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Towards an Italian way in the valorisation of results from public research

Chiara Balderi, Paola Butelli, Giuseppe Conti,
Alberto Di Minin, Andrea Piccaluga

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Abstract

The paper is an attempt to discuss the strategies and actions of Italian university Technology Transfer Offices (TTOs). For this purpose, relevant data have been collected in a four-year annual survey (2002-2005) which the authors are coordinating within NetVal, the Italian University Network for the Valorisation of Research, in collaboration with ProTon Europe and Crui.

The empirical evidence seems to suggest the existence of several concurring processes, with a strong impact on TTOs' performances. In particular, the development of a *valorisation culture* among Italian TTOs physiologically requires time and experience in order to occur. On the other side, the progressive *professionalization* of TTO staff is strictly dependent on the intensity of the commitment of the staff itself and it does not necessarily require a long time in order to be achieved. Last but not least, *imitation effects* at national level have pushed an increasing number of Italian universities to get more deeply involved in TT activities.

Despite the fascinating power of the (not always) profitable US licensing model, this appears to be not replicable within the Italian context, where the main mission of TTOs is generally recognized as that of effectively valorising the results of academic research rather than increasing licensing income for universities and inventors. In this respect, the possibility for the TTOs to contribute to the creation of *an Italian way in the valorisation of results from public research* appears to be not only desirable but also feasible.

1. Introduction¹

Over the last thirty years the discussion about Technology Transfer (TT) theory and practice has been very intense among both scholars and practitioners. At present, a heated debate whether universities should or not be directly involved in the valorisation process of academic results is still taking place. On the one side, the potentially relevant supporting role played by universities in fostering TT from academia to industry is emphasized, whereas, on the other side, the occurrence of spontaneous and independent TT mechanisms, especially in presence of good quality research, is advocated. In this respect, being aware of the strengths and weaknesses of these two extreme visions, often represented by the terms “Triple Helix” and “Republic of Science” models, we adopt an intermediate position between them, recognizing the need for a sort of an intermediate model, enriched by the inclusion of a number of characterising factors, such as the type of disciplines, the type of public research organizations (PROs), the type of countries/regions involved and so on.

We are in fact convinced that a ‘good’ Technology Transfer Office (TTO) can effectively support TT processes without incurring in the failings which may characterize excessively entrepreneurial attitudes which are sometime undertaken by universities. Consequently, we recognize the need for a constant focus on university TTOs’ activities and performances, in order to be able to monitor their peculiarities and – if possible – their outputs and impact on public research as well as on the industrial system as a whole. In fact, there are still several issues related to TTOs’ activities which need further investigation, and therefore empirical data at international level have to be analysed with the support of appropriate theoretical contributions.

The European Commission (EC) has participated to this debate over time, through various documents, among which the ‘Green Book on Innovation’ in 1997 and then, more recently, by supporting the ‘Innovation Model’ originally formulated by ProTon Europe (Capart, 2003; European Commission, 2004a). In this document, the EC acknowledges once more that innovation is not a linear process and that it should involve feedbacks and frequent interactions at different levels between Science and Industry. In such a context, universities surely play a relevant role, but a lot of discussion still exists about the specific orientation of their contribution. For example, it is discussed whether university TTOs should be active in mastering various tools and services to manage Intellectual Property Rights (IPRs) efficiently and effectively through the wide range of exploitation avenues which are possible. More recent documents (European Commission,

¹The authors would like to acknowledge Italian university delegates who have participated to the NetVal survey, as well as Riccardo Pietrabissa and Massimiliano Granieri for the numerous inspiring discussions about the management of university research results. A previous version of this article was accepted for the VI Triple Helix Conference, Singapore, May 18th-21st 2007.

2007a; b) indicate as desirable the embracement of the 'Open Innovation' Model (Chesbrough, 2003) at European level.

Within this stream of literature, in which different views are continuously discussed and compared, this paper is an attempt to analyse and discuss the performances registered by Italian university TTOs by defining a set of indicators to analyse them in terms of both efficiency and effectiveness.

Worldwide, the relevance of TT processes from academia to industry is widely recognised and is progressively gaining an increasing level of attention from both scholars and policy makers, and Italy is no exception. If compared with the US and other European countries, in Italy the phenomenon has just left its infancy phase, but it has been intensively growing (Cesaroni *et al.*, 2005b). In fact, although the first explicit university TT activities appeared in the early-1970s, they were considered as a sort of an 'epiphenomenon'. In fact, universities were often totally indifferent to explicit TT activities and sometimes even opposed to them.

Only recently (since the mid-Nineties), TT activities from university to industry have aroused growing interest among both academics and politicians. Most Italian universities have progressively realized the exploitation potential deriving from their own research results. Not surprisingly, most Italian university TTOs have been founded over the last decade.

In this context, a relevant event was that, in November 2002, a group of Italian universities felt the need for joining together in order to support their R&D exploitation strategies. NetVal (Italian Research Valorisation Network) was created with this specific purpose and its members now represent a vast majority of Italian universities. In addition, the Italian Ministry of University and Research (MUR) has been recently devoting funds to strengthen university TTOs.

Isolated and (often) successful initiatives in the fields of the valorisation of research results initially fostered by pioneer universities have stimulated 'imitation effects' among other national universities, so that approximately since the year 2000 the carrying out of TT activities has become a rather diffused practice (Cesaroni, Piccaluga, 2003). Moreover, the institutional changes occurred in the national legislative framework have further facilitated TT activities from universities to industry. In this respect, the national law 297/1999 has been the first legislative measure to contemplate – even though indirectly – the case of academic spin-off companies. Also, the national laws about academic researchers' IPRs, albeit generally not appreciated by universities and often by firms, have at least contributed in attracting attention towards the exploitation of research results.

As a result of all these concurring factors, TT licensing activities are currently carried out by Italian TTOs' staff with good intensity and professionalism (Cesaroni *et al.*, 2005b; Pietrabissa, Conti, 2005; NetVal, 2006), with performances which are very similar, if not superior, to those of countries which we often refer to as "best in class" examples.

In this context, the final aim of this paper is to provide new methods and data to analyse and discuss the performances registered by Italian university TTOs, through the definition of a set of indicators. In order to address this research objective, detailed annual data about TT activities carried out by Italian

universities in the 2002-2005 period have been analysed and commented. The dataset has been collected by the authors on an annual base, within a specific national survey promoted by NetVal in collaboration with Crui and ProTon Europe.

TTOs' performances (both in terms of efficiency and effectiveness) have been evaluated by adopting specific indicators. In particular, different indicators have been identified and tested, not only for assessing TTOs' performances in each branch of activities, but also for further investigating the existence of significant relationships between absolute and per-head values.

A four-year observation period is rather significant in order to evaluate the trend experienced by some observed indicators, among which (i) the number of FTEs (full time employees) in the TTOs, (ii) the total number of patents managed by the TTO staff per year, (iii) the annual number of patents per-head, (iv) the annual expenditure for Intellectual Property (IP) management, compared to the TTO patent portfolio, (v) the average IP expenditure per existing patent, and so on.

A rather consolidated opinion is that Italian TTOs' performances are growing rapidly and professionalism is spreading throughout the country. While we basically agree with this and argue that this is a positive fact, other scholars, in other countries, argue that the professionalization of university TTOs might make interaction with industry more difficult since universities might become excessively concerned about the economic returns of their TTOs' activities. This paper is an attempt to provide further evidence on this issue.

The paper is organised as follows. Section 2 deals with the conceptual framework, by providing a concise overview of the critical dimensions of TT processes, as well as a very brief description of the Italian innovative system. Section 3 describes the methodology of the data collection. Section 4 analyses the empirical evidence and, finally, Section 5 concludes the paper.

2. The Valorisation of research results in Italian universities: Evolution and Critical Dimensions

The contribution of the knowledge producing sector to the innovative activity of firms and to economic development in general is widely recognised. Nevertheless, several new important subtopics have emerged during the last two decades, which represent increasingly important research issues for academics and policy makers.

In fact, the undisputed importance of scientific and technological knowledge finds no unanimously accepted policy and strategy recipes in either industry or academy, nourishing the ongoing debate concerning the long-term mission of universities and publicly-funded research organisations (PROs).

Both in the US and in several other countries in the world, universities and PROs have started to play a more "entrepreneurial" role (Clark, 1998; Etzkowitz

et al., 2000). They are more and more engaged in starting new companies, providing training to private companies, paying more attention to regional economic development, managing incubators, science parks and even their own venture capital (VC) companies. All this represents a new set of activities for them.

The economic and managerial literature has already explored several dimensions of this process (among others, see: Geuna, 1999; Gibbons *et al.*, 1994; Lowe, 1993; Mansfield and Lee, 1996; Mustar, 1995; Roberts, 1991; Piccaluga, 2001). It has been well documented that the main factors which have favoured this trend can be identified in the decrease and change of funding sources for universities, the increasing autonomy of universities, the growing pressure for universities in being directly active in regional development processes and the “scientification” of production processes.

