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The evaluation of policies for knowledge transfer: some emerging issues

Elisa Barbieri

Abstract

Governments in western countries are seeing Universities as the key actor to promote a transition to a knowledge-based economy that can help the future competitiveness challenges posed by new entrants in the global market. In this context, specific industrial policies are designed to promote a transfer of technology, and a more general transfer of knowledge from universities to firms, in order to favour innovation, that is the economic exploitation and commercialisation of new products and processes generated by inventions within universities.
Although the use of these policies is rapidly expanding, the same cannot be said of the evaluation efforts made to understand the effects of the reforms promoted in western economies. This paper offers a contribution to the existing literature and highlights some key open issues on which future research can build in order to improve the knowledge on the effectiveness of reforms we are witnessing, in particular in the U.S. and in Europe.

Keywords: Evaluation of policies; university technology transfer; university patenting; university spin-off
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1. Introduction

The role of Universities in society is constantly changing, from places where the *elites* governing countries were formed, to places where the sciences and the technical competences were developed in the XVIII and IXX century, to places whose research begun to be supported by governments in the XX century. Today, more and more, Universities are seen as hubs to diffuse knowledge and it is gaining *consensus* the idea of Universities working in strict collaboration with firms and assuming functions that are typical of businesses.

Governments in western countries are seeing Universities as the key actor to promote a transition to a knowledge-based economy that can help the future competitiveness challenges posed by new entrants in the global market.

In this context, specific industrial policies are designed to promote a transfer of technology, and a more general transfer of knowledge from universities to firms, in order to favour innovation, that is the economic exploitation and commercialisation of new products and processes generated by inventions within universities.

Although the use of these policies is rapidly expanding, the same cannot be said of the evaluation efforts made to understand the effects of the reforms promoted in western economies. This paper offers a contribution to the existing literature and highlights some key open issues on which future research can build in order to improve the knowledge on the effectiveness of reforms we are witnessing, in particular in the U.S. and in Europe.

Section 2 recalls the debate on policy evaluation, explaining why the meaning and the use of policy evaluation differ substantially in the U.S. and in Europe. Section 3 reviews the major reforms on technology transfer promoted in the U.S., in Europe and in Italy, concentrating in particular on the available experiences of evaluation of the effects of such reforms. Section 4 briefly highlights some of the main tools of technology transfer, such as technology transfer offices, and the way they have been evaluated. Section 5 concludes pointing out some suggestions for future research, in the attempt to stimulate a need for a greater awareness on the effects of policies that governments are promoting.

2. Emerging issues in evaluation

The debate around policy evaluation, and more in general around policy analysis, highlights some commonly acknowledged facts on the diffusion of policy evaluation as an institutional practice (Dunn 1994; Haveman, 1987; Jarabek 2001; Katz 1988; Meny e Thoenig 1991; Rossi e Freeman 1989; Shadish *et al*. 1991; Stame 1998). The U.S. is normally viewed as the first-comer with whom one should compare. It is in fact in the U.S. experience that one can observe a gradual shift of attention from “politics” to “policies”: a long process that has gained momentum in the economic theory with the Keynesian revolution and in practice with the massive state intervention of the New Deal. This intervention was accompanied by an increasing awareness of the need to know how and how effectively were the money spent and therefore a large number of social scientists were employed in those years in public agencies to evaluate the effects of public policies. The idea that policies should be designed according to “facts” and

"evidences" became even more diffused during the Kennedy's and Johnson's Administrations, where the "War on Poverty" programs required analyses, statistics and indicators to define the target population and social experiments to understand the extent to which social assistance programs where effective in increasing the living standards of such population. At the basis of social experiments was the need to create a counterfactual situation, where one could observe what would have happened without the policy intervention, by means of a scientifically rigorous method. Following the debate, it emerges therefore how the nature of policy evaluation and its origins are strictly linked to the research of the best estimate of the counterfactual.

For a while, especially during the 80s and the 90s the practitioners of policy evaluation emphasized the complexity of policy evaluation as a whole, suggesting that more important than concentrating on the estimation of a counterfactual is taking into account other important issues such as the stakeholders' point of view, the opinions of experts, qualitative rather than quantitative methods and case studies rather than generalized surveys. Those were the years of the Thatcher and Reagan legislations, of the Washington Consensus, where a dominant theory of government failures suggested that the fewer the government interventions in the economy, the better; they were the years of a "New Public Management" where public institutions were thought to be better governed if guided by principles of performance typically applied to private firms. In a few words the trust in government policies, and as a consequence, in the possibility to correctly evaluate them, was very scarce.

