to fight an infringement make absolutely certain that you are in the right as a lawsuit could otherwise be a quick route to going out of business". However, the problem is that even a small inventor 'in the right' could easily lose a patent litigation. This unavoidable uncertainty can push many small firms to stay out of the IPRs market and, then, reduce their incentives to invent and innovate.

8. Discussion and policy considerations

Compared to large patent holders, small inventors are affected by a variety of drawbacks. Aside from those associated with the limited size of their organizations, we have shown, for instance, that small inventors have a lower level of education and rely less on codified sources of knowledge. However, due to the high costs and difficulties for obtaining European patents, there are no reasons to assume that their inventions are less valuable than those patented by larger companies. In effect, by employing forward citations, claims, withdrawals and refutations to grant, we found that there are no significant differences in the average quality of the patent applications held by small and medium-large inventors. Nevertheless, one third of small applicants reports a strongly negative assessment of its patenting experience while it is true for only a scanty fraction of larger patent holders. On the basis of supplementary interviews, we found that the high level of satisfaction reported by the bigger companies was mainly due to a successful enforcement of their

patent rights while dissatisfied small inventors, being unable to bear the burden of legal disputes, did not succeed in that. Eventually, the latter decided to withdraw their patent applications and stop seeking for international patent protection. Obviously, as witnessed by the numerous cases of successful small inventors, the above failures are not the rule. However, it cannot be denied that the inventive activity of many small firms is hampered by the way the current system of IPRs protection works. This is what emerges from US studies (cf. section 2) and this paper has provided some evidence (although concerned with a small sample of inventors) that such a problem is equally severe in Europe.

Looking at the US case, Lanjouw and Shankermann (2004) identify the development of a market for patent litigation insurance as a way to reduce the asymmetries in patent enforcement. In principle, this could be a viable solution for small firms whose capability to finance litigation is constrained by the presence of imperfect capital markets. However, as stressed by the same authors, although patent litigation insurance has been available since many years both in the United States and Europe, "the market remains severely underdeveloped" (ibid., p. 68). In particular, the insurance prices are too high to be affordable by small companies. Albeit little or no evidence is available on this issue, it is likely that the potential for enlarging the supply of litigation insurance is much lower in Europe than in the United States[11]. The reason is that, in the former, the risk of incurring in a lawsuit is amplified by the lack of a unitary system of patent validation and enforcement.

At present, a European patent granted by the EPO is a collection of national patents so that if, for instance, a patent holder discovers that her/his right is violated in different countries she/his has to undertake separate legal actions in front of different national courts. Obviously, the same may occur when the validity of a patent is disputed by competitors. This makes extremely complicated, costly and uncertain the enforcement of IPRs in Europe and, as we discovered with our interviews, small inventors are particularly discouraged by the current state of affairs. The solution would be that of a Community (or, at present, EU-wide) patent, an idea that dates back to the Sixties. However, after almost four decades of discussion, the negotiations have been stalled since 2004. Thanks to the initiative of the EPO and some EU member states two alternative solutions to a Community patent have been proposed: the European Patent Litigation Agreement (EPLA) and the London Agreement on translation costs.

The EPLA, launched in 1999, aims at creating a unique European Patent Court. Although substantial progresses have been made, this voluntary agreement is still under discussion and, in order to be effective, it will have to be ratified by many member states of the European Patent

Organisation. Needless to say, the benefits of such a big jurisdictional change will be numerous and substantial especially in terms of reduction of litigation costs (cf. European Patent Office, 2006a), convergence in the outcomes of legal disputes and availability of competent patent judges.

Even though legal costs represent the main obstacle for European SMEs, a reduction of those required to obtain a valid patent would be important as well. In particular, the translation costs - needed to validate the patent in each designed state - make patenting in Europe much more expensive than in the United States and Japan[12]. The London Agreement (adopted on October 2000) aims at diminishing the post-grant translation costs. This is done by dispensing the holders of EPO patents with the translation requirements for their validation in the states with a national language in common with the official languages of the EPO (such as France, Germany, Switzerland and the United Kingdom). For the validation in all the other countries, only the claims of the patent must be translated into national languages (European Patent Office, 2006b). In July 2006 the Parliament of ten states has approved the London Agreement and, after the French ratification on October 2007, it will probably come into effect within the first half of 2008. Unfortunately, up to now, Italy has not ratified the agreement.

Then, contrary to those concerned with translations, in the near future the costs associated with legal disputes will remain the most relevant barrier to patent for European SMEs. However, waiting for the EPLA ratification, something can be done to alleviate the problems faced by small inventors. A policy intervention that can be implemented by the central and/or regional governments of the EU is that of providing financial supports to the small firms involved in international patenting. The EC Regulation No. 364/2004 concerned with the extensions of state aids for research and development (cf. Commission of the European Communities, 2004) has been the first official document to establish that, along with R&D, patenting can be sustained by public subsides. Such a provision has been recently re-established by the 2006 Community Framework for state aids for research and development and innovation (Commission of the European Communities, 2006). Section 5.3 of the above Framework states that: "Aids to SMEs for the costs associated with obtaining and validating patents and other industrial property rights shall be compatible with the common market". According to Section 5.1, this means that the intensity of aid for a small enterprise that has come to an invention by performing applied research can be up to 70% of its patenting costs. Instead, for a similar firm involved in experimental development the intensity of subsides can be up to 45% of the eligible costs. Among the latter, there are not only those for

[11] Lanjouw and Shankermann (2004, p. 68, footnote 48) report the example of Lloyds of London which offered this kind of insurance in the Eighties but stopped to do that for the lack of profitability.