This topic has profound implications for the industrial sector. The reason is twofold. First, from a macro-economic perspective, PROs represent the main “producers” of scientific and technological knowledge in modern economies. The way in which these organisations communicate and exploit the results of their research activity directly influences the extent and the mechanisms of knowledge diffusion and transfer. Since firms’ innovative efforts are strongly linked to external sources of knowledge, a change in the knowledge diffusion mechanisms will directly influence firms’ innovative performance and competitiveness.

Second, from a micro-economic perspective, the exploitation strategies set up by PROs directly influence the procedures of interaction between university and industry. If PROs decide to patent (and subsequently license) most of their research results, or if they decide to exploit those results by creating new spin-off companies, firms will then face potential partners that have quite radically modified their objectives and behaviour. University-industry collaborations will have to be established upon new (and partly still to be defined) bases, and firms will adapt to this new model.

In general terms, universities have tended to follow an *evolution path* which can be summarised in the following steps (Cesaroni *et al.*, 2005a):

1. IP generation: the first step of the TT process is strongly linked with university basic research, because of its raising up from research developed by university researchers and funded with public funds. The main actor of this phase is the researcher. During the IP generation process, it is extremely important to take into account that IP exploitation is possible only if IP generation comes from solid bases and strengthened rights. This means that it is important to have a due IP protection of the research results in order to be able to guarantee a fruitful valorisation in the future. The researchers responsible of a research group have to be aware of the university policy regarding IP protection, but they have not to be expert in patents and legal issues. University TTOs will provide all the necessary information and help researchers in determining and implementing the appropriate strategies as well as in negotiating and establishing fair collaboration and licensing agreements.

II. IP valorisation: in this phase, the university subscribes TT agreements with industries and obtains commercial results from the research outcome that have been patented in the IP generation phase. There are basically three ways to exploit a technology:

1. *Licensing:* this mechanism transfers commercialisation rights on existing university know-how and results (i.e. the outcome of the IP generation phase) to existing companies by means of a legal agreement. Mostly, it concerns the rights on a patent, a trademark or an industrial design, developed and owned by the university. The researchers are the main players in this process. They have created the IP, which is transferred, and they may have industrial contacts which can be used to find possible licensees. Of course, TTOs may play a central role in finding customers for the university IP. This is especially true when the IP created by the researchers can be exploited in application fields outside their normal research scope. One of the most important role of the TTOs is however that of supporting the researcher in negotiating fair deals in which pricing and IPRs are clearly determined.

2. *Spin-off companies:* this mechanism consists in starting a new company, commercialising existing university know-how and research results. The main reason to establish a spin-off company is the valorisation of research results and the industrial development of new products based on technology generated within university laboratories. In this mechanism the researcher plays a key role because he/she becomes an entrepreneur.

3. *Research contracts:* this mechanism is based on transferring university know-how and results to an existing company (or a consortium of companies) by setting-up a joint collaboration project based on a specific research field.

III. Interactions between IP exploitation mechanisms: these three valorisation mechanisms do not exclude one another. Indeed, both research contracts and license agreements bring researchers in contact with industry and, on the other hand, often a spin-off company is a university partner for research contracts or license agreements. However, they have different financial consequences. Research contracts and consultancy generate an almost immediate return and are almost risk-free. Research contracts often act as a founding mechanism which enables investments in patents and spin-offs that only generate a return in longer terms. Licensing is more risky than research contracts, as the major part of the revenues depends on further successful technological and market developments. However, as licensing is done by existing companies, the market risk is lower than when starting a spin-off.

With regard to the Italian situation, the traditional National Systems of Innovation (NSI) approach (Nelson, 1993; Porter, 1990) has clearly emphasized that a country's research and innovative performance is influenced by the characteristics of the institutions which are active both at the supply and demand sides (typically, research institutions and firms). Similarly, TT activities of Italian universities are strongly influenced by the characteristics of the Italian system of innovation, both in terms of supply and demand conditions. *On the one hand*, the

quantity and quality of research results available and potentially ready to be transferred to industrial partners depend on the resources that the Italian system on the whole devotes to research activities performed by academic institutions. *On the other hand*, university research is influenced by the demand of technology by the industrial sector (Rosenberg, 1982), and hence by the characteristics of the industrial structure.

Regarding these two dimensions, Italian conditions seem to be particularly weak in comparison to other European and non-European countries (European Commission, 2004b). Specifically:

- among European countries, and compared to Japan and the US, the share of Gross Domestic Product (GDP) that Italy devotes to Research and Development (R&D) expenses is traditionally low, and declining over time. Italian R&D intensity is lower than European average;
- the lower propensity to spend in R&D is mainly due to the weak role played by Italian industry. If the total level of R&D expenditure is subdivided in terms of sources of funding, it emerges that the industrial sector participates with a share which is lower than that of both the US and Japan, and the European average;
- the poor participation of the industrial sector to the funding of R&D activities is mainly due to the fact that the Italian industrial structure is characterised by the presence of small and micro firms which is higher than the European average. While the share of larger firms is comparable to that of Europe, the overall average size of Italian firms is 4 employees, which is lower than the average European firm size (7 employees).

The combination of these conditions has created a situation of weakness of the national system of research. Curiously enough, the average quality of Italian public researchers is good in terms of publications (the problem being the relatively limited number of researchers) and the number of patents held by companies in which academics are inventors is relatively high (which means, once more, that university contribution is relevant).

As a matter of fact, only in recent years explicit involvement of universities in TT has become central in the public debate. Italian universities have only recently started to promote their own TT activities, and primarily activities directed to an active IP and spin-off creation. In the past, the traditional approach towards TT was mainly the result of efforts of individual researchers and professors, who were often able to create connections with the industry without any formal support from their parent organisations (Balconi *et al.*, 2004). It is worth noting that the main goal of a TTO, as commonly intended by Italian universities, is that of guiding research groups in establishing appropriate valorisation and exploitation strategies. This includes the definition of a strategy in IP management, supporting negotiations with industries and helping in the management of the legal and contractual aspects. From such a perspective the possibility of generating additional income plays a secondary role. The growing attention posed by MUR and by individual universities on the exploitation of

research results has coincided with an increasing complexity and variety of the activities promoted by universities to meet such a goal.

However, the evolution of the academic research valorisation process within the Italian context may be represented as a *sequence of five phases* (Piccaluga, Balderi, 2006), which are shared by most Italian universities, suggesting the existence of a possible *TTO life cycle* (see Table 1).

Table 1 – A possible life cycle for Italian TTOs

Period	Phase	Main characteristics
1970-1985	Discovery of the Phenomenon	▪ Sporadic TT initiatives by single researchers and/or universities ▪ Scarce or null formal involvement by universities
1986-1997	Acceptance of TT phenomena and spontaneous actions	▪ Growing awareness by universities about TT potential ▪ The first attempts: TT activities carried out informally by already existing offices ▪ Growing number of initiatives by researchers
1998-2000	Enthusiasm and expectations	▪ Radical change in universities attitudes towards TT activities ▪ Formal creation of <i>ad hoc</i> TTOs for the provision of TT support services (especially patents/licence and spin-off companies) ▪ Institutional changes: national law 297/99 ▪ 'Me too effect': TT becomes a fashionable practice among universities
2001-2006	Learning processes and service provision	▪ Need for a rationalization process of services provided by universities ▪ Introduction of formal procedures and routines ▪ Experimentation of different possible solutions for TT activities ▪ Regulation about university researchers' IPRs: national law 383/2001 ("Tremonti Law") ▪ Need for a collective learning: the creation of NetVal
2007	The need for a positive discontinuity	▪ Strategic choices to be made by Italian TTOs ▪ Need for the definition of a specific Italian TT model ▪ Towards an Italian way to the valorisation of academic research results?

Source: authors' elaboration based on Balderi, Piccaluga (2006).

Phase I: discovery of the phenomenon: from the early Seventies to the mid-Eighties TT processes were the result of sporadic initiatives attempted by inspired researchers. The involvement of parent universities in such activities was almost null, and sometimes they even represented an obstacle.

Phase II: acceptance of TT phenomena and spontaneous actions: since the mid-Eighties Italian universities have started to realize the potential of TT processes, becoming both aware of their peculiarities and familiar with their technicalities. TT activities started being carried out informally by already existing

offices, originally created for achieving different purposes (such as the Legal Office, the Statistics Department, the International Relationships Office, and so on).

Phase III: enthusiasm and expectations: in the late Nineties the progressive acceptance of TT processes by Italian universities led to a radical change in their attitude towards such activities. Not surprisingly, most universities formally established *ad hoc* TTOs in this phase. Specific human and financial resources were devoted to valorisation activities and formal policies in order to support TT processes were adopted.

Moreover, institutional changes further encouraged the adoption of policy measures individually introduced by each university. In particular, the national law 297/1999 was the first law to deal – even if indirectly – with the issue of academic spin-off companies.

In addition, successful stories exhibited by some universities which first undertook TT processes generated an ‘imitation effect’ among Italian universities, so that the valorisation of academic research results became a diffused, almost fashionable, practice. As a consequence, the number of TTOs and academic spin-off companies increased significantly.

