Paper presented in the VI Globelics Conference at Mexico City, September 22-24 2008

Globelics

In search of accurate models to valorise academic research: qualitative evidence from three regional experiences

Hussler Caroline[1]
Picard Fabienne[2]
Tang MingFeng [3]

Short abstract

In this paper we aim at providing a critical appraisal of academic research valorisation models adopted in three regions in the world: the Provincia di Milano in Italy, the Technology-Region Karlsruhe in Germany and the Chinese municipality of Chongqing.

Our first originality consists in developing a three-step analytical framework to characterise and classify existing valorisation tools. In a second step, we depict and compare, thanks to a qualitative analysis run on fine-grained data (collected through in depth interviews and frequent interactions with actors of the regional innovation systems), the research valorisation policies adopted in the three regions so as to test for specificities in the implementation of academic knowledge transfer.

Our analysis exhibits on the one hand a strong similarity among regions in terms of variety of existing tools. On the other hand, we also notice some specificities in the nature of the tools: European regions are characterised by a significant under-representation of absorption and appropriation tools, whereas the Chinese region seems to put great stress on direct

[1] BETA - ULP- 67000 Strasbourg FRANCE, RECITS – UTBM- 90010 Belfort FRANCE, hussler@cournot.u-strasbg.fr; caroline.hussler@utbm.fr
[2]RECITS – UTBM- 90010 Belfort FRANCE, fabienne.picard@utbm.fr
[3] BETA - ULP- 67000 Strasbourg FRANCE, School of Finance and Economics - Chongqing Jiaotong University, 40010 Chongqing CHINA, Tang MingFeng

valorisation mechanisms. Finally, rather than supporting the imitation, multiplication and superposition of newly created tools, our study encourages policy makers to be more selective and adapt their tools to regional needs.

Extended abstract

If much has been written on the theoretical benefits of knowledge transfers from academia to business activities, the channels of academic knowledge diffusion to be prioritised in order to accelerate innovation and to increase growth are not clearly identified yet. Echoing this lack of theoretical harmony, the number and variety of knowledge transfer tools recently exploded (ranging from financial incentives to create start ups to technical support in the drafting of patents, or incentives to favour human mobility), whereas public budgets stagnated, calling therefore for a fine-grained analysis of existing tools and of their respective contributions.

In this paper our aim is precisely to provide a critical appraisal of academic research valorisation models adopted in three regions in the world: the Provincia di Milano in Italy, the Technology-Region Karlsruhe in Germany and the Chinese municipality of Chongqing. To do so, we chose to collect detailed data (through in depth interviews and frequent interactions with actors of the regional innovation systems) on the existence and use of technology transfer tools in those regions.

Concretely, our first originality consists in developing an analytical framework to characterise and classify existing valorisation tools, distinguishing between tools created to disseminate public research, tools developed to improve the absorptive capacities of regional actors, and tools dedicated to monitor technological and scientific needs of regional firms. A second originality of this contribution lies in depicting and comparing, thanks to a qualitative analysis, the research valorisation policies adopted in two European and one Chinese regions so as to test for sectoral and/or national specificities in the implementation of academic knowledge transfer.

Our qualitative and comparative examination exhibits on the one hand a strong similarity among regions in terms of variety of existing tools. On the other hand, we also notice some specificities in the nature of the tools, European regions being characterised by a significant under-representation of absorption and appropriation tools, whereas the Chinese region seems to put great stress on direct valorisation mechanisms. Finally, rather than supporting the imitation, multiplication and superposition of newly created tools, our study encourages policy makers to be more selective and adapt their tools to regional needs.

Key words

Technology transfer tools, Research valorisation, Regional and national innovation systems.

Acknowledgements: This paper strongly benefited from the funding of the UE network MOVARE (to collect information on the European regions under study), but also from OECD funding (to run the Chinese interviews).

1. Introduction

"*The acceleration in economic growth over the past two centuries has been attributed to the advancement of science*" (Sorenson and Singh, 2007), a more rapid accumulation of scientific knowledge leading to increasing spillovers towards the industrial realm. In parallel, in recent years one noticed that the location of research was a critical asset in the economic and innovative competition, as created knowledge was at least partially embedded (Granovetter 1985) and therefore could not easily be diffused and replicated (Cowan *et al.* 2000).

The discovery of this strategic role for science and universities (as engines of economic development) progressively led to the emergence of a new and third mission for universities: a role of technology and knowledge transfer (in addition to the former missions of education and research). This phenomenon described as the "*second academic revolution*" by Etzkowitz *et al.* (2000) reveals that today many science policy measures are putting pressure on academic - and more broadly public - research to become more directly and clearly useful. The identification of the mechanisms contributing to this positive linkage between science and society are thus becoming at the same time a topical issue.

This change in the nature of science (no longer the pursuit of knowledge "*for its own sake*" but the pursuit of knowledge for socio-economic returns) finds its origin in the evolution of the innovative models at stake in contemporary economies and goes in hand with a change of nature of the relationships between university, firms and governmental institutions. Hence, historically, in the linear model of innovation, research had been conducted at university, disseminated in the economic sphere (through publications for instance) and then absorbed by industries in their development processes and embedded in their products. But progressively one noticed that there was also innovation in the opposite direction, starting from socio-economic needs (Gibbons *et al.* 1994 talks about a mode 2 where "*knowledge takes place in the context of application*"), a development of innovative scientific ideas following a technology pull approach, creating a kind of "*reverse linear model*" (Etzkowitz *et al.*, 2000). Step by step, non linear models of innovation (based on Kline and Rosenberg's seminal paper in 1986) emerged, taking interactive and recursive terms into account, arguing that relations linking the actors were necessary to make this model work and to ease knowledge creation and appropriation. We enter today in a systemic dimension of innovation but above all the links and the attributes of the links between those actors become crucial explanatory variables of successful economic development. Triple Helix models (Etzkowitz and Leydesdorff, 2000) go even one step further, stressing that each innovative partner evolves by his/her own, but individual evolution impacts the relationships developed between the key innovative partners, calling now for an analysis of the mechanisms allowing this co-evolution.

To sum up, the boundaries between science and technology become progressively more blurred and the division of labor between on the one hand academia dedicated to scientific discovery, and on the other hand firms involved in development activities, sounds less accurate, leading to the emergence of this new role for academic research.

At the same time, this change in the nature of academic research is reinforced by historical factors - among which Calvert (2002) mentions the decrease and stringency in research funding after the end of the cold war, coupled with a simultaneous increase in the costs of research - which motivates policy makers to ask for research leading to tangible benefits. To put it differently, the impact of universities and research on economic development becomes a central issue of public expenditure efficiency, as policy makers look for a maximisation of spillovers and returns from public investment in science, and as research institutes are in turn increasingly requested to exploit their research achievements not only scientifically but also economically.

All those arguments put research valorisation at the heart of the innovative process of a knowledge-based economy and present it as a major stake for the competitiveness of firms, regions and nations. Indeed, if we adopt the definition provided by the CNE (National Comity for the Evaluation of French Research) the purpose of valorisation is "*to allow the use and commercialisation of results, knowledge and competences resulting from research activity*" (French Senate Report 2005). Valorisation is thus a privileged way of linking research actors to the economic area. But, if much has been written on the theoretical benefits of valorization of ideas, inventions, technologies and research achievements from academia into marketable products, the channels to be created and prioritised to accelerate this extremely complex process (involving a series of intermediate steps and requiring the competences of the different actors to be brought together in a well-coordinated way) are not clearly identified yet. Several reasons might explain this phenomenon.