The beginning of the XXI century has seen a change of attitude in this respect. A new interest in government intervention and in evaluation seems to emerge, probably as it often happens, as a counter-reaction to the dominant view of the previous decades. The idea that "what works is what matters" gains consensus in countries like Great Britain and the so-called evidence-based government puts evaluation at the centre of the debate, since only policy interventions that can be proved to be efficient can be justified (Sanderson, 2007; Davies, 2004).

The current economic crisis, has had, of course, some impact on this. Industrial and economic policies are back on the agenda of many governments around the world, or at least they are widely and explicitly debated. The need for evaluation in this context is higher than ever, on the one hand to understand if and which policy interventions possibly contributed to the crisis and on the other to define the most effective countermeasures to stimulate the recovery.

When comparing the experience of the U.S. on evaluation to the one of Europe, it is worth noting that in 1999 the European Commission gave a strong burst to evaluation in the European Community by dedicating to it a whole chapter of the regulation of structural funds. Together with this regulation the European Commission has circulated publications that provided guidelines for evaluators (European Commission, 1999).

This process had several consequences in the diffusion of an evaluation culture in many European countries. First of all, the regulation imposed by the European Commission has been for some of them, among which Italy for instance, the only push to the adoption of evaluation practices. The demand for evaluation in these cases is external and evaluations are done basically because they are compulsory. This implies that, very often, in Europe evaluation is basically associated to the evaluation of Structural Funds and all the other policy intervention are left aside (Oliva e Pesce, 2001; European Commission, 1999).

Evaluation has different uses: it can be done only for accountability purposes, when it is compulsory and imposed at a supra-national level; it can be done for managerial purposes, to support the management of public firms or public projects; or for political purposes, when the results of policy evaluations are diffused, debated in public and contribute to legitimize a government intervention (European Commission, 1999). A part from a few northern European countries (Sweden, Denmark, the Netherlands, UK) that use evaluation for political purposes and evaluate also policy interventions other than Structural Funds, most of the European countries use it for managerial purposes (Finland, Germany, North Italy, Austria, Belgium) and are still quite linked to Structural Funds (a part from Germany and France) or they do it just because it is compulsory and they basically evaluate only structural funds (South Italy, Portugal, Spain, Greece) (EC, 1999; Furubo et al., 2002).

The strong push to evaluation that has come from the European Commission has had consequences not only on the "object" of evaluations (Structural Funds rather than other interventions) but also on the methodologies applied to evaluate and on the structure built to manage evaluation procedures.

As for the methodologies the European Commission has accompanied the new regulation of Structural Funds with a publication entirely dedicated to evaluation (European Commission, 1999) in six volumes that explain the details of several techniques and criteria applicable at different stages of the evaluation procedure (ex ante, in itinere, ex post). This undoubtedly contributed to the diffusion of standardized practices and methods of evaluation. On the other hand evaluation risks to be viewed as a mere technical exercise, a mere application of methods developed elsewhere, a way to demonstrate a presumption of effectiveness instead of a way to question with a critical attitude the effects of policies.

In countries that do not have a strong tradition for evaluation, the EU regulation urged the establishment of structures in charge of assessing the activities related to Structural Funds. This again encouraged an increasing demand for evaluation. On the other hand such structures are inevitably linked to Structural Funds and to the standardized procedures suggested by the European Commission.

The recent booming interest for evaluation has other possible side effects. The word "evaluation" is largely inflated nowadays and associated to activities that can differ very much from one another. As a consequence it is hard to know what to expect from an "evaluation" report and it is now, more than ever, fundamental to clearly state what is meant by "evaluation". In general terms evaluation is used often to describe activities that differ completely from one another and that go from the selection of beneficiaries, to the performance measurements of public administrations, the degree of satisfaction of consumers and citizens, the monitoring of public expenditures, the compliance with declared objectives or standards, cost-benefit analyses, and so forth. Even when there is agreement on a broad definition where the term basically means "to give a judgment on the *effects* of a policy" (Shadish et al., 1991), there is no consensus on the definition of the "effect" of a policy. In particular the term of comparison to use in order to decide whether a policy has been successful or not can differ substantially from one study to the other: it can be the initially declared objective - with pros and cons Scriven (1973) - pre-defined standards, comparisons with other experiences, and others.

However, we would like to recall in this paper that originally policy evaluation was born with a very clear question in mind, a question of a very simple nature that has guided evaluation research since it's very beginning: what would have happened without the policy intervention? If this question is overlooked, the result of evaluation, meaning the final judgment over a policy effect, can be misleading. In other words, any evaluator of the effects of a policy has to bear in mind that it is necessary to think in counterfactual terms.