Phase IV: learning processes and service provision: after this first wave of enthusiasm, since the early 2000s universities became increasingly aware of the need for a rationalisation process. It was necessary to offer more efficient services through a progressive process of collective learning by doing, as well as through the introduction of formal procedures and routines. In this phase, several possible solutions for TT activities were experimented, varying the level of involvement of the parent organisation in the valorisation processes.

Moreover, the introduction of specific laws, regulating university researchers’ IPRs increased the level of attention on this topic, by stimulating further discussions about this issue. In particular, the national law 383/2001, the so called ‘Tremonti Law’, has attributed for the first time exclusive IPRs on the inventions to university researchers, who were then only obliged to inform the parent university about the filing of the patent application. The university had the right to determine licensing fees as well as receive part of them, and inventors were entitled to receive between 50% and 70% of the total licensing income.

The introduction of the Tremonti Law led Italian universities to better define IP issues through the specific rules regarding patenting (Baldini *et al.*, 2004). Usually, in these sets of rules universities offered to cover all IP protection expenditures and to share with inventors eventual licensing income, in exchange for the conveyance of the right to file the patent application. However, this learning process experienced by universities required time and efforts, in order to introduce accurate and adequate sets of rules regarding IPRs.

Not surprisingly, in November 2002, a group of Italian universities, feeling the need for joining together in order to share their best practices and exploitation strategies created NetVal².

Phase V: the need for a positive discontinuity: nowadays, satisfaction about the results achieved by Italian TTOs is generally good, but nonetheless the need for some discontinuity is widely recognised. Once the initial, pioneering phase has been overcome, university TTOs are now coping with the extremely complex issue of defining a specific TT model. If on the one side the possibility of carrying out profitable TT activities (as in the US model) is somehow attractive, on the other side they are realistically aware of the difficulties involved in covering TTOs' costs. In this respect, the possibility for TTOs to create an *Italian way to the valorisation of academic research results* - in which the main mission is the carrying out of effective TT activities from academia to industry rather than merely pursuing economic returns - appears to be the most likely for the future, as well as coherent to our NSI.

By considering the five phases which have been described, *three critical dimensions* may be identified at national for TT activities carried out by Italian universities. The positive evolution of the national system of valorisation might be highly dependent upon them.

1. *Valorisation Network.* The valorisation network refers to the number and size of Italian TTOs. It represents the critical mass of offices and people involved in the process and, as we will see, has been growing in the last few years.
2. *Valorisation Results.* These are the results of valorisation efforts and are therefore represented through all the quantitative information related to TT activities such as patenting, licensing, spin-off processes, and so on.
3. *Valorisation Culture.* This refers to the professionalism of TTO staff in Italian universities, their enthusiasm as well as the pervasiveness of a valorisation culture among researchers and administrative staff.

A descriptive analysis of the first two dimensions (*Valorisation Network and Valorisation Results*) within the Italian context is presented in Section 4.

3. Methodology of data collection

In order to explore the efforts recently made by Italian universities in protecting and transferring the results of their research activities, we submitted to the TTOs of such institutions a questionnaire for four consecutive years. In 2003 a questionnaire was sent to Italian universities which was very similar to one used in the UK in a survey organised by UNICO together with the University of

²More information is available on the Network website, at: <http://www.netval.it>.

Nottingham; the following year a slightly modified questionnaire was sent, this time very similar to the one used by ProTon Europe, which started a European survey to which NetVal participated. Since then, the survey has been carried out on an annual base, only slightly modifying the questionnaire according to the feedbacks received from respondents and to emerging research questions.

The questionnaires included both quantitative and qualitative questions and aimed at exploring the functions and the mission of TTOs, the human and financial resources devoted to TT activities and the results obtained (number and characteristics of patents granted, number and characteristics of licenses and/or options concluded, number and characteristics of spin-off companies created, and so on).

The questionnaires have been submitted through e-mail to all Italian universities. Potential respondents were identified and contacted to confirm receipt of the questionnaires and a dialogue was maintained to ensure progress was being made in completing the questionnaires. The procedures adopted made it possible to identify appropriate respondents with accuracy and to reduce delays in obtaining information. Furthermore, the institutions surveyed were asked to provide their best estimate for each question if an exact response was not known.

In total, 30 universities answered the 2002 survey, 26 the 2003 survey; 48 the 2004 survey and 50 the 2005 survey. These latter represent 53.2% of the total number of Italian universities, 72.3% of total Italian university students and 74.6% of total Italian university professors. In particular, the responding universities represent 61.1% of Italian professors in Science & Technology (S&T) disciplines.

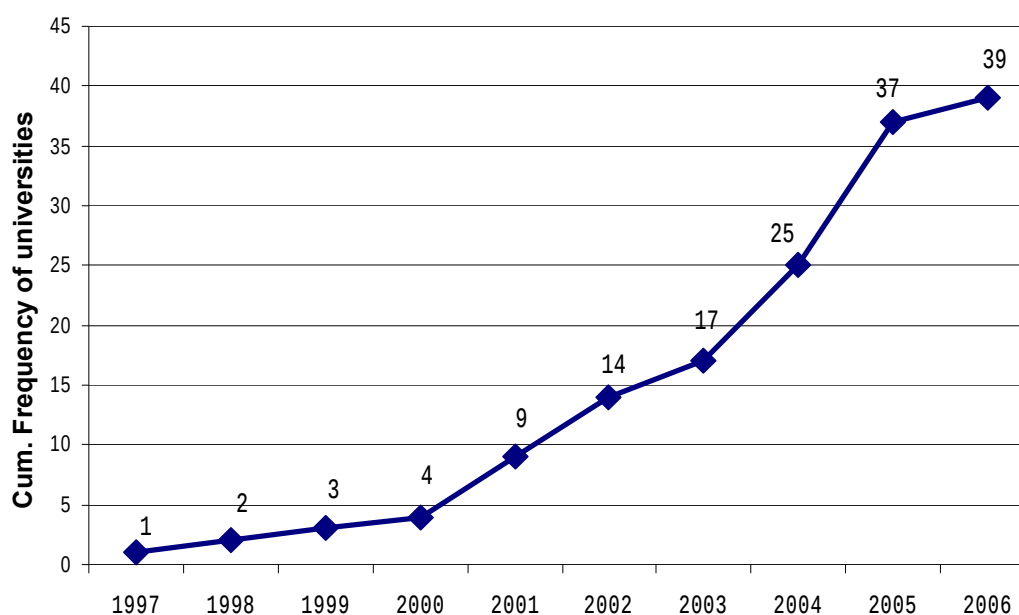
In the following section, some descriptive statistics about the empirical results are presented. In most cases, annual frequencies have been calculated. Moreover, scatter diagrams, trend lines and frequencies depending on the actual years of universities' experience in TT activities as well as on TTOs' age and size (in terms of FTEs) further deepen the analysis. In addition, some descriptive statistics have been processed depending on the distance between the TTOs' age in the year of the survey and their median year of foundation (by distinguishing between 'old' and 'new' TTOs). Finally, in several cases, trend lines, scatter diagrams and frequencies depending on the different valorisation performances achieved by responding universities have been calculated, by distinguishing between 'expert' and 'learning' TTOs. The criterion adopted in order to draw this distinction consisted in calculating the *y/x ratio* (that is the ratio of the *dependent variable y* to the *independent variable x*) and then selecting the best performing universities, by labelling them as 'experts'. The minimum level to be obtained by the responding TTOs in order to be included among the 'expert' ones varies depending on the variables considered and it has been clearly indicated in the empirical analysis. The definition of this 'threshold value' for each statistical elaboration has not been particularly problematic, as it has been significantly facilitated by the peculiar distribution of the data in the scatter diagrams, which regularly turns out to assume a bifurcate, swallow-tailed shape.

4. Empirical evidence about Italian university TTOs

As expected, the commercialisation of research results emerged as a rather recent phenomenon in Italy. Several universities began their involvement in TT activities by appointing existing departments (such as the International Relations Office, the Statistic Department, the Patent Office, and similar) to this further function, and only later setting up an *ad hoc* office, oftent with a variety of names ranging from Industrial Liaison Office to Knowledge Transfer Office, etc.

The formal involvement of Italian universities in TT activities started in the mid-Nineties and it grew in the last five years. 84.6% of respondents set up their TTOs between 2000 e 2005 (Figure 1).

Figure 1 – Year of foundation of university TTOs in Italy (n=39)



Source: authors' elaboration based on NetVal (2006).

Existing TTOs employ slightly more than four people on average (see table 2). In the largest offices, employees have specialised responsibilities and tasks, and are mainly dedicated to the commercialisation activities and/or to the promotion of technology licenses and the management of IPRs. In some other cases, probably because of the small size of the office, the personnel has no specific responsibilities, and all the employees together are engaged in the various activities, according to specific needs. As table 2 shows, the average size of TTOs has significantly grown over the period considered. In 2002 most universities had no more than two employees and no one had an office with more

than four employees. By contrast, in 2005 many TTOs have increased their size, and a few of them have employed even more than 10 employees. A general consideration must be done concerning the drop in 2004 data. We registered a flexion in each indicator (TTO's size, number of patent applications, number of licenses and so on) due to the fact the number of respondent TTOs dramatically increased (almost doubled in some cases) and most of the new respondent were "new" TTOs.