First and historically, academic spillovers were presented as floating in the air (being immediately and freely accessible): this assumption postponed any analysis of the mechanisms (and efficiency) of academic knowledge valorisation. However, with the pioneering article by Breschi and Lissoni (2001), a new strand of articles started investigating how academic knowledge flows from scientific labs to industrial realm. If many articles point out the crucial role played by star scientists in the effectiveness of academic knowledge absorption (Zucker, Armstrong and Darby 1994, Zucker and Darby 1998), other and more recent contributions rather stress the beneficial role of the mobility of scientists and engineers in the technology transfer process (Almeida and Kogut 1997, Song, Almeida and Wu 2003, Moen 2005), and a third group of papers highlight the benefits of incubators and spin-offs creation (Lockett and Wright 2005; Phan, Siegel and Wright, 2005; Chan and Lau, 2005).

As a consequence, the number and variety of valorization tools recently exploded (ranging from financial incentives to create start ups to technical support in the drafting of patents, or incentives to human mobility), whereas public budgets stagnated, calling therefore for a scrutinised analysis of the respective uses and contributions of each tool to social welfare and growth. Unfortunately, as far as we know, only few empirical contributions run comparisons of the use and effect of valorization tools in various geographical areas, and existing studies on the topic mostly concentrate on the analysis of one (nation-specific) technology transfer tool. However, if innovative models differ across countries, regions and even sectors why should there be "*one (unique) best way*" of organising an efficient valorisation policy?

To tackle this question and test for the context-dependence of valorisation measures, we analyse in the present paper how to transform scientific knowledge (and more generally the product of academic/public R&D activity) into economic assets, with the ultimate goal to provide a critical appraisal of academic research valorisation models adopted in three regions. Actually, we describe and characterise different regional models of research valorisation using the information on the existence and use of various valorization measures gathered during the MOVARE project[4] and an OECD program in China.

Concretely, our first step consists in developing an original analytical framework (section 2) to characterise and classify existing valorisation tools, distinguishing between the impact of tools created to disseminate public research (and therefore make economic actors aware of existing scientific knowledge), tools developed to improve the absorptive capacities of regional actors (and help them to use academic knowledge for their business), and tools dedicated to monitoring technological and scientific knowledge required by firms (and by doing so informing public research organisations about the needs of economic actors in terms of knowledge). Then, thanks to an in depth qualitative analysis, we depict (section 3) and compare (section 4) the research valorisation policies adopted in two European regions - namely Provincia di Milano (in Italy) and Technology-Region Karlsruhe (in Germany) – and one Chinese region – Chongqing region - so as to test for specificities in the implementation of academic knowledge transfer. In section 5, we provide a tentative interpretation of our

[4] This collaborative research program financially supported by the European Union aims first at fostering the benchmarking of research valorisation policies and second at facilitating the implementation of European best practices in the domain. Actually, the ultimate goal of the MOVARE (MOdel for VAlorisation in REgions) project lies in increasing the R&D investment at regional level, in order to make European Union regions the most competitive worldwide and to achieve a sustainable regional economic development.

qualitative investigations, before drawing some preliminary conclusions on the definition of an efficient valorisation model.

2. Framework for an interactive model of research valorisation

Research valorization systems involve a huge diversity of actors, prompted by various interests: researchers or labs (mainly public), managers or firms (often called private sector), and interfaces or intermediate organisations (technology transfer offices, incubators, development agency, regional or local institutions…) have different and sometimes conflicting rationales (Dasgupta and David, 1994). For instance, research valorisation still does not play a significant role in researcher's careers and academic researchers are still not very interested in valorisation - valorisation being considered as a commercial activity too far from the scientific interests of researchers. On the other hand, firms might be suspicious towards academic research.

Under those conditions linking research to the industrial sphere may be non-trivial. Research valorisation tools should be delineated with the objective to boost relationships between the actors of the system and to ease knowledge circulation and accumulation. Indeed, research valorisation is a complex process occurring within a creation-diffusion / appropriation-absorption dialectics. Its efficiency is conditioned by on the one hand the scale of the knowledge spillovers and on the other hand the knowledge absorption capabilities of the actors. Indeed, an interesting property of knowledge is its capacity to produce further knowledge by transfer: knowledge spillovers between academic research and firms generate a cumulative mechanism of knowledge creation. However, the literature emphasizes the existence of spatial limits to knowledge spillovers due to the tacit and non-rival nature of knowledge (Jaffe 1989, Audretsch and Feldman 1996, Jaffe and Trajtenberg 1998, Varga 1998) and shows that the regional innovative capacity of firms depends on knowledge generated by local universities. Under this condition, it is not surprising that a large part of valorisation tools are dedicated to help the diffusion of existing academic knowledge.

However, most of the time, knowledge resulting from (academic) research activities is not immediately appropriable by firms (Cohen and Levinthal 1989) as research results are not technical information that a firm can incorporate in a new product or process for free. On the contrary, according to Nonaka and Takeuchi (1995), part of knowledge (the tacit one) can not easily be disseminated out of its producers as it may be (at least partially) embodied in its creator. Therefore, research valorisation cannot be reduced to a mechanism of codified knowledge transmission; tacit knowledge is also crucial to be exchanged and accumulated among actors. Consequently, research valorisation tools have to follow the channels of both codified and tacit knowledge flows and to go beyond the problem of codified knowledge dissemination from university to firms.

Based on the preceding remarks, we consider that a research valorisation system is built on three complementary dimensions linking actors together, each dimension being characterised by a specific goal. The first one is concerned with the dissemination of public research results in order to make economic actors aware of existing scientific knowledge. Its ultimate goal lies in increasing the reliance of industry on knowledge originated in regional academic institutions. The second dimension of the research valorisation system aims at improving the absorptive capacities of regional actors and helps them using academic knowledge for their business. The third step of the research valorisation process is dedicated to monitoring technological and scientific knowledge required by firms and to informing public research organisations and academic researchers about the needs of economic actors in terms of knowledge.

- **Step 1: Making economic actors aware of existing regional scientific knowledge and competences**

To achieve this objective, communicating about the scientific and technological knowledge available on a given territory sounds accurate. Indeed, when academic research has already been undertaken and results are already available, the first missing link lies in making this new knowledge production open, accessible (in disseminating information on those discoveries) to academic and non-academic actors who are not directly connected to universities and therefore are not aware of new discoveries. It is also a way to alert firms about scientific knowledge frontiers - the actual scientific state of the art in a given field.

Historically, R&D public policy focused on this specific dimension due to the conception of technological knowledge as information (Arrow 1962), easily appropriable as soon as it diffuses in the ambient air. That may explain why most research valorisation tools still support this first dimension of the process. Among this first category of valorization measures, we find licensing. According to Siegel *et al.* (2003) licensing is traditionally the dominant way to valorise research results: by using it, universities avoid spending time and money to commercialize a technology or product on their own, whereas firms get access to newly created knowledge, without bearing their respective costs of discovery. This first type of valorization tools also includes more informal or traditional ways to communicate about research results such as meetings of local professional associations, university seminars, conference attendance, open days, scholarly journal publications, or university consulting (Varga 1998).