This is not to say that counterfactual estimation is easy done, not least because the counterfactual, by definition, cannot be observed. On the contrary, sometimes it is just impossible to build a credible counterfactual. In that case, whoever is in charge of the evaluation should try other ways, stating it clearly. What is important, from our point of view, however, is that researchers and practitioners at all level keep constantly in the back of their minds that simple question of "what would have happened without the policy intervention". Traditionally there are three ways to estimate the counterfactual situation: 1) through social experiments; 2) through quasi-experiments; 3) with direct interviews to the beneficiaries of the policies. Much of the evaluation literature in recent years has developed new and more sophisticated ways to measure the counterfactual, especially as regards the quasi-experiments, benefiting from the progresses made in other disciplines (and their tools) such as statistics and econometrics.

Social experiments have been extensively applied in the U.S. especially in the 60s and 70s, they are characterized by a random selection of beneficiaries from a target population that has all the characteristics to be eligible to the policy benefits. Such a selection is made before the policy is implemented and as a true experiments the process leaves the evaluator with an experimental group that eventually receives the benefits of the policy and a control group that acts as a counterfactual. It is indeed the same procedure used for clinical trials, although these normally have a placebo for people that end up in the control group. This can hardly be done in the case of social experiments which are therefore characterized by more complications due to the fact that people are not given medicines or medical treatments, but they are offered jobs, or incentives for investments, training courses and so on. Social experiments are crucial for evaluation for two reasons:

1) they are the first best in terms of rigorousness of method and results. The two groups (beneficiaries and controls), once the selection is random, are statistically equivalent and only differ for being or not being "treated" with the policy; the observed differences at the end of the evaluation between the two groups can be entirely attributed to the policy;
2) they represent the only situation where the decision to evaluate a policy is necessary taken before the policy itself stars: that is evaluation is in the policy maker decision process since the very beginning. Countries that have used social experiments are inevitably the ones where a culture for evaluation and an internal demand for evaluation has emerged and developed.

Of course social experiments have also many drawbacks. The experience of experiments in the U.S. such as the National Supported Work Demonstration (Rossi and Freeman, 1979), shows that can be uncontrollable reactions or distortions, and the human component that characterizes such experiments makes it hard to reach the final results without any inconvenience. Nevertheless, social experiments remain a reference method and quasi-experiments are all about re-constructing ex-post a situation similar to that of social experiments.

In brief, in most cases the decision to evaluate a policy intervention is taken when the policy itself is already applied. Evaluators in this case have to look for a counterfactual,

that is for a control group or a comparison term that resembles as precisely as possible what would have happened to the beneficiaries had they not received the policy program. In the case of cross-section data, or whenever a population that has not received the policy is available, such population can be used as a control group. However, the selection of these controls is not random, on the contrary it is biased, and statistics and econometrics can help to correct such a bias. The evaluator has the difficult task to understand and reveal the kind selection process that has determined the choice of a beneficiary group and select a control group that is statistically identical to the former.

When working with longitudinal data, or with policies that apply to the whole population (and therefore it is not possible to build a control group) the main challenge is to measure the impact of a policy while taking into account all the possible variables – beyond the policy - that might have had an influence on the final outcome. In technical terms the selection bias and the omitted variables bias are the main obstacles to the definition of a credible counterfactual.

There is another challenge however, for evaluators, one that should not be taken for granted: the choice of the outcome, of the final variable on which he/she wants to measure the impact of the policy. In other words, the translation into measurable terms of the aim of the policy. This is often a very difficult task, laws and regulations normally state aims in very general terms and the purposes of a policy can be very broad and manifold. Evaluators have to interpret the ratio of policies and the intentions of the policy makers and choose the "outcome variable" accordingly.

Quasi experiments are being extensively used for evaluation, and the progresses made in the field of causal inference are noteworthy. They have nevertheless one major drawback: they are extremely data hungry. When data are not available the risk to produce gross and misleading estimations is high.

In these cases the evaluator can opt for direct interviews to the beneficiaries, to ask them directly what would have been their situation had they not received the policy. The method does not require many additional data, it is simple and not too resource and time consuming. However, beneficiaries might be induced to overstate the importance of the policy (they might fear to be excluded from future policy benefits) or they might not have all the information needed to produce an accurate estimation. However, speaking directly to the people and the stakeholders involved in the policy gives perceptions and information's otherwise difficult to obtain. For this reason, a combination of quantitative and qualitative analyses, where possible, should be pursued.

3. Policies to promote knowledge transfer: an evaluation perspective

The creation of inventions, innovation and more broadly of new knowledge requires a government intervention. When speaking of industries investing in the technological progress and developing new products and processes, there is a case for market failure and industrial policy becomes necessary. The production of new knowledge has in fact characteristics that are typical of market failures situations (non-rivalry, non excludability, externalities, asymmetric information), where markets alone do not produce the optimal level of investment in innovation. Governments are called to intervene to correct such failures, first of all through regulations that can grant to

inventors the appropriability of the benefits of their innovations: property rights, patents, registered brands, regulations to defeat falsification have this rationale. Governments intervene also for strategic reasons, because innovation is seen as a key determinant of the industrial development, and more in general of the wealth, of countries. In the long run the investment in innovation is seen as a crucial factor for the future capacity of a country to compete in the international global market.