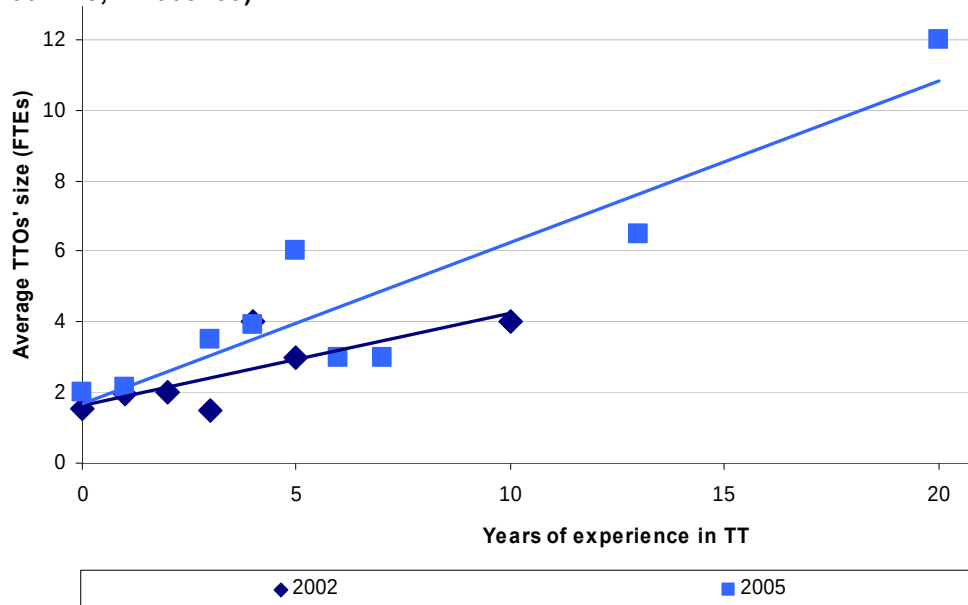
Table 2 - Size distribution of TTOs (number of employees - FTEs)

Number of FTEs	Number of universities			
	2002 (n=25)	2003 (n=19)	2004 (n=37)	2005 (n=39)
0-1	9	6	10	4
1-2	10	3	12	12
2-3	3	5	4	11
3-4	3	1	7	4
4-5	0	0	0	2
5-6	0	1	1	1
6-7	0	0	0	1
7-10	0	2	1	1
>10	0	1	2	3
<i>Total</i>	<i>47.8</i>	<i>65.5</i>	<i>112.3</i>	<i>160.8</i>
<i>Mean</i>	<i>1.9</i>	<i>3.4</i>	<i>3.0</i>	<i>4.1</i>

Source: authors' elaboration based on NetVal (2006).

By analysing the average TTO's size in relation to the number of years of activity (figure 2), several considerations arise. *First*, TTOs' average size appears to be positively related with the years of involvement of universities in TT activities. *Second*, the evolution experienced by universities which first started being involved in TT activities shows a smoother and more gradual growth trend than the growth path exhibited by those universities which only recently started such activities. However, the initial TTOs' size in their very first years tends to be the same in the two periods surveyed, the average size of newly established TTOs being about two employees.

Figure 2 – Average TTOs' size (FTEs) and years of experience in TT activity (n 2002=25; n 2005=39)



Source: authors' elaboration based on NetVal (2006)

As recalled above, one of the main motivations which have led to the establishment of TTOs within universities is the protection of research results through patents. Accordingly, services devoted to IP protection have been the first activity usually provided by TTOs. This is confirmed by the results of our survey as well. As table 3 shows, patenting is widely diffused among Italian universities, even though with some differences among them. *First*, although almost all universities have applied for Italian patents at least once, only a smaller share of them have applied for patents at either the European or the US patent offices (EPO and USPTO respectively). *Second*, only a marginal fraction of universities has an overall number of patent applications – independently from the patent office they have applied to – higher than 10 applications per year. Nevertheless, most universities have increased their attention to patenting during the last years, and indeed the average number of patents per institutions has increased from 2002 to 2005.

Table 3 – Patent applications by Italian universities

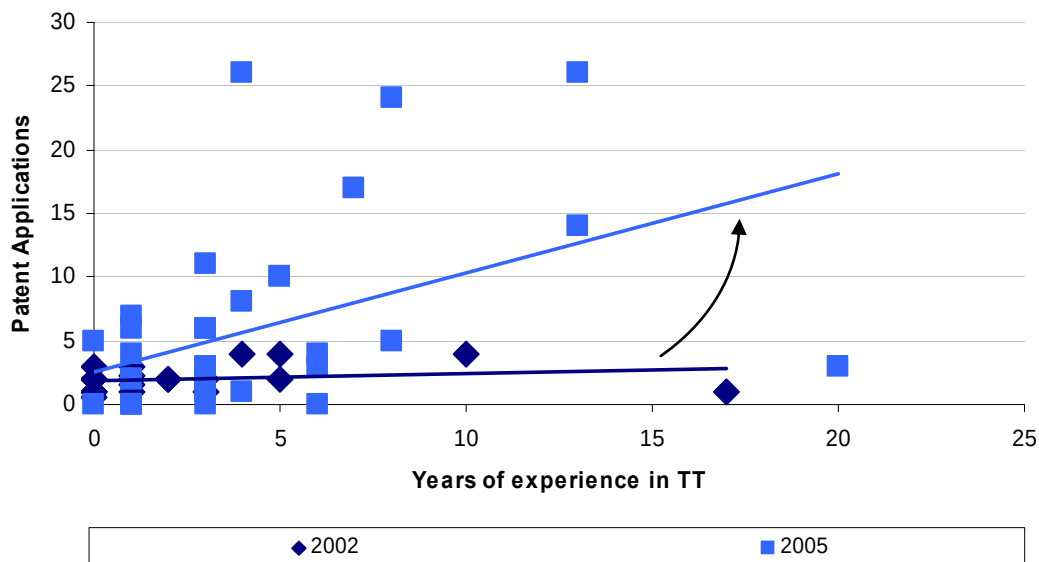
N. of patent applications	Number of universities											
	Italy				USPTO				EPO			
	'02	'03	'04	'05	'02	'03	'04	'05	'02	'03	'04	'05
0	4	1	13	9	11	8	28	23	8	5	24	21
1-5	12	10	21	22	6	5	14	14	7	10	16	15
6-10	3	6	5	3	1	0	1	0	1	0	2	1
11-15	2	1	2	2	0	1	0	1	1	1	0	1
16-20	0	1	1	2	0	0	0	0	0	0	0	0
21-25	0	0	0	0	0	0	0	0	0	0	0	0
26-30	0	0	0	0	0	0	0	0	0	0	0	0
31-35	1	0	0	0	0	0	0	0	0	0	0	0
>35	0	0	0	0	0	0	0	0	0	0	0	0
Total	112	99	140	129	21	23	37	36	33	39	45	52
Mean	5.1	5.2	3.3	3.4	1.2	1.6	0.9	1.9	1.9	2.4	1.1	1.4
N. Univ.	22	19	42	38	18	14	43	38	17	16	42	38

Source: authors' elaboration based on NetVal (2006).

As can be observed in Figure 3, there is a positive correlation between the experience cumulated by universities in carrying out TT activities and the total number of patent applications filed per year. However, this has not always been the case. In fact, at the very beginning of Italian universities' involvement in TT processes, patenting activities were not directly related to universities' experience (see trend line related to year 2002). Only recently have patent applications started to grow significantly as universities become more experienced (as confirmed by trend line related to year 2005). From this evidence, it is possible to argue that the 'valorisation culture' needs time to develop and be fruitful.