Once the potential users are informed of and have access to the scientific knowledge produced at universities, the next step consists in appropriating this knowledge ie in providing this knowledge with an economic value by using it in the industrial process or in the commercial activities so as to improve the performances of firms and their competitive advantages.

- **Step 2: Helping economic actors to use knowledge for their business**

The second dimension of the research valorisation system aims at improving the absorptive capacities of regional actors and at helping them to use academic knowledge for their business. Knowledge does not create economic value by itself. It only gives a potential of economic value creation but effective economic value results from the absorption process developed by firms. Actually, firms need to understand, integrate, adopt and adapt the knowledge to their market needs (Cohen and Levinthal 1990). Here the challenge of research valorisation tools is thus to prepare the firm to integrate and use external knowledge for their business. According to the literature a first way for firms to improve their absorption capacities consists in investing in internal R&D (Cohen and Levinthal 1989). Developing R&D cooperation and more generally joint projects, funding PhDs in partnership with industry, by facilitating a co-construction of knowledge are also valuable means to increase firms' absorptive capacity. Supporting the mobility of human capital (Almeida and Kogut 1997, Moen 2000, Zucker *et al.* 1998, Cockburn and Hendersson 1998) is a third way to build an absorptive capacity, by allowing the embodied part of knowledge to circulate and to be absorbed by firms. The creation or existence of a flexible local labor market of scientists and engineers is also a way to gear up this second step of valorization. Lifelong training programs developed by universities to form on-the-job students appears as a complementary means to either preserve or improve the level of absorptive competences within firms. Indeed, students of such programs evolve close to professors active in academic research and thus have the opportunity to get additional explanations on a given knowledge or technology.

The third step of the research valorisation process is dedicated to monitoring technological and scientific knowledge required by firms and to informing public research organisations and academic researchers about the needs of economic actors in terms of knowledge. Here we reverse the logic and try and understand whether and how universities and other public research organizations are informed about technological innovations and improvements on the one hand but also about technological and scientific problems firms are confronted with, on the other hand.

- **Step 3: Informing research providers about the needs of economic actors in terms of new knowledge and market opportunities**

This is a way to measure how science (and more broadly public research) adapts its respective centers of interest and research topics to technological and economic needs. Indeed making science useful by shortening the time span between discovery and utilization can also be achieved by selecting and investing in research topics that are more directly and rapidly useable and economically valuable for firms .

Researchers can identify different options to direct their research thanks to national programs (key technologies, innovation agency) or with the help of specific organizations in charge of projects and private contracts prospecting for labs. Proximity and regular contacts between actors are in all probability one of the best ways to develop research programs matching industrial needs, that is why clusters, industrial parks or "pôles de compétitivité" are crucial organizations. Foresight activities involving academic researchers but also actors from the economic and business sphere can also be used to achieve this third goal.

To sump up, the system of (academic) research valorization can be viewed as a combination of those three steps, and can be represented by the following figure, where:

1) refers to actions supporting the diffusion of academic research results
2) refers to measures supporting the adoption/exploitation of academic research, and
3) refers to policies devoted to the stimulation of academic research.

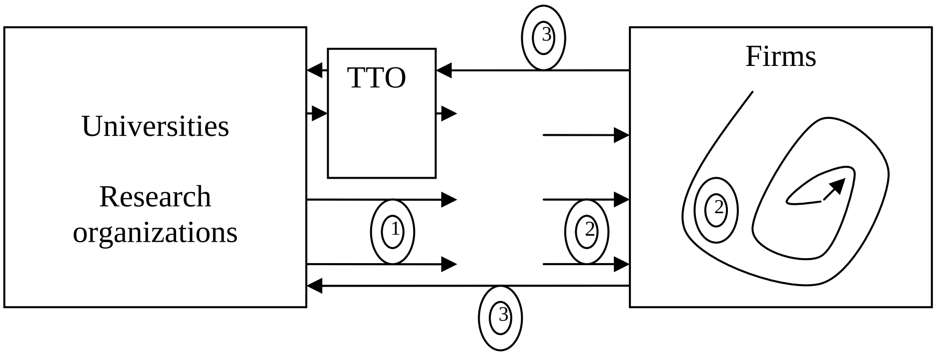

Figure 1: Making academic research useful: a three-dimensional process

To achieve each of those steps, tools of different types are necessary and available, as summarized in Table 1.

Table 1: The academic research valorization tool-kit

Tool-type	Main goal[5]	Examples of tool
1	diffusion of academic research results	publications, licences, conferences, patents
2	adoption/exploitation of academic research	spin-offs, mobility of human capital, training programs
3	stimulation of academic research	industrial parks, TTO, foresight activities

[5] This taxonomy of valorization tools does not mean that each tool is exclusively targeted at one and only one objective and cannot be useful to achieve other goals. For instance, research contracts are of course favorable contexts to simultaneously disseminate knowledge, improve absorptive capacities and exchange knowledge about economic needs. However, we believe that each tool mostly answers one of those three goals.

To build our 3-step model, we assumed that research valorisation is a non direct process involving on the one hand the knowledge producer and on the other hand the knowledge user, who are distinct economic actors who need to be connected. However, the translation of existing academic knowledge into economic value can also take a more direct way: in the direct research valorisation process the knowledge producer takes upon himself the economic valorisation of his/her research, through spinning-out/off a company for instance (a huge literature is already dedicated to this phenomenon, see Franklin *et al.*, 2001; DiGregorio and Shane 2003; Wright *et al.*, 2004, Siegel and Phan 2005).

The next step of the paper consists in looking at the models of research valorisation adopted in three regions (Technology Region Karlsruhe, Province of Milan, Municipality of Chongqing) through the analytical lenses we just presented.

3. Regional backgrounds[6]

In this section, we present some general characteristics of our regions of analysis, recall their recent history and provide their main economic and technological features with the ultimate aim to be able to sketch a short profile of our context of study. In a second step we briefly motivate the selection of those three specific regions.

The Technology Region **Karlsruhe** is the product of the voluntary merger of eight towns and cities (among them Karlsruhe, the former capital of Baden) and two regional administrative districts of the German state Baden-Württemberg, willing to cooperate on business, science, culture and administration, and thus ready to give birth to a governance structure of regional economic policy on a partnership basis. The specific geographical location of the Karlsruhe

[6] Many thanks to Innov-Germany AG (and among its members K. Petersen, L. Schmerber and I. Winter), KEIM (with J. Fahrenberg), Provincia di Milano (M. Camarero, C. Raia) and Politechnico di Milano (with G. Serazzi and L. Muttoni among others) for their dynamic support in collecting the data on the European regions.

region (bordering France/Alsace in the west and the state of Rhineland-Palatinate in the north-west) reinforces this network structure, as it motivates this territory to engage in voluntary collaborations and joint initiatives to support its economic development and attractiveness both on a supra-regional level and internationally. The socio-economic dynamism of the Technology Region Karlsruhe is grounded on a population of almost 1 million inhabitants (against 10 million for the state of Baden-Württemberg), 300 000 of which live in the city of Karlsruhe.

The economic structure of the Technology Region is characterised by a growing service sector, trend-setting high technologies and mainly SMEs, the city and region relying on a solid reputation in science and research. More precisely, automotive, nanotechnologies and information technologies are the main economic sectors. In terms of employment, services and trade (including public services) enrol 77% of regional employees, whereas industry attracts roughly 23% of them, 17% of the working population being involved in high tech sectors. This balanced economic structure ensures a high productivity and a high purchasing power (12% above the national average) to regional inhabitants.