The long term strategy for Europe's growth was set in Lisbon in 2000 and goes exactly in this direction. The Lisbon Agenda (European Parliament, 2000) had the main objective to make Europe the *most competitive and dynamic knowledge-based economy in the world*. The transition to a dynamic and competitive knowledge-based economy should be achieved through a number of specific goals that include the establishment of a European area of research and innovation, the creation of a friendly environment for starting up and developing innovative businesses, especially SMEs and the provision of an information society for all.

In this context, the European Commission has showed a remarkable commitment to the promotion of tighter relations between universities, research institutions and industries (EC, 2007). Specifically the aim is to promote first of all a technology transfer from the places where research takes place to the business sectors, to allow new products and inventions to be commercialized faster and offer advantages to the final markets, to consumers. More in general the EU wishes to promote a wider knowledge transfer that consists of several activities aimed at capturing and conveying knowledge (even in tacit forms, such as know-how), skills and competence from the places where knowledge is generated to the places where it produces economic outcomes (EC, 2007). In this scenario, research collaborations consultancies, spin-off creation, researcher mobility and joint publications are all activities to promote, and policies for knowledge transfer normally have this priority.

The experience of the EU in this field seems to differ substantially from that of the U.S., to an extent that made scientist claim that Europe lives in a "paradox" where it produces innovation, but it is not able to commercialize it and turn it into economic outcomes (Dosi et al., 2006; Clarysse et al., 2007). According to the European Commission (2007), European research institutions are, for instance, less performing in terms of invention disclosure, patent applications and patent grants than the US ones. On the other hand, they are more successful in the number of start-ups established. These are presumably, at least in part, the results of different policy interventions of EU and US governments to promote the commercialization of R&D, that range from guidelines at national levels, changes in national legislations, the creation of institutes for knowledge transfer or networks of knowledge/technology transfer offices. Within Europe itself countries have developed different tools to promote technology and knowledge transfer. The extent to which the effectiveness of such tools has been proven by means of systematic evaluations varies from country to country. The particular history of development of evaluation practices in Europe contributes to an approach towards evaluation in Europe that is shared by many and that it is often far from the counterfactual perspective, but at the same time countries can display some extremely different evaluation experiences.

Covering all the single laws, regulations and interventions that form the "policies" - meaning the set of actions promoted by governments to hit one particular need or public interest - for knowledge transfer in Europe and in the US is too difficult a task for one

single paper. Sometimes it is just impossible to find a law, or one single identifiable policy intervention, that has changed radically the support to knowledge transfer and that can therefore be evaluated. Often a number of policy tools are implemented one after the other, with no clear-cut changes in the *status quo* but with marginal improvements. Evaluation is a hard task in these last cases and one can only concentrate at one policy measure at a time. We will briefly overview here *some* relevant experiences of policies that have been either evaluated or that we think might help designing future guidelines for evaluation of knowledge transfer policies.

4.1 The US experience of the Bayh-Dole Act

In the U.S. experience the Bayh-Dole Act is widely acknowledged to be the most influential single policy intervention directed to technology transfer and more in general to university-industry relations. Although several studies evidenced a general increase of collaborations between universities and firms prior to the Bayh-Dole Act (Henderson et al., 1998; Mowery et al., 2001; Mowery and Ziedonis, 2002), highlighting a trend that was therefore already in place when the reform started, the Bayh-Dole Act is still widely discussed, evaluated and taken as a reference model for the debate over university and industry relations. The Bayh-Dole Act entered into force in 1980 and it gave universities the right to retain the property rights to inventions deriving from federally funded research. Prior to that date, the government retained all the rights and income stemming from federally funded inventions. The aim of such a reform, as stated in article 200 of the Code was to:

"*use the patent system to promote the utilization of inventions arising from federally supported research or development […] to promote collaboration between commercial concerns and nonprofit organizations, including universities; to ensure that inventions made by nonprofit organizations and small business firms are used in a manner to promote free competition and enterprise without unduly encumbering future research and discovery*".

The idea behind the reform (as explained by, among others, Mowery and Sampat, 2005; Sampat, 2006; Mowery et al., 2001) is that patents are an effective tool of technology transfer and therefore encouraging university patenting is an effective way to stimulate commercialization of knowledge and relations between universities and industries. The main risks, that have been and are being widely discussed by academic research are intuitive: risk to increase academic patenting per se (meaning that the pace at which universities innovate remain the same, but everything is patented), risk to re-direct academic research towards fields where patenting is easy, risk to restrain the spread of knowledge by creating legal monopolies.