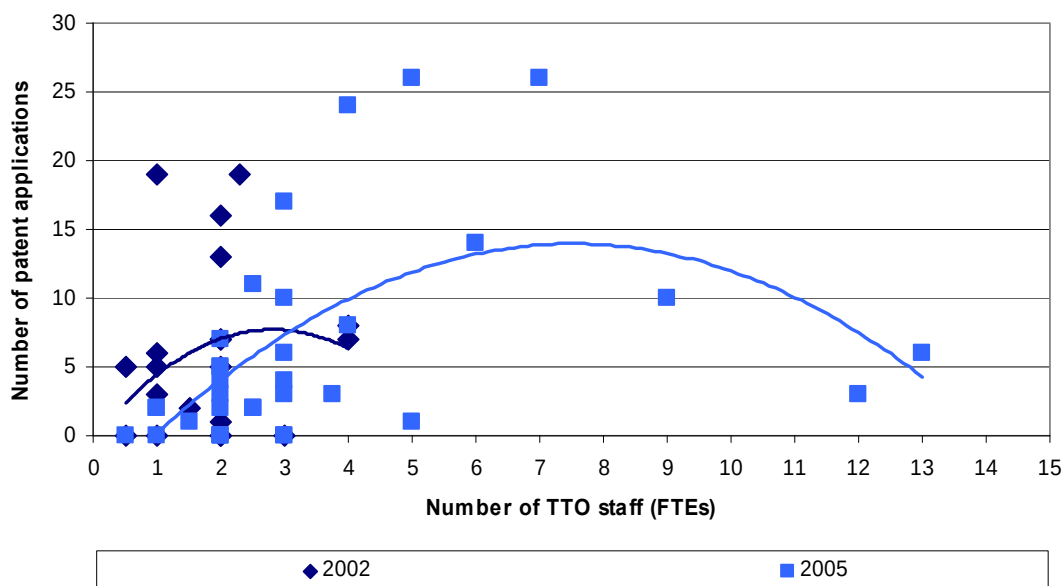
On the contrary, the number of patent applications annually filed does not show any significant relationship with the TTOs' size (see figure 4). In other words, TTOs with more FTEs do not necessarily carry out more patenting activities than smaller organizations. In fact, the evolution observed from year 2002 to year 2005 exhibits a wide spread in patenting performances. This may be due to different ways of organising TT activities adopted by each TTO, apart from their size. In this respect, over the last years, some inefficient situations, in which large TTOs are filing very few patent applications may be observed.

Figure 3 – Total number of patent applications and years of experience in TT activities (n 2002=24; n 2005=38)



Source: authors' elaboration based on NetVal (2006).

Figure 4 – Total number of patent applications and TTOs' size (FTEs) (n 2002=25; n 2005=38)



Source: authors' elaboration based on NetVal (2006).

The number of active patents in universities' portfolios has significantly increased in the period 2002-2005 (+180.4%; see table 4). In 2005, the total

patent portfolio included 973 patents: each responding university holding – on average – 26.3 patents. In particular, altogether Italian patents were 614 in 2005 (+189.6% in the 2002-5 period), each university owning an average portfolio of about 17 patents. The total number of active US patents was 156 (+178.6%) and the corresponding mean is 4.5 patents, whereas European patents altogether were 203 (+157.0%), each university holding on average almost 6 patents.

Table 4 – Number of active patents in Italian universities' portfolios

Active patents by country of application	Total number of active patents				Average number of active patents			
	2002	2003	2004	2005	2002	2003	2004	2005
Italy	212	473	473	614	9,2	14,8	13,9	17,1
US	56	168	128	156	4,0	5,8	4,0	4,5
EU	79	211	157	203	4,9	7,3	4,9	5,8
<i>Total*</i>	347	852	758	973	15,1	26,6	19,3	26,3
<i>N. Universities</i>	23	32	42	43	23	32	42	43

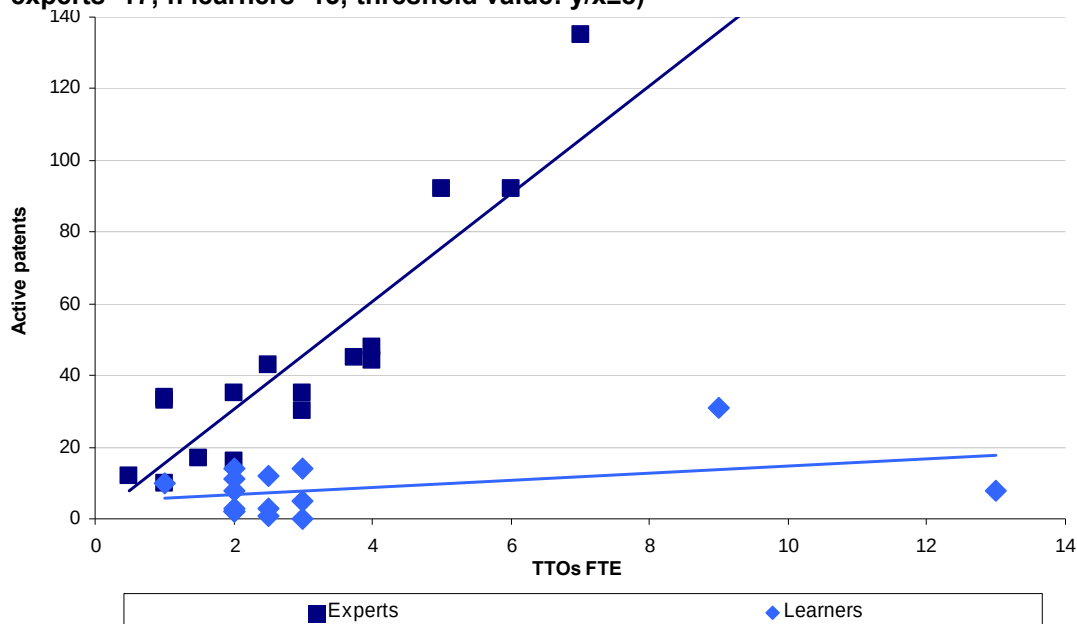
Source: authors' elaboration based on NetVal (2006).

Note: some inventions have been patented in Italy, in the European Union and in the US

As observable in Figure 5, the overall size of the patent portfolio is positively related with the TTOs' size (number of FTEs), even though a relevant spread exists. In particular, two different speeds depending on the different patenting approach undertaken by universities are observable. In fact, 'expert' TTOs exhibit a more steeply growing trend line as they get older, whereas 'learning' TTOs register a smoother growth trend.

The co-presence of these two different trends may be ascribed to the existence of two concurring factors. If, on the one side, the *valorisation culture* requires time, experience and continuous efforts to be developed and to become fruitful; on the other side, *TTOs' professionalization* is suitable to occur even in a very short term, if there is a strong commitment among the TTO's staff and proper training activities. This is a *sine qua non* condition for the TTOs to achieve better performances in patenting activities and represents the determinant factor which allows us to distinguish between 'experts' and 'learners'. In fact, as can be argued after observing figure 5, also the younger TTOs among 'expert' ones, achieve relevant patenting performances since their very first years of activity, whereas this cannot be observed for the 'learners'. The missing ingredient for the latter ones is perhaps the commitment to patent.

Figure 5 – Active patents in patent portfolio and TTOs' size (year 2005; n experts=17; n learners=15; threshold value: $y/x \geq 8$)

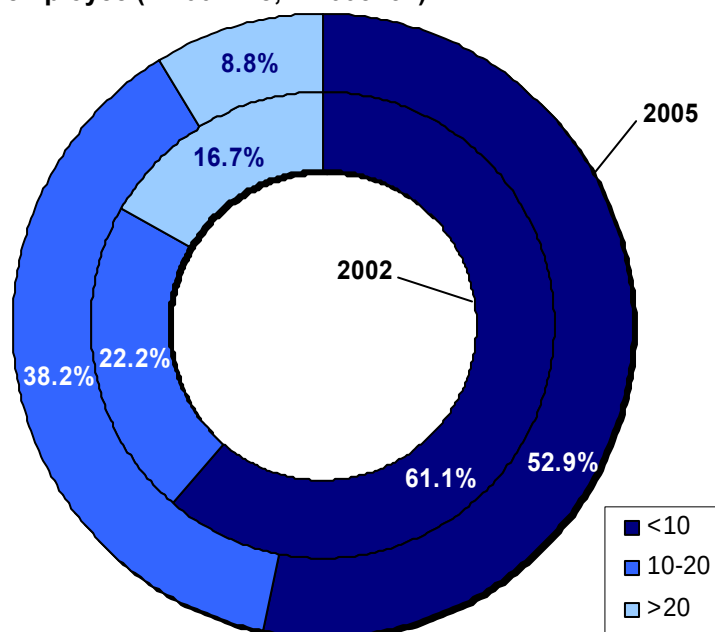


Source: authors' elaboration based on NetVal (2006).

The co-existence of these two drivers is also reflected by considering the breakdown of responding universities according to the number of active patents per FTE employee (see figure 6), and confirmed by the significant increase registered between 2002 and 2005 in the percentage of universities in which the patenting productivity per FTE employee varies between 10 and 20 patents per FTE.

In fact, if such an increment (from 22.2% to 38.2%) may be partially ascribed to the progressive development of the *valorisation culture* among responding universities over time, this seems to be only part of the story. Between 2002 and 2005 the number of respondents has almost doubled, including several young TTOs. Not surprisingly, the percentage of best performing universities (exhibiting a patenting productivity per FTE employee higher than 20) has reduced. Instead, what strikes in the analysis of the 2005 breakdown is that a significant number of young TTOs have soon achieved a patenting productivity per FTE in line with the performances registered by their older counterpart. This result may be attributed to the growing efforts and commitment recently devoted to TT activities by universities and by NetVal itself which have led to the *TTOs' professionalization*.

Figure 6 – Breakdown of responding universities and active patents per FTE employee (n 2002=18; n 2005=34)



Source: authors' elaboration based on NetVal (2006).