The Province of **Milan** (including 189 municipalities) belongs to the Lombardy Region in the north of Italy and can be considered as one of the most important metropolitan areas in Italy with 3.8 million inhabitants. Around 6.5% of the Italian companies are located in the Province of Milan and the region concentrates 15% of the high-tech companies (both manufacturing and services) and 31% of the Italian high-tech workers. The GDP per capita is over 28 000 euros and contributes to 10% of the national GDP.

A diversified economic structure[7] allows Milan to compete with the main European cities in attracting foreign investments. The decline of heavy industrial production during the 70s left

[7] Major industrial activities are mechanical, metallurgical and electromechanical industry, ICTs, textile-clothing and leather, fashion-design, wood-furniture.

space for the service and tertiary activities (actually around 28% of companies belong to the industrial sector and 68% to the service sector). Those activities are developed very close to the productive companies located in the area; they employ qualified workers and create high added value. During the 90s economic globalization and technological evolutions definitely modified the traditional production model. Nowadays, the development model of the Province of Milan is based on a compact network of productive companies of small and micro dimension integrated with a limited number of medium-large firms – which make up the famous Italian industrial district. The creative sector includes activities that generate wealth and intellectual property and constitutes one of the key factors of the Milanese area development, as it exerts important pulling effects on traditional productive activities.

The region of **Chongqing** is the youngest but also the biggest Chinese municipality among the four existing ones. It covers 40 administrative districts and counties with a population of over 30 million inhabitants. Over 3000 years of history resulted in Chongqing becoming a dynamic economic center in upstream from the Yangtze River and also a major and modern manufacturing center in China. Today, the primary sector absorbs 13% of the labor force, secondary industry[8] 33% and tertiary industry 54% (the manpower recently arrived from rural areas is mainly enrolled in manufacturing, retail and wholesale, hotels and restaurants).

The economic backbone of the region consists in five industries (automobile and motorcycle, chemical medicine, architecture and building material, foodstuff and tourism) and three high-tech industries (IT, biotechnology and environmental protection), some of them (motorcycle, glacial acetic acid and polyvinyl alcohol fiber) providing up to 20% of the Chinese national production. About 15,000 enterprises get involved in manufacturing activities, and over 600

[8] Secondary industry includes mining and quarrying, manufacturing, electricity, gas and water production and supply, construction.

ones are high-tech firms. Military technology used for civil service is a third major economic sector of the region.

If state-owned enterprises are the main contributors to regional economic development, the structure of local industries is however upgraded by the presence of 93 foreign-owned companies (among the world top 500).

In addition to its internal competitive resources, Chongqing takes advantage of strong networking activities with its neighboring economic centers. Indeed, due to its former administrative subordination to the province of Sichuan (until 1997) and thanks to the support given to the creation of the Chongqing-Chengdu economic region (the merger of both governments), industries from those two provinces still continue their supra-regional cooperation, especially in motorcycle, automobile and iron or steel manufacturing. All those characteristics coupled with the national development strategy ("develop the west" and the construction of the Three Gorge Dam Region), led Chongqing to experience in 2007 a record growth rate of 15.6%, taking the third place among all Chinese regions.

Table 2 sums up the main descriptive characteristics of the regions under analysis.

Table 2: Basic elements for interregional comparisons

(data collected during the MOVARE and OECD projects)

	Karlsruhe	Milan	Chongqing
Population (million) % of national population	2.73 3.2%	3.87 6.5%	28.08 2.1%
Surface (km2) hab./km2	6 919 394	1 982 1939	82 400 305
GDP/hab (€) % of national GDP	31 115 3.78%	35 776 10%	1166[9] 1.65%
Unemployment rate	7.1%	4.2%	4%
Industrial specialization	High industrialization (35.2% of total jobs), strong presence in high-tech industry: automobile, nanotechnology, ICT	High industrialization (31% of total jobs), strong presence in high-tech industry: mechanical and metal industry, ICT, biotechnology, textile, leather, fashion, design, wood and furniture.	Moderate industrialization (19.2% of total jobs), strong presence in heavy industry: transportation manufacturing, chemical industry, ordinary equipment manufacturing, smelting and pressing of nonferrous/ferrous metals and coal mining
R&D personnel (% of national R&D personnel) % in the private sector	36 634 (2.95%) 46%	46 023 (1.13%) 49%	77 616 (1.2%) 49.7%
Researchers % in the private sector	20 869 43%	20 474 43%	24 898 68.7%
R&D expenditure - /hab - /GDP R&D intensity	 1 175€ 3.83% 2.5%	 347€ 1.2% 1.1%	 12.7€ 1.2% 1.42%
% of private R&D expenditure National average	61% 70%	66% 48%	78.3% 71.1%
European patents/million habitants	547	178	230[10] (patent applications)

[9] 1€=10.66RMB, Bank of China, June 21st, 2008.
[10] The patents are filed and granted at State Intellectual Property Office of China.

Our three case studies seem pertinent to test our assumptions about differences among valorization systems since, as evidenced by Table 2, the analytical regions we consider differ in size (stock of human capital), in the nature of research organizations located within their boundaries, in the sectors of activity they host, and finally in the governmental structures they have (as they belong to different countries). Put differently, the three major building blocks of their innovation systems (university, firms and government) show specific characteristics which motivates our idea to analyse whether those three regions adopt and implement differentiated valorization systems. If those three regions differ, they however present some similarities when we consider them in pairs. First, Milan and Karlsruhe are European regions, which allow us to test for any European harmony in terms of valorization policies. Regarding Milan and Chongqing they present some common features in terms of unemployment rate, R&D expenditure and personnel, which seems useful to test whether transforming economies and western market economies (with similar activities) exhibit specificities in the format of their innovation and valorization policies.

4. Innovation and valorisation models

According to Carlsson *et al* (2002: 234) a system is made up of components ("*the operating parts of the system*"), relationships ("*links between the component*") and attributes ("*properties of the components and relationships between them*"). In the subsequent presentation of the regional valorization systems, we try and describe those three building blocks for each region, in order, first to see whether some systemic dimension emerges in the valorization models presented, and second, to provide some comparable elements for all the regions.

Karlsruhe hosts Germany's oldest technical university (with over 20,000 students and approximately 2250 researchers) and is home to numerous research facilities. Hence, the *Forschunguniversität Karlsruhe* offers curricula in engineering, natural sciences, economics and arts, and host six centers of highly qualified in-depth research. Another major Higher Education institution is the *Hochschule Karlsruhe*. It offers an original professional academic education, in which courses are focused not only on academic learning but also aim at fulfilling industry requirements. Within this university, the *Institute of Applied Research* (IAF) is the central application-oriented research institution and is in charge of looking for funding sources for innovative ideas. A third major higher education institution of the Technology Region Karlsruhe is the university of applied science located in Pforzheim which trains people in business, design and engineering, and enrols around 200 university-professors.

But research is not only implemented at universities in the Technology Region Karlsruhe. Indeed, this region is also the seat of one of the largest non commercial-science and engineering research-institutions in Germany (the *Forschungszentrum Karlsruhe*), whose research goals are defined by the state of Baden Wurttemberg and the Federal Republic of Germany, its (funding) partners. It is an effective research engine as it develops on the one hand programmes dedicated to support researchers at every phase of the research and development process, and at the same time it cooperates with partners from science and industry to conduct its own research activities.