Most of the studies and academic researches available on this topic try to quantify and qualify the effects of the reform, by looking at changes that occurred in a number of relevant variables, such as the number of university patents, the direction of academic research, mandate and priorities of the universities and so forth.

Shane (2004) suggests that the Bayh-Dole act has significantly changed the attitude of universities towards patenting: Universities shifted their patents towards sectors and lines of business where licensing is more effective and more easily exploited. The author looks at the differences in the university-share on the total amount of patents over time (1969-

1996) and across 117 different lines of business. When comparing the pre- and the post-Bayh-Dole situation the author controls for a number of factors, in addition to the Bayh-Dole Act, that can change the university-share of patents (i.e. the relevance of licensing for each line of business, the closeness to basic science, the bio-medical orientation, the type of funding received etc.). Shane'S results point at two possible explanations: either Universities have re-directed research to activities where licenses are higher and more effective, or they simply have changed the propensity to patent inventions of already existing researches in which licensing is more effective. Handerson et al. (1998) in their study agree to some extent with Shane's (2004) second hypothesis, concluding that the Bayh-Dole act mainly increased the propensity to patent along existing research lines rather than shifting the research towards inventions that can be easily commercialized. According to the authors one of the effects of the Bayh-Dole Act is an increase in the production of "low quality" patents. To reach this conclusion they look at changes in the citations of patents as a proxy of their quality; they perform longitudinal analysis to analyze differences in citations before and after the Bayh-Dole Act between University patents and a random selection of non-university patents used as a counterfactual. In doing so the authors control for other factors that over time might have changed the citation patterns of both groups irrespectively of institutional reforms (such as the technological area of reference).

Mowery et al. (2001) analyzing some specific case studies (University of California, Stanford and Columbia) suggest that the Bayh-Dole Act is not the only factor that determined the increase in patenting in US universities. Other factors, particularly relevant in the case of biomedical sectors, have contributed to push the patenting activity of Universities. The progresses made in the field of biotechnologies, the feasibility of patenting in biotechnologies, a general higher attention to property rights all occurred together with the Bayh-Dole act and contributed to increase university patenting. The authors however question the premises of the Bayh-Dole Act, they stress that an increase in university patenting is not necessarily equivalent to an increase in technology transfer. Indeed, firms rely heavily on other channels in order to benefit from university research (publications, conferences, informal exchanges and consultancy) and an excessive administrative effort towards university patenting might even hinder the diffusion of knowledge. Movery et al. (2001) rather that quantifying the effects of the reform on the three Universities, qualify the internal mechanisms related to technology transfer in three Universities and the way such mechanisms changed in the years of the reform. The authors specifically recall a lack of a "compelling counterfactual" in their analysis. Therefore, based on their learning of the history, internal organization and management of the three Universities they make hypothesis on the counterfactual situation.

Sampat et al. (2003) do not agree on the decrease in the quality of University patents and Sampat (2006) suggests that, notwithstanding the several published studies, the effects remain unclear. The author poses the basic question of "where is the public interest?". Universities should patent only when strictly necessary for the use of inventions. In other words, public diffusion of inventions or non-exclusive licensing should be the rule, whereas many of the above cited studies highlight a general increase in the propensity to patent whatever exists and engage in university firm-relations that end up in exclusive licensing. Once Universities are free to patent and gain from the returns of their own research, the risk is to incur in a classical principal-agent problem where the agent

(Universities) act for their own interest and measure their degree of success through "patent revenues" instead of diffusion of knowledge and technology.
The author also stresses the necessity to build a credible counterfactual, one that is able to identify the cases in which commercialization of inventions would have taken place anyway, even without patenting. In these cases patents become a tax to industry – and ultimately to consumers – and society suffers from the typical deadweight loss that characterizes monopolies. Sampat (2006) recalls some well-known examples where commercialization of inventions was already occurring even before patenting and licensing had been introduced[1].