With regard to the licenses and/or options annually executed, a significant share of institutions (53.1% of the respondents in 2005) were able to commercialize at least some of their research results (table 5). In the 2002-5 period the number of licenses and/or options executed has significantly grown (+83%), both because the number of institutions signing at least one contract has increased, and because the average number of contracts per institution has increased as well (from 1.4 in 2002 to 1.7 in 2005).

In order to analyse more carefully the breakdown of responding TTOs depending on their active licenses and/or options, only those university TTOs taking part to all the editions of the survey since their year of foundation have been taken into account. In our sample we then generated two groups of respondents, which have been labelled as 'old' and 'new' TTOs. For the old TTOs we got answers for all the four editions of the survey, whereas for the new TTOs, we got answers for the latest two years of the survey (2004-05) only. The median year of foundation of the old TTOs is 2001, whereas the median year of foundation of the new TTOs is 2004.

Table 5 – Number of licenses and/or options executed per year by Italian universities

Number of licenses and/or options executed	Number of universities			
	2002 (n=22)	2003 (n=17)	2004 (n=35)	2005 (n=32)
0	12	5	22	15
1	2	3	5	6
2	3	4	5	2
3	3	1	1	3
4	0	1	1	3
5	1	1	0	1
6	0	1	0	0
7	0	0	0	1
8	1	0	0	0
9	0	0	0	0
≥10	0	1	1	1
<i>Total</i>	30	39	33	55
<i>Mean</i>	1.4	2.3	0.9	1.7

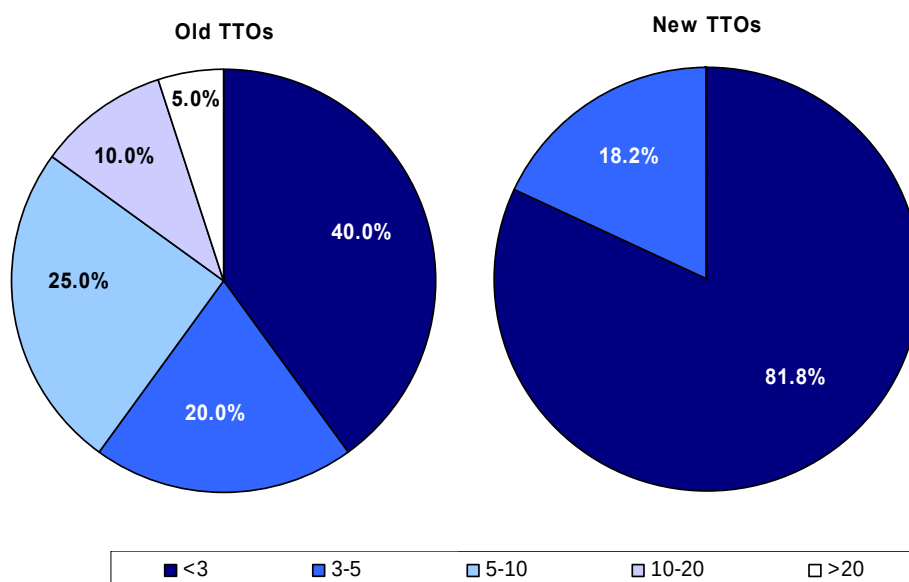
Source: authors' elaboration based on NetVal (2006).

The number of active licenses and/or options in 2005 clearly exhibits a progressive growth trend as the TTOs get older (see Figure 7). In fact, 40% of the old TTOs have more than five active licenses and/or options in their portfolio, whereas there is no new TTO exhibiting more than five active licensing agreements. Also, 40% of the old TTOs have less than three active agreements, while the share of new TTOs with less than three licensing agreements is 81.8%.

These results clearly show that time and experience do matter in the exploitation of academic results. If a strong commitment since the very beginning is sufficient to achieve good patenting performances through TTOs' professionalization, the progressive ripening of a proper valorisation culture through the accumulation of multiyear experience turns out to be a *sine qua non* condition in order to obtain satisfactory licensing performances.

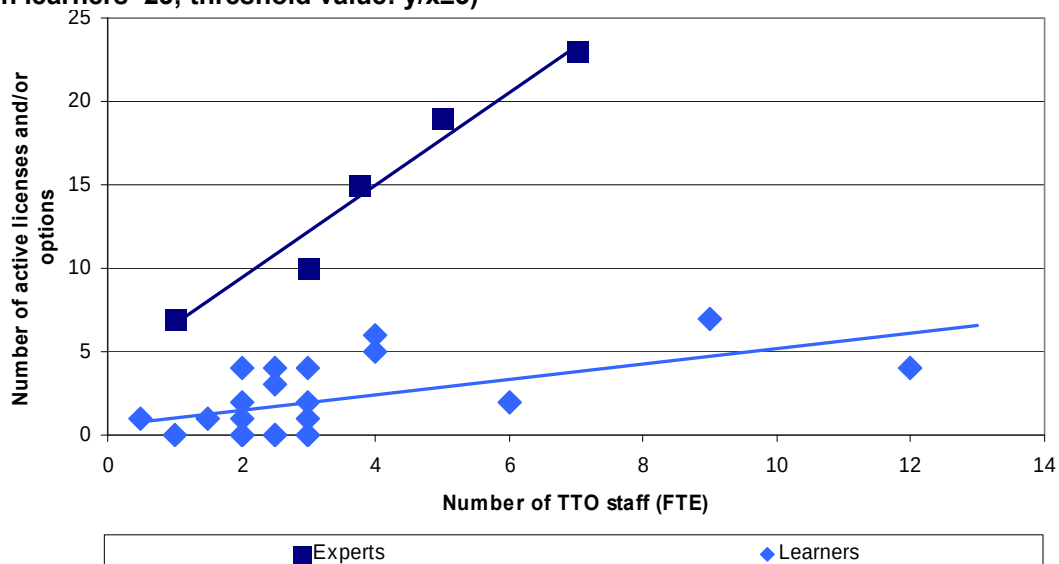
By analysing the number of active licenses and/or options held depending on TTOs' size (number of FTE employees), what emerges is the co-existence among Italian TTOs of two different attitudes towards licensing activities: (i) on the one side, some TTOs show a significant commitment to grow and to improve their licensing performances (they are labelled as licensing 'experts' in Figure 8); (ii) on the other side, other TTOs' mission is not that of fostering licensing processes, leading them to pursue different achievements (i.e. an effective management of university IPRs). As a consequence, even if these TTOs also provide support services to inventors, they are not generally aiming at obtaining relevant licensing performances, as they mostly tend to deal with licensing processes in a less committed way (they are labelled as 'learners' in Figure 8).

Figure 7 – Breakdown of old and new TTOs and number of active licenses and/or options (n old=20; n new=11)



Source: authors' elaboration based on NetVal (2006).

Figure 8 – Active licenses and/or options in year 2005 and TTOs' size (n experts=6; n learners=23; threshold value: $y/x \geq 3$)



Source: authors' elaboration based on NetVal (2006)

Differently from the typical US TT model, Italian TTOs (even in the case of the so called 'expert' universities) generally undertake licensing activities in order to properly valorise the results from academic research. The economic outcome deriving from the valorisation activities usually plays a secondary, albeit not insignificant, role.

The total number of active licenses and/or options yielding revenues per year (table 6) has significantly increased in the period considered (+150%). The average number of profitable agreements per university also registered an increment (+44.4%), even if the trend in the years 2002-2005 does not appear to be linear. In 2005, the total number of licenses and/or options yielding revenues held by the responding universities is 40: on average, each university owns 1.3 profitable licensing agreements.

Table 6 – Number of active licenses and/or options yielding revenues

Number of licenses and/or options yielding revenues	Number of universities			
	2002 (n=17)	2003 (n=15)	2004 (n=37)	2005 (n=30)
0	12	6	24	18
1	1	4	7	4
2	2	2	2	1
3	1	3	1	2
4	0	0	1	3
5	0	0	0	0
6	0	0	1	0
7	1	0	1	1
8	0	0	0	0
9	0	0	0	1
>10	0	0	0	0
<i>Total</i>	<i>16</i>	<i>17</i>	<i>31</i>	<i>40</i>
<i>Mean</i>	<i>0.9</i>	<i>1.1</i>	<i>0.8</i>	<i>1.3</i>

Source: authors' elaboration based on NetVal (2006).

With regard to the income from licensing contracts (table 7) the overall amount of licensing income has increased significantly from 2003 to 2005 (+137,5%), but this is the result of isolated and lucky cases, rather than a general trend. The total licensing income in 2005 is over 4.5 millions Euros, which means that on average each university has (in theory) registered a licensing income flow of more than 170 thousands Euros.

Table 7 – License income generated by Italian universities

License income generated ('000 Euros)	Number of universities		
	2003	2004	2005
0	8	15	13
0-20	4	5	4
20-40	1	0	0
40-60	0	1	2
60-80	0	4	0
80-100	1	1	0
100-120	0	0	1
120-140	0	0	1
140-160	0	0	0
160-180	1	0	0
180-200	0	0	0
Oltre 200	2	3	5
Total	1,923.3	1,480.5	4,571.0
Mean	113.1	51.1	175.8
Nr. Univ.	17	29	26

Source: authors' elaboration based on NetVal (2006).