The innovation system of the Technology Region Karlsruhe also benefits from the presence of three *Fraunhofer Institutes*, commissioned and funded by federal and state ministries to carry out future-oriented projects which contribute to the development of innovation in strategic fields and key technologies. They are specialised in information and data processing, chemical technology and in the analysis of the economic and social aspects of technical development and innovation.

Over 20 transfer agencies ensure the transformation of research results into innovative and trend-setting products and processes. Among them, the *MAP* is a central service unit of the Forschungzentrum which has four main missions. First, it presents the research and technology offers and potentials of the entire research center to external partners and partners-to-be. Second, it identifies, in collaboration with industry, interesting projects and brings them to maturity. Third it is in charge of patenting the inventions of the members or the research center and managing the related licenses. Besides, the *TLP* (technology licensing office of all nine universities of Baden Wurttemberg) plays the role of detecting potential inventions and advising and supporting inventors until they find an industrial partner willing to use their invention through a licensing agreement. Moreover, technology transfer is carried out by transfer centers from the *Steinbeis foundation* which play the role of gatekeepers between university and the business world. Indeed those organisations (funded by firms) thanks to a highly qualified technical equipment and staff coupled with a long experience of consultancy and development activities, do provide substantial support to research valorisation (each Steinbeis TT center being specialised in a technological domain). Lastly, each university has its own technology transfer office, handling the transfer process whatever the technology concerned.

The action of those transfer agencies in terms of knowledge creation and dissemination is complemented by the activities of the *Chamber of Industry and Trade*. Indeed, in the field of entrepreneurship, this institution organises information events in the region mostly dedicated to making potential entrepreneurs sensitive to financial and legal aspects of firm creation.

A more original actor of the innovation system is the *L-Bank* which is involved in a multitude of state's technology parks through its intervention as provider of support and funds to business founders.

Regarding the city of Karlsruhe and the Technology Region, they are also actively involved in the valorisation process. Hence, since 1998, the region benefits from the *KEIM e.V infrastructure* (and its successor the *KEIM forum e.V*). The KEIM eV infrastructure was established to build a qualified network of technology-oriented start-ups in the region of Karslruhe and Pforzheim and to take part in the confidence building process among the network members. Funded by the city of Karlsruhe, the state ministry of research and supported by the European social fund, the KEIM forum eV mainly focusses its activity on organising seminars at universities dedicated to stimulating and facilitating researchers' entrepreneurial abilities, with the motto "being a boss is better". It is particularly active at the very beginning of the process by detecting promising business ideas but it also offers support and information about accessibility to public funding and a platform to implement the business concepts (thanks to the help of the *engage AG* public-private organisation). A similar association has been recently created to help set up companies in the field of internet and new media (CyberForum eV)

Another important actor of the innovative and valorization model of Technology Region Karlsruhe is the *Technologiefabrik Karlsruhe*, one of the country's biggest and oldest incubators. Since its beginning in 1983, this incubator supported the foundation of more than 200 technology based companies (and 3500 jobs). In addition, the region hosts a supraregional network for nanotechnology materials, gathering (German and Polish) research centers, universities, Max Planck institutes, and major companies willing to coordinate their research programmes on the topic. This thematic platform plays a major role in the valorisation process as membership of the *Nanomat* network enables close cooperation and easy exchanges of knowledge, allows technological problems to be quickly solved, and offers the unique opportunity to create and adopt new, innovative and dedicated education and training programmes. Finally a regional cluster on “mobile solutions” (mobile Region Karlsruhe) recently emerged with the objective to develop contact possibilities among actors interested by this future-oriented research topic).

The **Milan** area is the most highly qualified scientific district in Italy, performing about 25% of the national scientific and technological research effort. The innovative potential of the Milan area is based on a well-structured university system and a high number of private and public research centres, as well as a quite developed system of innovation supporting structures.

There are seven universities[11] totalizing 187,200 students, more than 130 research and university institutes in the scientific and engineering sectors, 44 public research centres (national research centres or other public bodies) and 80 further private research facilities. All these organizations invest in research: 20% of R&D expenditure are carried out by universities, 69% by private firms and 7% by public administrations and 4% by non-profit organisations). Consequently, in 2003, 37% of European patents delivered in Italy came from the Province of Milan.

Offices of technology transfer work within universities to valorise research results, especially at Politecnico di Milano where three main organisations exist. Born in 1999, the *Technology Transfer Organisation of Politecnico di Milano* supports researchers in patent filing activity (evaluation of patent requests, patent portfolio managing, licensing activity, spin-off generation support activity, training…). Established in 1999, *Poli Design* is a consortium of Politecnico of Milan linking polytechnic expertise and industrial competences. This flexible

---

[11] Milan State University, Politecnico of Milan (technical university), Catholic University "Sacro Cuore", University of Milan-Biccoca, University of San Raffaele of Milano, Commercial University of Luigi Bocconi, University of Languages and Communication.

structure involves many experts working on design issues and their promotion and it tries to aggregate the best available expertise in university research and the demand coming from companies and professionals. The third organisation is the *incubator of the Politecnico of Milan* whose mission is to provide well-equipped facilities for small start-ups in the high-tech sector and to assist the start ups by providing access to professional counselling services in the fields of business organisation and management. Another structure was created in 2005 at the University of Milan, the *UNIMITT-TTO* in order to contribute to building up a modern entrepreneurial approach of the university, supporting the valorisation process of competences, products and opportunities of the University. All these structures are able to cover the three dimensions of the research valorisation process.

The action of those transfer agencies is completed by regional (region Lombardy) and local (Province of Milan) measures aiming at supporting economic development and managing relationships between different organisations. Concerning the Region of Lombardy there are two main structures for promoting innovation: Finlombarda and Cestec spa. *Finlombarda* is a joint venture between regional administration and private finance aiming at providing assistance to the regional, local administrations in the use of public-private partnership models for making investments and using innovative financing tools. *Cestec spa* is an enterprise controlled at 51% by the Region aimed at supporting SMEs and handicrafts activities. Cestec's activity is aimed at improving the diffusion of technological development, at sustaining research and management needed by SMEs in order to innovate. Concerning the Province of Milan, several agencies are in charge of promotion of innovation (for instance, *Milano Metropoli Development Agency* (territorial marketing, promotion of strategic economic sectors, special re-industrialisation projects), *Agintec, Euroimpresa* and its incubator for highly innovative firms).

The Chamber of Trade and Industry also plays a role of promoting innovation thanks to the Euro Info Centre providing information and consultancy services to SMEs and the Formaper aiming to promote entrepreneurial culture. Its mission is not directly to valorise research results but to improve the receptivity of the research environment.

Finally, other actors are involved in the research valorisation system. The Cariplo Foundation promotes scientific research and technology transfer. The non-profit organisation Assotec acts as a technology broker especially dedicated to SMEs. The Consorzio Politecnico Innovazione (a non-profit consortium gathering industrial associations, public entities and research institutes), created in 2000 by Politecnico of Milan, tries to bridge the gap between academia and industry by facilitating the creation of joint research programs and innovation projects. Finally, the Technological Park of Padano plays a central role within the Centre of Excellence for Agro-Food Biotechnologies. The park gathers together University, private research labs, and a firm incubator.