4.2 European Experiences and the Abolition of the Professor's Priviledge

The U.S. Bayh-Dole Act experience is of extreme relevance since it has been considered by other countries as a reference model for their reforms (OECD, 2003; Mowery and Sampat, 2005). In recent years the laws and regulations governing intellectual property rights (IPR) generated by public funds and more in general by universities are being discussed under the common perception that the pace at which European countries innovate needs to increase (EC, 2007; Valentin and Jensen, 2007; OECD; 2003). In this scenario university-industry collaborations are thought to be not enough developed and European countries feel that more needs to be done. In the European context, an intervention is seen as necessary in order to provide the right incentives for university to innovate and at the same time to transfer such innovation to industries. Following these directions, policy changes have taken place in several European countries. In most cases such changes are inspired by the Bayh-Dole act's general idea that it is necessary to give more responsibility to universities in the management of their intellectual property rights and to give them, as an incentive to innovation, the right to earn from their research through patents and licensing. This is realized in Europe mainly through two channels: abolition of the so-called professor's privilege and construction of technology transfer offices. Starting from 2001 Denmark followed by several other countries (Germany, Austria, Norway, Finland) adopted cross-cut policy changes abolishing their previous regulation that gave to the employers (professors) the right to patent their inventions and to earn from licenses arising from such inventions (Lotz et al. 2009; OECD, 2003; Breschi et al., 2006; Valentin and Jensen, 2006). After the policy change such rights are transferred to the University where the inventor is employed. Each country regulates the options that Universities have in their patenting activities, for instance in Germany, that abolished the professor's privilege in 2002, Universities have a three-month period to file patent, after that the IPR go back to the professor. Universities that decide to file patents have to ensure 30% of the earnings generated by such patents to inventors (von Ledebur, 2009). In Denmark the time span for Universities to decide whether to patent an

1 It is the case of recombinant DNA, as pointed by Sampat (2006, p. 783): "For example, the Cohen-Boyer recombinant DNA technique was being used by industry even before the Universities of California and Stanford began to license their patents; patenting (and licensing widely) allowed the universities to generate income, but did not facilitate technology transfer".

invention or leave the choice to the inventor is of two months only (Lotz et al., 2009). Irrespectively of the single-country regulations, the common tendency is to place more emphasis on University patenting and to endow Universities with the necessary structures to manage their patenting activity (i.e. technology transfer offices and the like). This tendency is coupled with a general observable increase in the number of patents filed by Universities across European countries (Breschi et al., 2006; Valentin and Jensen, 2007).

Some authors, among which Mowery and Sampat (2005), highlight the risks of transferring one particular policy reform from the American context to different ones. In particular they recall that in the U.S. case the reform was designed in a context where the rights generated by federally funded research remained unexploited in the hands of federal government. The idea was that by giving more power and a higher participation to the earnings to Universities they would have a stronger incentive to innovate. When turning to the abolition of the professor's privilege the situation is reversed. The rights are transferred from the single person to the institution. It is probably not as much a question of incentives as of capacities. The idea is that the single professor might not have the expertise and skills to exploit its inventions in a commercial way, whereas Universities, endowed with the necessary infrastructures can favor a technology transfer. In addition to this, the single person does not have to bear the financial risks and the costs of patenting and commercializing. Universities, through their dedicated offices, undertake these risks. Again, the experiences are very diverse, not all universities have the same expertise in patenting activities. The process of university patenting seems to be path dependent and the effectiveness of such reforms rests very much on the ability of Universities to acquire the needed competence (von Ledebur, 2009).

As several observers note (see among others Jensen and Valentin, 2007) the attitude while studying the effects of such reforms is to over-concentrate on the patenting activities of universities *per se*. In particular, the tendency is to look at trends and trend changes in the number of university-owned patents. When studying the application of Bayh-Dole inspired reforms in Europe and their effects, several European observers make an effort to deviate from the issue of patenting *per se* and they concentrate more on technology transfer, which can take place through patents but also through other channels. Lotz et al. (2009), in their study on Denmark, look at the distribution of patent's ownership before and after the abolition of the professor's privilege. They cannot infer from the data whether the abolition caused an increase in the number of academic patents[2]. However, they can observe how the composition of patent ownership has changed over the reform. By confronting the experience of Denmark, several European countries and the U.S., they note three important aspects (Lotz et al., 2009, p. 9):

- First: all over Europe the vast majority of patents is owned by firms;
- Second: the remaining share belongs to universities, research centers, single researchers and the distribution of such share depends on the specific IPR regulation and characteristics of the innovation system of the country;

2 They only have data for academics active between 2001 and 2005, they loose track of those who retired therefore as the authors suggest, the farther the analysis goes back in time the higher the risk to underestimate the number of patents.

- Third and more important: if one looks not only at university-owned patent, but also at university-invented ones (where academics contributed to the invention but the patents were subsequently transferred to firms) the figures for Europe are comparable to those of the U.S.