These results clearly show that the possibility to earn additional income does not represent, at least at the moment, the main outcome of TT activities promoted by universities. At present, in most cases, returns generated by licenses (in terms of royalties or fixed fees) do not even cover the expenditures incurred for IP protection. If indirect costs, such as personnel costs or the costs for running the offices, were also included, this situation would even worsen. Actually we have to consider an average time for reaching a licence agreement, since the patent priority date, of two years. Taking into account the time to market of the product related to the licensed patent and the accounting period for royalties cash flows we have to consider significant incomes after 3 – 4 years.

As it has been demonstrated by the experience of US universities, only in a few isolated cases TT represents a valuable source of financial resources for universities. Nonetheless, in our survey, the possibility to generate additional funds for the university and its departments represents the main institutional goal that university officers declared to pursue (in our survey) with TT³, together with the ability to manage properly the results of academic research, from both a legal and a commercial perspective. Other goals, such as generating knowledge spillovers for the economy, both at the local and national level, are also indicated. In some cases, universities promote the commercialisation of research results in order to gain revenues for the researchers themselves and to the academic staff. And, indeed, almost every university regulation concerning IPRs and patents defines the share of (potential) revenues which have to be allocated to the inventors (Baldini *et al.*, 2004).

³In our experience, this same objective is not indicated as the most important when TTO managers are involved in informal talks or in workshops, and the objective of contributing to regional and national economic development is growing in importance.

In our view, on the whole, these results can be used as a sort of an indicator of the stage of the “life cycle” at which Italian TTOs are currently positioned. As discussed above, most of them are very young, and have started to actively promote the commercialisation of research results only recently. We could argue that they are in the introduction phase of their life cycle. They are building up the experience and competence which are necessary to effectively evaluate the difficulties involved in the marketing of new technologies and in meeting the demand for their research outputs, but they surely have enthusiasm and interest in the topic. Sometimes this interest comes from the top of the university, the chancellor and the Senate, and in other cases it comes from single professors or middle-level university managers who try and start this kind of activity despite weak motivations from top university managers and leading professors.

As a matter of fact, a large part of the TTOs analysed in the survey have been created as a consequence of the growing attention and public discussion about the valorisation of scientific research that has taken place in Italy during the last few years. A genuine interest in these activities by university managers and professors has to be acknowledged, since they actively experiment and exchange practices, and try and find concrete and effective ways to manage protection and commercialisation issues, often experimenting new contractual forms with both large and small firms.

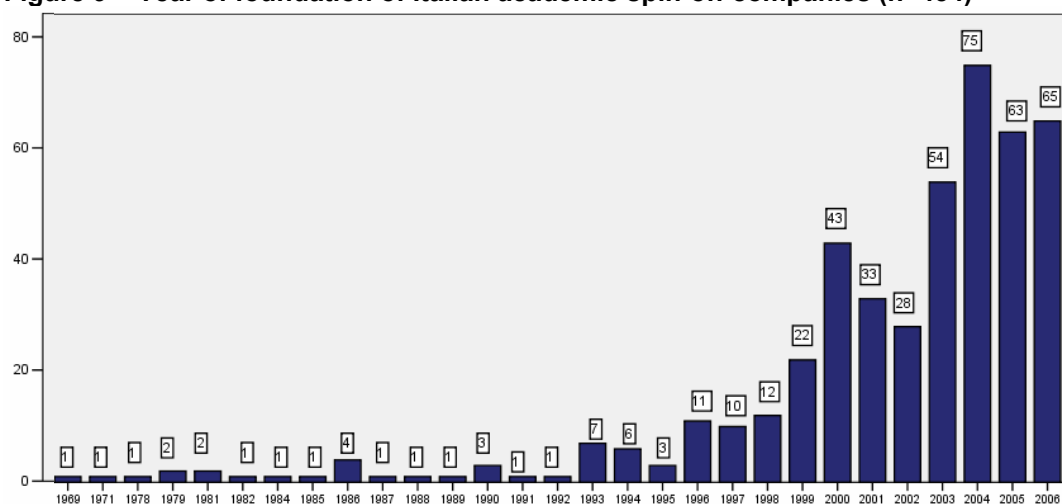
Only at a later stage of their life cycle, when more experience is accumulated, and effective obstacles and opportunities addressed, “correct” expectations can be formulated. It is also worth noting that this situation can represent a favourable solution of the current debate about the role of universities. In fact, those people who are contrasting a more entrepreneurial role of universities in modern economies can find in these results a rather positive solution. More precisely, as it seems, no radical changes in the university mission are likely to take place. Rather, if the possibility of obtaining huge revenues is not feasible (as most empirical evidence shows), the real effects of efforts in technology commercialisation made by universities will be to increase the diffusion of university knowledge and technologies, and to generate positive spillovers for the economy. In other words, we argue – although further analyses at international level are certainly needed – an intensification of valorisation practices may take place without negative influences on the “fundamentals” of the university systems in terms of choice of research topics, independence, orientation towards the diffusion of research results.

One of the means through which universities can facilitate the diffusion of knowledge is the creation of new technology-based spin-offs. The formation of these new companies is largely dependent upon technologies generated within the parent organisations. Hence, by supporting the creation of a spin-off, universities not only attribute a value to their technological competencies and efforts, but also contribute to the economic development of local economies. Furthermore, they favour an increase in the local employment rate of skilled and qualified workers. All these purposes seem largely desirable from a social point of view.

In order to meet this goal, beyond TTOs, many universities have developed internal facilities (such as business incubators or science parks) specifically devoted to the creation of new ventures. Among respondents to our survey, in 2005, 37.5% have declared to have a business incubator and 48.2% are taking part to a science park. In turn, many universities have supported the formation of new firms.

As reported by Piccaluga and Balderi (2006), on the whole, the stock of spin-offs created by Italian universities during the last years is rather high: currently, their total number is more than 450 units. In Italy, the process of creation of academic spin-off companies is a quite recent phenomenon. Some isolated experiences can be observed since the early 1970s, but spin-off creation started assuming a relevant and growing intensity only since the mid-Nineties. However, it is since the year 2000 that the phenomenon has actually assumed a critical relevance within the Italian context: about the 80% of the total number of currently existing Italian spin-off companies have been created in the last six years. In particular, over 60 new firms per year have been established since year 2004 (figure 9). Moreover, the survival rate is astonishingly high (greater than 97%).

Figure 9 – Year of foundation of Italian academic spin-off companies (n=454)



Source: Piccaluga, Balderi (2006).

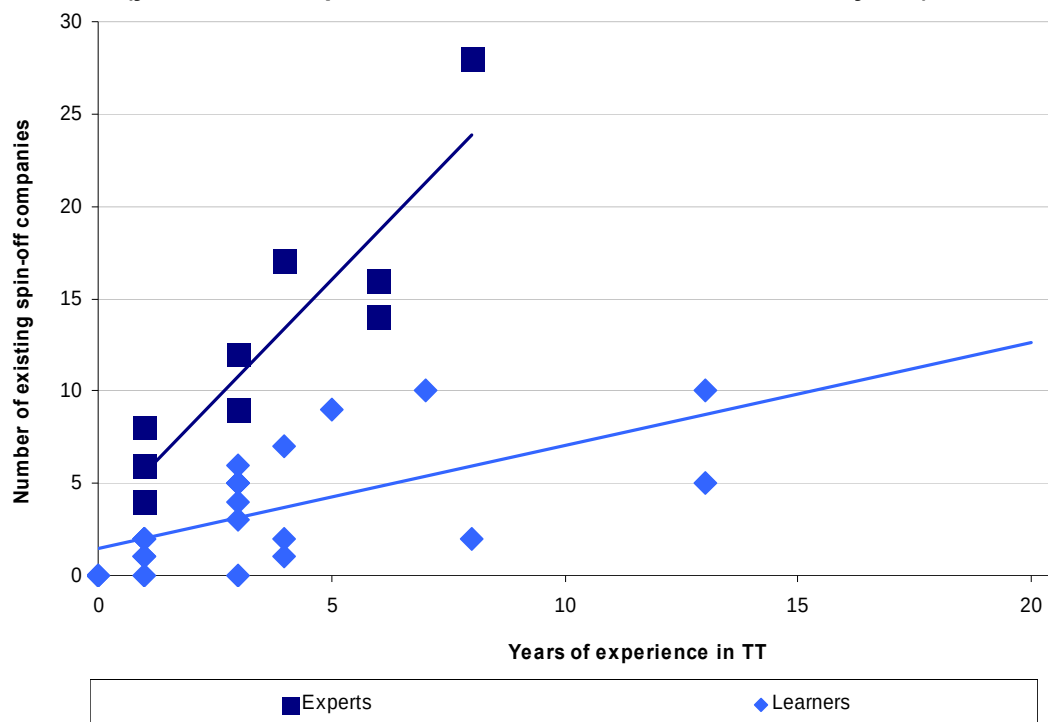
By analysing the number of existing spin-off companies depending on the years of universities' experience in TT activities over time (figure 10), it can be observed that the number of new ventures from academia is positively related to universities' experience in dealing with TT processes. This may be ascribed to several concurrent factors. *First*, physiologically, as we consider the total number of existing firms (which - as recalled above - exhibit a very high survival rate), their number tends to continuously increase over time. *Second*, the progressive

ripening of the valorisation culture as universities get more experienced and skilful in providing support to the creation of academic spin-off companies contributes significantly to the growth of their spin-off portfolio. *Third*, recently the spinning-out of new ventures from academia has become a sort of a fashionable practice, generating an imitation effect among Italian universities, including less experienced ones.