Chongqing is one of the leading western regions of China in terms of S&T resources. It hosts 38 higher education institutes with 376,118 students[12], 715 research institutes employing an S&T staff of over 36,717 people[13], and 26,826 R&D personnel hired in large and medium size enterprises (LMEs), higher education institutions and R&D institutes[14]. The most famous universities in the region are *Chongqing University* and *Southwest University*. Chongqing University specializes in electromachinery, energy, material and IT, whereas Southwest University focuses on social science and ecological agriculture. Together with other military and civil universities, they get actively involved in regional and national S&T programs. For instance, the identification of TD-SCDMA standard in telecommunication, the silkworm

[12] Data collected from http://www.stats.gov.cn/tjsj/ndsj/shehui/2006/html/0227.htm Number of Students Enrolled in Undergraduate or Specialized Courses in Institutions of Higher Education by Province (2006).
[13] Data collected from Chongqing Statistic Report on Science and Technology, 2006.
[14] Data collected from http://www.stats.gov.cn/tjsj/qtsj/zgkjtjnj/2007/t20071130_402448601.htm National Bureau of Statistics of China, 2006.

genetic design, new generation of hybridized high-quality rice are some of the research outputs of those universities.

In addition to universities, research institutes, enrolling almost half of regional S&T staff and investing half of the R&D expenditure, play an important role in regional innovation. Most of them are former public research institutes (PRIs) oriented towards development activities which have been transformed into private organizations since 2001. Their main duty lies in commercializing academic output and in exploring markets. Their activities are in line with the regional industrial strategy, covering high-tech industries and ecological agriculture. Although research institutes are either independent or hosted by universities, most of them are embedded in LMEs.

Under political and economic pressure, academia and industry get closer through joint R&D projects, mobility of human capital and technology training. One successful science-industry linkage case is the *national engineering research center for magnesium alloys*. This center was founded in 2000 by university, industry and military research institutes and is today the biggest production base of magnesium alloys in Asia. Another successful partnership led to the creation of *TD-SCDMA 3G mobile* and core micro mobile chip: it demonstrates the feasibility of making indigenous firms in telecommunications innovative thanks to academic help.

A complex system of capitalization of academic research findings exists in Chongqing. First, technology transfer offices (*TTOs*) are widely integrated in universities and research institutes, acting as double intermediaries between academia and innovators on the one hand (to clarify problems related to intellectual property rights for instance), and between academia and industry on the other hand (to ease knowledge transfer).

Second, *technology market* plays an important role in commercializing and diffusing knowledge. This market is the biggest technology dealing center in the West of China. Market transaction mainly concern technology service and technology development contracts (each of them accounting respectively for 52.8% and 40.8% of the total amount of transactions). 76.32% of the total transaction volume is generated by technologies arising from S&T programs, and the majority of traded technology is used to promote industry, such as advanced manufacturing technology, energy saving technology and electronic information technology. Firms are at the same time the biggest technology demanders and suppliers, but PROs also play a role on this market. About 64% of traded technology remains in Chongqing; the rest flows outside the region or even abroad.

Third, national and municipal-level science and technology industrial parks (*STIPs*) have been set up since 1991 in order to form clusters of innovation and cooperation between science, industry and education, to support technology-based start-up creation, and finally to industrialize high-tech products. STIPs focus on the development of telecommunication, modern manufacturing, apparatus and instruments, biotechnology and cultural and creative industry.

Technology business incubators (*TBIs*) are another valorization tool created by the Torch Program to nurture new technology-based firms. They provide potential innovators with absorptive capacities and marketing capacities so that they are able to transform their original idea into an effective business (some TBIs provide incubation service at a very preliminary stage of the R&D process and even when research findings have not been out of laboratories yet). TBIs do not only support indigenous technology-based start-ups but also imported technology-based ones. Concretely, Chongqing hosts 27 technology business incubators (including 2 university science parks of national scope). Up to 2006, these two university science parks have hosted 386 tenant firms, creating 13,403 jobs. More than 40% of those tenant firms have directly or indirectly been launched by university professors and students (mainly from Chongqing University and South-west University). Moreover, 70 tenant firms have already graduated from the parks.

Productivity promotion centers (*PPCs*) are a fifth bridge between universities, firms and research institutes. They are composed of a group of intermediary and consulting organizations devoted to supporting small and medium size innovation-based firms. The Ministry of Science and Technology together with a local S&T Commission manage these centers in terms of macro-policies and business guidance. Local government acts as the major financer of PPCs. These centers (which are government-backed) provide diversified services ranging from consulting to information, training, talent hunting, but focus on information provision for firms. Among the 18 existing PPCs[15], one PPC belongs to the national demonstrative PPCs and works in close cooperation with Hong Kong.

Another supporting infrastructure for regional innovation is the financial system. The funding of S&T activities mainly depends on industry and government. Due to uncertainty of research output and commercial potential, bank loans play a comparatively weak role in financing innovation activities. National and regional innovation funds, venture capital firms and guarantee agencies, all these institutions with government background, specialize in financing technology-based small-medium enterprises. Universities also set up venture capital to fund spin-offs, especially at the early stage of incubation.

5. From regional innovation systems to regional valorization systems? Tentative interpretation

A first interesting point to be stressed is that, in Technology-Region **Karlsruhe**, research valorisation is implemented by publicly funded organizations but also by a foundation (Steinbeis) financed by private partners. Moreover, public research is not only carried out in

[15] See Chongqing statistical report on science and technology, 2006.

universities but many public research organizations co-exist (each of them being specialized in very specific fields and in more or less applied research topics), each of them developing its own office (or offices) of valorization. This specific organizational structure of the valorization process might be explained by the characteristics of the German national system of innovation. Indeed, if we refer to Keck (1993), historically (in the 18th-19th century), engineering activities were considered as lacking the dignity of science and therefore were not admitted at German universities, which led to the creation of Technische Hochschulen (or technical universities). Later, during the 20th century, the German research landscape experienced a new step with the birth of research institutes founded jointly by government and industry, outside the university system, and taking the form of foundations. In more recent years, the German nation gave birth to the Fraunhofer Society, which is an organization carrying out applied research mainly on contractual basis with industry in order to reduce the gap that opened in the German innovation system when the Max-Planck Society (the most reputed PRO) moved towards basic research and abandoned close interactions with society. To sum up, it seems that historically different types of PROs progressively emerged, with the ultimate goal to develop high quality basic research on the one hand, and to link it with an innovative socio-economic sphere, on the other hand. This original division of public research might also explain why, today, some PROs (Forschungzentren) need to invest more in TTOs than others (Hochschule Karlsruhe, Fraunhofer Institutes), the first ones being more active in so-called basic research, the second ones being used to collaborating and cooperating and even co-producing knowledge with industry.

A second feature worth emphasizing is the original teaching method adopted in Hochschule Karlsruhe. Indeed, this method can be seen in our typology of valorization tools as a deliberate way to increase firms’ absorptive capacities by providing them with a manpower used to the business way of functioning. Again this specific valorization method can be understood as a continuation of the long German history of vocational training and apprenticeship.

The rather local logic and funding of the valorization policy also seem specific to the German system.

Lastly, it should be noticed that most valorization measures adopted consist in networking innovative actors, creating links between them, and are not very concerned with providing researchers and/or firm founders with technical infrastructures, as it might be the case in some types of incubators. This fact might find its origin in the very specific sectors sponsored by the valorization implemented in Technology Region Karlsruhe. Indeed, as they are mainly interested in attracting and developing the service sector (and in particular high tech service sector) the needs in that type of activities rest rather in new knowledge than in physical capital. Thus, facilitating knowledge exchanges and knowledge building through interactions within a network sounds more appropriate in this region because of the specific economic structure of the territory.