In other words the suggestion of Lotz et al. (2009) is to look at *university-invented* patents and in their study they find that, right after the reform, Denmark witnessed a substantial shift in the ownership of patents from single academics to universities, but the overall contribution of academics to patents has not changed. In the end even the overall share of company owned patents has not changed remarkably, registering only a slight increase. Although the analysis has some limits, because it does not take into account other related phenomena, such as academic spin offs, it poses some serious questions. It points at the risk of having too a narrow view: longing on discussions over the professor's privilege *per se* might be of little relevance, since the only effect of a change in such regulation is to alter the distribution of a marginal part of patents, whereas the concrete contribution of academia to industrial innovation remains basically the same.
Valentin and Jensen (2007) on a parallel study on Denmark suggest to look at the effects of the reform on academic-industry collaborative research (again measured through *university-invented* patents). The counterfactual situation in this case is represented by Sweden, that had not experienced at the time the same change in regulation as Denmark. In order to build a credible counterfactual the authors look at the biotech sector, where the two countries share extremely similar trends in terms of new start-ups per year and number of patent applications by dedicated biotech firms. They compare the trends in the share of university scientists contributing to patents assigned to dedicated biotech firms. They also distinguish between domestic university scientists and foreign ones. They reach the conclusion that the reform has reduced the contribution of Danish academic scientists to the patented inventions of domestic biotech firms. This reduction is not substituted by an increase in university-owned patents nor by an increase in spin-off activities. They suggest that this could reflect a change in the attitude of firms that see the introduction of a third party (the university) in the collaborative research with the academic scientist as a threat. This holds especially when the nature of the research makes it difficult to forecast the rights arising from the research and their possible sharing (this is particularly true the closest we move to basic research). This interpretation seems to be supported by the fact that domestic scientists have been substituted with foreign ones in the collaborative researches, confirming that the academic contribution is seen as necessary, but the introduction of a third institutional party that might exert rights on future new products and processes refrains from collaboration. Valentin and Jensen (2007, p. 272) conclude that the abolition of the professor's privilege in Denmark has changed "the contractual principles of academia-industry collaboration". The university interest shifts from the research of intellectual synergies and industrial financing to the research for a potential revenue and this has negative effects on specific industry-academia collaborative researches. A study on Germany by von Ledebur et al., 2009, reaches similar conclusions stating that the reform has produced a shift towards university ownership of patents, which displaced both individually-owned and firm-owned patents, thus not contributing necessarily to an increased technology transfer.

4.3 Italy Experience: the introduction of the Professor's Priviledge

As reported in several specific case-studies (Baldini et al., 2006; Baldini et al., 2007; Breschi et al., 2006; Lissoni et al., 2004) the major institutional reforms regarding technology transfer in Italy are: Law 168/1989 - that found full application only after 1996 - which gave Universities a greater degree of autonomy in the elaboration of their statutes and internal regulations; Law 383/2001 that introduced the professor's privilege amending the previous Law of 1939 that gave employers the IPRs of the inventions of their employees, while ensuring a reward to the employees; the Code on Industrial Property (Ministerial Decree of 10th February 2005) that maintained the professor's privilege, although an explicit exception is introduced for researches financed with private funds or with funds coming from public institutions that differ from the one of the inventor (in these cases the IPRs are granted to the employer).

Law 168/1989 was not designed with the purpose to affect directly technology transfer activities, however, since it entered into force Universities started introducing IPR regulations (Baldini et al., 2006). On the contrary Law 383/2001 and the Code on Industrial Property directly change the regulation of IPRs of inventions coming from university and therefore, supposedly, have a direct effect on technology transfer. In addition to the abovementioned regulation, Decree 262/2004 contains the discipline for University Industrial Liaison Offices and Decree 297/1999 regulates the creation of spin-off firms from Universities.

The overall scenario of reforms that were promoted in Italy in the field of technology transfer points to an unquestionable effort of policy makers to converge towards other countries experiences in taking into consideration the potential role of Universities in terms of knowledge transfer to industries. The increased autonomy given to Universities, the support to Industrial Liason Offices, the generation of spin-offs, all go in this direction. Yet, in some respects Italy has made opposite choices compared to the EU common tendencies. While other countries, fascinated by the experience of the Bayh-Dole Act are abolishing the professor's privilege, Italy introduced it. There are other cases where such a "privilege" still holds - Sweden is an example – mainly because the ongoing debates on its abolition have not found an extensive consensus (Valentin and Jensen, 2007). However Italy is the only example where an explicit reform took place to introduce it, followed then by other regulations to restrict the applicability of such a privilege (Baldini et al., Lissoni et al., 2004; Mowery and Sampat, 2005).

In this respect, the scenario of institutional reforms in Italy is to some extent confused, it seems to be made more on attempts and marginal adjustments rather than policy choices based on evidence, even when such attempts go in the opposite direction with respect to the rest of the EU. The available evidence and studies on the effects of these regulations on technology transfer is limited, and this is true for Italy and for EU more in general (Geuna and Nesta, 2006).