However, also in this case, the speed by which the number of existing spin-off companies grow as the TTOs get more experienced differ significantly depending on universities' attitudes towards spin-off processes: (i) on the one side, some TTOs show a strong commitment to support academics and researchers in the creation of new high-tech ventures (they are labelled as 'experts' in Figure 10); (ii) on the other side, other TTOs' mission is not to actually foster spin-off processes, leading them to pursue different achievements. As a consequence, even if these TTOs also provide support to researchers-entrepreneurs, they are not generally aiming at exhibiting noticeable spin-off portfolios, as they mostly tend to deal with spinning-off processes in a less committed way (they are labelled as 'learners' in Figure 10).

Again, commitment is the critical element which allows us to distinguish between 'experts' and 'learners'. In fact, as can be observed in figure 10, among 'expert' TTOs also the youngest ones achieve relevant performances in terms of spin-off portfolios since their very first years, whereas this cannot be observed in the case of the 'learners', whose main goal is not exactly to foster spin-off processes.

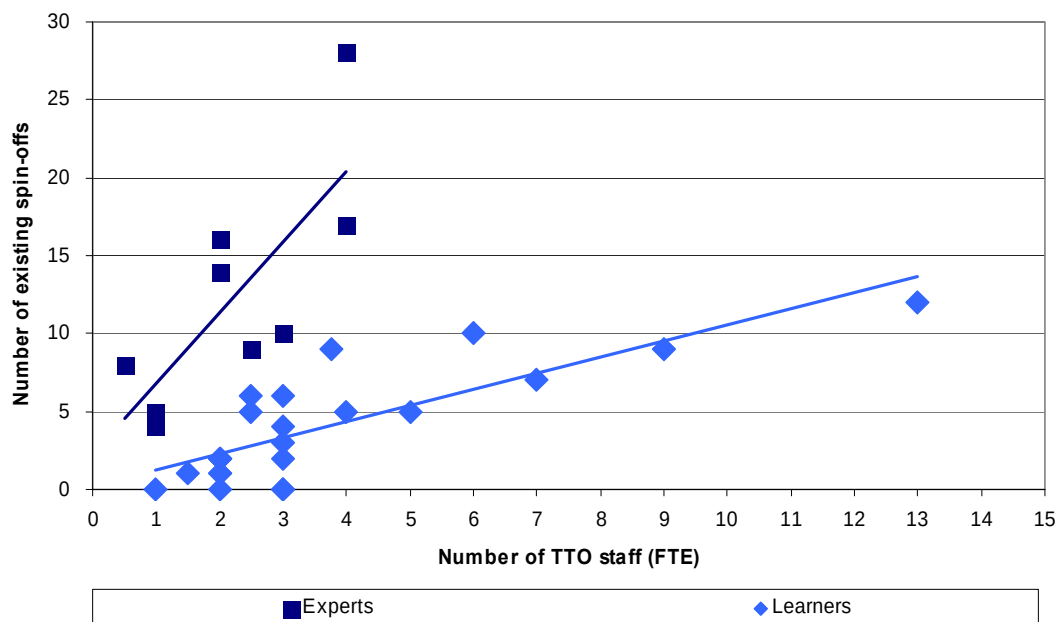
Figure 10 – Number of existing spin-off companies and years of experience in TT activities (year 2005; n experts=10; n learners=21; threshold value: $y/x > 2$)



Source: authors' elaboration based on NetVal (2006).

The co-existence among Italian TTOs of two different attitudes towards spinning-off processes also emerges by analysing the number of existing spin-off companies (by December 2005) depending on TTOs' size (in terms of the number of FTE employees; figure 11). In fact, beyond the development of a *valorisation culture* which can be observed – even with different levels of intensity – in both 'expert' and 'learning' TTOs, also in this case the discriminating factor is represented by the universities' commitment to foster and support spinning-off processes. Indeed, commitment is the critical element in determining the significant performances achieved by the 'experts' in terms of number of existing spin-off firms per FTE employee, leading them to a rapid process of *TTOs' professionalization* which sets the pace for the 'learning' TTOs.

Figure 11 – Number of existing spin-off companies (December 2005) and TTOs' size (n experts=9; n learners=23; threshold value: $y/x \geq 3$)



Source: authors' elaboration based on NetVal (2006).

These results suggest that the creation of new technology-based firms is a critical component of the strategy of research valorisation pursued by Italian universities. As a partial demonstration of the considerations expressed above concerning the real motivations of Italian universities to contribute to the diffusion of technological knowledge rather than to an increase of revenues (research funds), it is worth noting that, in many cases, the efforts directed towards the activity of spin-off creation are even higher than the human and financial resources devoted to the commercialisation of (patented) technologies through licensing.

5. Conclusions

We argue that the empirical evidence presented in this paper can contribute to the discussion and further understanding of the phenomenon of valorisation of university research results and at the same time open some new specific research directions, offering some insights about possible empirical exercises.

University TTOs are a rather vibrant component of the Italian NSI. They seem to be able to strike a balance between the two extreme university organizational models often labelled as "Republic of Science" and "Entrepreneurial University", which depict rather precise – and different - roles that universities should play in

contributing to economic growth. Obviously, the mission and importance of university TTOs vary a lot according to the model which is chosen. In order to contribute to this debate and try to further investigate the role that university TTOs might play in an intermediate model between the two mentioned above, we tried to offer a detailed analysis of TTOs' performance.

In particular, the Italian survey gives a picture of the early stage of development of Italian TTOs. Among the many indicators which is potentially possible to build and monitor, those which we have presented show a relevant increase in the volume of TTOs' activities. What we expected to see and what the data effectively seem to show is that TTOs' growth is both intense and somehow 'wise'. In other words, in the majority of TTOs we don't observe an excessive growth of the patent portfolio and IP expenditures, even if visibility and results appear to improve. It is, in fact, a growth which characterises first of all old and then new TTOs, and which is fast enough to describe the university TTOs' system as a rather vibrant component of the Italian national system of innovation. At the same time the growth can be interpreted as wise and/or thoughtful, in the sense that it does not seem to pursue objectives of excessive growth of the patent portfolio, of the number of spin-off companies and of overall IP expenditure. Rather, Italian TTOs seem to approach a phase in which inventions are patented and spin-off created not because those actions are desirable per definition, but only when the necessary conditions seem to exist.

What further investigation is needed to confirm is the hypothesis that TTOs are also going through a phase of collective learning. This process might hopefully allow the absorption of best practices and at the same time the capacity to avoid the danger of interpreting TT activities solely as an income producing function. In fact, during this phase TTOs mature from the stereotypical image of a mere "center of profit" for the university, and learning through the example of national best practices takes place.

As TTOs go through this phase, further research should also keep other considerations in mind. At the *local level*, the main goal to be achieved for TTOs is a sustained, yet not merely quantitative, growth. In measuring performance at the university level, patenting activities should not be considered as a substitute for publications. Rather, patents should be filed only when necessary. In this perspective, TTOs' selective capacity plays a critical role and further investigation should be aimed at analysing publications and patents trends together.

Also, qualitative evidence, as well as data on the turnover of spin-off firms show that they are not always involved in the development of cutting-edge technologies. Italian spin-off companies are not, albeit with a number of relevant exceptions, fast-growing firms: a limited number of high tech rising stars is in fact surrounded by a large majority of smaller high-tech companies and it is wondered whether an *Italianate* variant of university spin-off is emerging. In this case, the major challenge would be represented by the identification of its strengths and weaknesses and the setting up of appropriate policy actions.

Finally, even if the first phase of the TTOs' life cycle has been characterised by the absorption and adoption of standard procedures, they should be expected to be able to achieve highly differentiated and context-specific strategies in the

near future. This will involve the continuous discussion and absorption of general principles at system level, and the necessary adoption of specific strategies at local/regional level.

At the *national and international level*, the main challenge is that of building an Italian network of TTOs with a specific identity. This implies: (a) the further definition of a national TT model, in conjunction with all TTOs, by further improving professional skills of TTOs' staff. In such a model, TTOs should have a well defined role and TTOs should be able to adopt different strategies according to specific economic and social contexts; (b) the establishment of collaborative relationships with industry marked by a higher degree of trust and cohesion; (c) the contribution of the Italian TT model to the definition of a European TT model, accepted by TTOs localized in different countries.

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