Regarding the Italian case, and more precisely the Provincia di **Milano**, it is first particularly interesting to note that one (but only one) valorization measure is specifically oriented toward SMEs. This suggests that at the same time SMEs are considered as specific innovative actors, and also that research does not require too many efforts to be valorized by SMEs. This perfectly echoes the analysis provided in Malerba (1993) according to whom the Italian system of innovation can be divided into two sub-systems (the one linking SMEs and the other one dealing with innovation in large multinational companies). The SME innovative system relies on close-knit local networks of small firms at the origin of a "*highly dynamic atomistic learning network, with advanced capabilities of absorbing, adapting, improving and tailoring new techniques to specific market*" (p. 234). In those networks innovation comes from informal learning and is rather of an incremental nature, the role of academic R&D being rather limited in the traditional sectors of activity of SMEs. Besides the economic sectors of activity of the Provincia are mainly related to design and fashion, which are fields that are probably less represented in public research organizations and which require specific competences to be handled. This second point might explain the limited use of valorization tools of type 2, as clothing trend-setting people are *a priori* able to quickly implement potentially revolutionary ideas coming from universities in their technical field thanks to their highly specialized knowledge of the job.

Finally, the rather reduced number of valorization measures existing in Provincia di Milano is striking. It seems to be that valorization is organized in a "*laisser faire*" way, rather than rigidly structured in specific policies. Again this might be understood by the rather spontaneous inclination of firms to engage in interactions and exchanges. Malerba (1993) suggests another explanation, as he mentions that the lack of efficiency and effectiveness of interfaces between universities and industry might be a consequence of the limited number of centers of research excellence among universities, which might have urged firms to innovate on their own or among themselves (rather than by relying on public R&D).

In the case of **Chongqing**, the valorization policy is mainly a governmental and legislative concern, as the government is the main promoter of valorization and at the same time plays a determinant role in the design, testing and implementation of valorization tools and policies. Hence, the regulation promoting the commercialization of S&T achievements has been launched in 1999, and since then the local government supervises its implementation and checks the more systematic use of existing tools by micro-executors (firms, universities and research institutes).

Large and medium size enterprises (LMEs) act as the major innovators in Chongqing: although they only represent 15.5% of the total number of regional firms, they contribute 67.7% of the regional GDP, and they account for 78.3% of total R&D expenditure. They succeed to finance more than 70% of R&D investments on their own, the remaining part of the expenditure being funded by bank loans and government funds. Those specific features might explain why on the one hand regional valorization measures are rather targeted towards those LMEs on the one hand, but also why we do not find tools dedicated to the provision of specific financial support.

The innovation clusters mostly involve heavy industries, which can be explained by the specific historical background of the region. Indeed during the anti-Japanese war, many military industries moved to Chongqing, outlining the bases of this region's contemporary industrial landscape.

Regarding the nature of existing valorization tools, it is worth stressing that licensing is not considered as an efficient way to commercialize academic findings. This phenomenon might be explained by the specificities of the Chinese Innovation System. First, the notion of property rights was rather recently introduced and is still not completely integrated by managers (Liu and Jiang, 2001). Moreover, according to Tang (2007), another Chinese originality lies in the (relative) lack of absorptive capacities of indigenous regional firms. This feature also helps to understand why joint R&D projects formalised in contracts is a popular way to transfer technology from academia to industry. And if we look at the more recent actions of the Chongqing government, we can stress that they are precisely oriented towards promoting indigenous innovation by setting up university-industry-research institute alliances.

Another originality of Chongqing innovation system, which differs from its European counterparts, is the active involvement of universities in the creation of spin-offs. Indeed, valorization often takes a direct way in this Chinese region, as academic researchers become entrepreneurs and launch their own firms to take advantage of their discoveries. This phenomenon might be the consequence of the Chinese university's past experience in running university-affiliated firms. Indeed, since the 90s, the Chinese government pushed for the creation for university-owned technology enterprises (Eun *et al.*, 2006), this policy being seen as the most logical solution to make technology transfer feasible –and overcome existing and blocking gaps- at the time (Wallin and Dahlstrans, 2006; Kroll and Liefner, 2008).

Finally, the valorization system implemented in Chongqing seems quite comprehensive as a large range of tools are available. However, one can notice a lack of interaction and the absence of redundancy and overlap among valorization tools, each tool being dedicated to one specific purpose. Hence, there is some room left for additional tools as confirmed by the government agenda, which plans the creation of 10 academy-industry parks and 15 key technology innovation service agencies from 2008 to 2010.

6. Conclusion

Our paper started with the ambition to analyse how research valorization is implemented in three regions in the world with the ultimate goal to investigate whether some context-dependence of valorization measures might be exhibited. To help us in our analysis, we created a taxonomy of potential/useable valorization tools, based on the literature on knowledge creation and circulation. This taxonomy gave us the opportunity to refine our perception of regional differences by investigating the more or less use of each category of valorization tools.

Finally, this theoretical framework coupled with an in-depth presentation of the innovative patterns allowed us to draw some interesting conclusions from our qualitative and comparative examination of the valorization models adopted in our three regions. Indeed, we first noticed that some common features emerge in the valorization models. The first one is the systemic dimension of the valorization process. Trilateral networks (between university, firms and government) and hybrid organisations are created in all the regions studied to facilitate exchanges of knowledge and value creation. A second similarity in the systems is the multiplicity and superposition of several valorization tools, most of them belonging nevertheless to our first category of tools, ie being designed to make economic actors aware of the existing academic knowledge or competences. A third common feature of all valorization models lies in the existence of "shared" valorization structures between various public knowledge providers: in most cases, it is not profitable to make the whole set of valorisation competences available within one university or non-academic research institution, due to a lack of critical mass. Therefore, cross-institutional alliances for the exploitation of research results, in which several universities and non-academic research facilities come together and are supported by an external professional valorisation structure seem to be an appropriate solution.

However, the three valorization models we studied also exhibit some idiosyncratic characteristics. Hence, we found that each region bases its valorization policy on a different number of tools, and on more or less numerous tools in each of the classes we distinguish. We explain those differences by the specific valorization needs of sectors of activities hosted in the regions, some of them being more or less science-based, being undertaken in more or less large firms (with more or less internal R&D and absorptive capacities) and requiring productive capital (and funds) of different kinds. At the same time, we highlighted an under-representation of tools of type 2 in European valorization systems, suggesting either that absorption and appropriation are supposed to be easy for firms or firms-to-be, or that this phase is assumed to be, in those two regions, out of the scope of public policy. As for Chongqing, the tools of type 3 seem to be more developed than in the two European regions. A huge effort is therefore invested in bridging the mindset of universities and firms (which originally –and before the economic reform initiated in 1979- were quite far away, according to Gu, 1999).The Chinese region also seems to rely on a more direct valorization process than its European counterparts: academic researchers commit themselves to venture creation and university-driven sponsored spin-offs flourish.

Hence, we show that both the organizational context of innovation and the socio-economic structure of the territories influence the form of valorization adopted. For instance, echoing Kroll and Liefner (2008) we evidence that "*technology transfer activities in transforming economies are grounded on potentials and motivations that significantly diverge from the ones leading the western valorization policies*". Thus, rather than supporting the imitation, multiplication and superposition of new tools, our study encourages policy makers to be more selective and to adapt their tools to regional (development) needs.