[12] As stressed by the European Commission (2007, p. 2) "a European patent designating 13 countries is about 11 times more expensive than a US patent and 13 time more expensive than a Japanese patent if processing and translation costs are considered".

preparing the patent application and completing the granting and validation processes, but also the costs "incurred in defending the validity of the right during the official prosecution of the application and possible opposition proceedings, even if such costs occur after the right is granted" (see point (c) of Section 5.3). As a consequence, the small companies admitted to benefit from this kind of support could not only save a remarkable portion of patenting costs but also have a higher potential to enforce their rights without the fear of being ruined by litigation costs. In other words, the litigation threats coming from bigger firms would be less effective and the propensity to bring them to court in presence of clear infringements would be higher. Obviously, this should not necessary give rise to a high number of effective patent lawsuits because large companies would be less inclined to dispute in front of a court the rights of small patent holders.

Unfortunately, albeit allowed by the EC since 2004, public subsides for small patenting firms are not particularly diffused. Looking at the Italian case, we found that, in spite of recording a very low propensity to patent, most regional governments - including that of Marche - have not inserted this type of intervention among the aids predisposed to sustain the innovative activities of small companies.

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Appendix

Table A.1 – Low patenting regions of the EU15 with an above-average manufacturing presence.

Label	Region (NUTSII)	EPO application per million inhabitants	Share of employment in manufacturing	Share of manuf. employment in high-tech industries	Per capita GDP in PPS
ES52	Comunidad Valenciana	21.81	22.94	1.48	18039
ES24	Aragón	25.15	24.64	2.92	19662
ES21	País Vasco	30.90	27.97	2.25	23451
ITE2	Umbria	37.57	24.38	3.16	21919
FR30	Nord - Pas-de-Calais	41.35	21.30	2.82	18486
ES22	Comunidad Foral de Navarra	45.23	28.34	1.94	23373
ES51	Cataluña	48.46	27.26	4.07	22272
ITF1	Abruzzo	51.91	23.24	5.98	18878
ITE3	Marche	52.27	33.79	2.60	22423
FR51	Pays de la Loire	55.11	23.02	6.91	20827
ITE1	Toscana	55.85	24.81	2.54	24811
FR21	Champagne-Ardenne	58.48	20.89	3.59	21530
UKE1	East Riding and North Lincolnshire	60.77	21.82	3.57	19551
UKC1	Tees Valley and Durham	61.78	20.90	4.78	16928
UKG2	Shropshire and Staffordshire	61.85	23.17	7.85	18256
UKD4	Lancashire	63.00	21.71	8.06	19900
UKG3	West Midlands	63.35	23.39	4.70	23089
FR41	Lorraine	70.53	23.09	5.98	19055
BE22	Prov. Limburg	76.98	24.58	5.66	20136
FR22	Picardie	83.28	24.06	3.53	18747
DE94	Weser-Ems	88.11	22.42	4.19	19990
FR72	Auvergne	89.55	21.48	4.00	19620
FR26	Bourgogne	89.95	21.18	5.24	21254
FR23	Haute-Normandie	93.31	23.51	6.08	21877
ITD3	Veneto	93.74	32.80	4.88	25928
UKF1	Derbyshire and Nottinghamshire	95.49	21.69	5.95	21102
FR24	Centre	97.98	22.65	6.18	20808
	Average	62.43	24.56	4.32	21146

Table A.2 – Percentages of EPO applications by technological field*

	Marche	EU6[a]	Italy[b]
Electrical engineering[I]	5.10	15.81	16.01
Instruments[II]	9.24	10.88	8.41
Chemichals and Pharmaceuticals[III]	1.59	18.53	16.18
Process engineering[IV]	20.06	24.94	26.27
Mechanical Engineering[V]	64.01	29.85	33.10

*OST/INPI/ISI- technology Classification defined by IPC symbol
a= Source: Giuri et al. (2007); b=Source: Gambardella et al. (2005).
I= Electrical machinery and apparatus; Audio-visual technology; TLC; IT; Semiconductors.
II= Optics; Analysis, measurement, control technology; Medical technology: Nuclear engineering.
III= Chemistry; Pharmaceuticals and cosmetics; Biotechnology; Agriculture and food chemistry, Chemical and petrol industry, basic materials chemistry.
IV= Chemical engineering; Surface technology and coating; Materials and metallurgy; Material processing, textiles, paper; Handling and printing; Agricultural and food processing, machinery and apparatus; Environmental technology.
V= Machine tools; Engines, pumps, turbines; Thermal process and apparatus; Mechanical elements; Transport; Space technology, weapons; Consumer goods and equipment; Civil engineering, building, mining.