At this stage, much remains to be done. Indeed, this preliminary step allowed us to highlight some common features but also major differences in the valorization systems adopted in different regions. We proposed some plausible explanations of the origin of those regional specificities, but, for the time being we only provided a positive perspective on valorization models. The next step of our analysis would then consist in evaluating the respective impacts of those three regional valorization models. Indeed, thinking in normative terms would give us the opportunity to build an analytical grid able to measure both the effectiveness (which valorization channels are the most regularly used?) and the efficiency (which instrument leads to higher economic returns, to larger employment creation...) of each valorization model, and finally to provide policy makers looking for (transferable) best practices with an exhaustive benchmark.

References

Almeida and Kogut 1997, " The Localization of Knowledge and the Mobility of Engineers in Regional Networks ", *Working Paper*, édité in *Management Science*, 1999, 45(7): 905–917.

Arrow 1962, “ Economic Welfare and the Allocation of Resources for Invention ”, in Nelson R. (ed.), *The Rate and Direction of Inventive Activity : Economic and Social Factors,* Princeton University Press, Princeton: 609–625.

Audretsch and Feldman 1996, “R&D spillovers and the geography of innovation and production”, *American Economic Review*, 86(3): 630-640.

Breschi and Lissoni 2001, “ Knowledge spillovers and Local Innovation Systems : A Critical Survey “, *Industrial and Corporate Change*, 4(10): 975–1005.

Carlsson *et al* 2002, "Innovation systems: analytical and methodological issues", *Research Policy*, 31: 233-245.

Calvert, J. 2002, “Making Science useful”, Rethinking science policy, SPRU conference, march.

Chan, KF, Lau, T., 2005, “Assessing technology incubator programs in the science parks: the good, the bad and the ugly”, *Technovation*, 25(10), 1215-1228.

Cockburn and Henderson 1998, "Absorptive capacity, coauthoring behavior and the organisation of research in drug discovery", *Journal of Industrial Economics*, 46(2): 157-183.

Cohen and Levinthal 1989, "Innovation and learning: the two faces of R&D", *Economic Journal*, 99(397): 569-596.

Cohen and Levinthal 1990 “ Absorptive Capacity : a New Perspective on Learning and Innovation ”, *Administrative Science Quarterly*, 35(1):128–152.

Cowan et al. 2000, "The explicit economics of knowledge codification and tacitness", *Industrial and Corporate Change*, 9(2).

Dasgupta, P., David, P.A., 1994, “Toward a new economics of science”, *Research Policy*, 23, pp. 487-521.

DiGregoria, D., Shane S., 2003. Why do some universities generate more start-ups than others? *Research Policy* 32(2): 209-227.

Etzkowitz 2002, "Incubation of incubators: innovation as a triple helix of University-Industry –Government networks", *Science and Public Policy*, 29(2): 115-128.

Etzkowitz H., Leydesdorff L., 2000, “The dynamics of innovation: from national systems and “mode 2” to a triple helix of university-industry-government relations”, *Research Policy*, 29(2), 109-123.

Etzkowitz et al. 2000,"The future of University and the university of the future: evolution of ivory tower to entrepreneurial paradigm", *Research Policy*, 29: 313-330.

Eun, JH., Lee, K., Wu, G., 2006, “Explaining the “university-run enterprises” in China: a theoretical framework for university-industry relationships in developing countries and its application to China”, *Research Policy*, 35(9), 1329-1346.

Franklin et al., 2001, "Academic and surrogate entrepreneurs in university spin-out companies", The Journal of Technology Transfer, 26(1-2): 127-141.

Gibbons et al. 1994, *Knowledge: The Dynamics of Science and Research in Contemporary Societies*, SAGE, London. *

Granovetter, M., 1985, “Economic action and social structure: the problem of embeddedness”, *American Jouranl of Sociology*, 91(3), p. 533-544.

Jaffe 1989, "Real effects of academic research", *The American EconomicReview*, 79: 957-970.

Jaffe and Trajtenberg 1998, "*International knowledge flows: evidence from patent citations*", *NBER*, WP6507.

Keck, O., 1993, “The national system of technical innovation in Germany”, in *National Innovation Systems: a comparative analysis*, R. Nelson ed., Oxford University Press.

Kline and Rosenberg, 1986, “ An Overview of Innovation ”, in Landau R., Rosenberg N. (eds.), *The Positive Sum Strategy*, National Academy Press:275–305.

Kroll, H. and Liefner I., 2008, "Spin-off enterprises as a means of technology commercialisation in a transforming economy – Evidence from three universities in China, *Technovation*, 28, 298-313.

Liu, H., and Jiang, Y., 2001, "Technology transfer from higher education institutions to industry in China: nature and implications", *Technovation*, 21, 175-188.

Lockett, A., Wright, M., 2005, “Resources, capabilities, risk capital and the creation of university spin-out companies”, *Research Policy*, 34(7), 1043-1057.

Lockett, A., Wright, M., Franklin, S., 2003, "Technology transfer and universities' spin-out strategies", *Small Business Economics* 20: 1985-2000.

Malerba, F., 1993, “The national system of innovation: Italy”, in *National Innovation Systems: a comparative analysis*, R. Nelson, Oxford University Pres.

Moen, J., 2005, “ Is Mobility of Technical Personnel a Source of RD Spillovers ? ”, *Journal of Labor Economics*, 23(1), 81-114.

Nonaka and Takeuchi 1997, *La connaissance créatrice. La dynamique de l’entreprise apprenante*, De Boeck Université, Paris, Bruxelles.

Siegel D.S. and Phan 2005, "Analyzing the effectiveness of University technology transfer: implication for entrepreneurship education", Rensselaer *WP in Economincs*, n° 0426.

Siegel, D.S., Waldman, D., Link, A., 2003a, "Improving the effectiveness of commercial knowledge transfers from universities to firms", *Journal of High Technology Management Research*,14: 111-113.

Siegel, D.S., Waldman, D., Link, A., 2003b,"Assessing the impact of organizational practices on the relative productivity of university technology transfer offices: an exploratory study", *Research Policy* 32 (1): 27-48.

Song, Almeida and Wu 2003, "Learning by hiring: when is mobolity useful?", *Management Science Archive*, 49(4): 351-365.

Sorenson O, and Singh, J, 2007, “Science, social networks and spillovers", *Industry and Innovation*, 14, 219-238.

Tang, MF, 2007, *Technology transfers from university to industry in the Chinese national innovation system*, PhD thesis, ULP, Strasbourg, France.

Varga 1998, *University research and regional innovation, A spatial econometric analysis of academic technology transfers*, Kluwer economic publishers, Boston.

Wallin, MW and Dahlstrand, AL, 2006, "Sponsored spin-offs, industrial growth and change," *Technovation*, 26, 611-620.

Wright et al., 2004, "Entrepreneurship and university technology transfer", *Journal of Technology Transfer*, 29: 235-246.

Zucker and Darby 1998, " Capturing Technological Opportunity via Japan’s Star Scientists : Evidence from Japanese Firms’ Biotech Patents and Products", *NBER Working Paper,* 6360.

Zucker, Armstrong and Darby 1994, "Intellectual Capital and the Firm: the Technology of Geographically Localized Knowledge Spillovers ", *Science, Technology, and the Economy*, *Colloquim at National Academy of Sciences*, Irvine CA, 20–22 octobre.