The available empirical studies for Italy (Baldini et al., 2006 and 2007; Breschi et al. 2006; Balconi et al., 2004) mainly concentrate on University patenting. Although patents are only one of the channels to realize technology transfer, together which research collaborations, researchers' mobility, formal and informal exchanges of knowledge, spin-off creation, incubators etc. (Baldini et al., 2007; Mowery et al., 2001), the increased trend in patenting in U.S. Universities associated to the experience of the Bayh-Dole Act

has made empirical researches on the European case concentrate extensively on this topic (Balconi et al., 2004). This holds true for Italy as well. Baldini et al. (2006) address directly the issue of institutional change in Italy, providing a unique effort to produce evidence for policy choices. They take 1996 (the year of fully entry into force of Law 168/1989) as a reference point for policy change and they look at variations occurring in the number of University patents after that year. They concentrate on patents filed by Universities, that is where the applicant is a University, and they perform univariate and multivariate analysis to take into account other factors that might have affected these changes (such as the actual year when universities introduced an IPR regulation, size, previous patenting experience, the presence of medical schools and the like). The authors conclude for a general positive effect of the regulation on the number of patents. A positive effect of the same kind is attributed to the adoption of internal IPR regulations by Universities. Although the contribution is a pioneering effort to understand the effects of policy regulations, some limitations emerge. As the same authors highlight in part, they are not able to consider the effects of other laws specifically aimed at technology transfer (eg. Law 383/2001, the regulations on Industrial Liason Offices and spin-offs) which might have contributed to determine the observed trends in patenting even more than the one considered. In addition the authors concentrate on patents filed by Universities, the distinction between University-owned and University-invented patents is taken into account marginally, although once again it is confirmed that the latter are far more diffused than the former, also in Italy (Baldini et al. 2006; Geuna and Nesta, 2006; Balconi et al., 2003 and 2004). The author's consider such a distinction while studying the likelihood of universities of adopting internal IPR regulations. They conclude that only patents filed but not owned by Universities increase the likelihood of adopting an IPR regulation. In doing so, they treat such patents as an explanatory factor of something else, while it is precisely in this kind of distinctions – university invented vs. university owned patents - that one can look for a measure of technology transfer. University invented patents, but owned by a firm, by nature incorporate the technology transfer. Concentrating solely on the trends in the number of patents that a University owns, misses the fundamental step – that comes after – of technology transfer.

Other studies on the Italian case do not address directly the effects of institutional reforms. Breschi et al. (2006) investigate the relation between patenting and scientific productivity. They conclude that academic inventors publish more and better quality papers than academics with no patents. The counterfactual in this case is represented by scientists in similar disciplines, of similar age and academic rankings but with no patents. The authors apply different methods (i.e. instrumental variables and inverse probability of treatment weights) to deal with selection biases and endogeneity. Their conclusion is strongly in support for patenting as it increases the quality of scientific publications, measured in terms of number of citations. Although such conclusions argue in favor of "patenting" in general terms, the authors actually treat in a similar way scientists that appear as inventors on patents owned by firms or by universities and scientists that applied and are owners of the patent. Being the share of patents owned by firms much higher than the rest, the conclusion should not be read as much as a positive impact of "patenting" on scientific publication, but rather as a positive impact of "collaborating" with the industry in doing research. The supposed trade-off between patenting and

publishing that the authors investigate, should probably be searched for specifically on the sub-sample of academics that patent by themselves, or through Universities.
Baldini et al. (2007) in a study taking a more micro perspective interview directly inventors of university-owned patents in order to understand what are the reasons that push academics towards patenting and the obstacles. The premise is always that patents are interesting because they are one of the channels of technology transfer and most of the study concentrates on the reasons that push inventors towards patenting and the improvements that can be done at the institutional level in this respect. Among these improvements are the creation of technology transfer offices and the adoption of internal IPR regulations, which are specifically treated as improvements to support the patenting activities of faculty members. Other studies (Balconi et al., 2004) suggest to apply social network analysis to understand the role of geographical and knowledge proximity in technology transfer.
As a whole none of the abovementioned studies produces evidence on the effects of the professor's privilege on technology transfer in Italy. Nor they produce evidence on other reforms specifically aimed at technology transfer in Italy. Notwithstanding the efforts made and the undoubted increased knowledge in the behavior of academics towards patenting, very little evidence is available on the policies that do work to expand transfer of knowledge and technology from universities to industries.

4. Tools for technology transfer: how are they evaluated?

The general tendency to shift IPRs to universities requires additional administrative structures within universities to manage the portfolio of patents. Increasing attention is being given to the role of technology transfer offices (TTOs) (Clarysse et al., 2007; Siegel et al., 2003), since they are in charge of the patent portfolio and they have to practically commercialize the inventions made by faculty members. TTOs can therefore become a channel for technology transfer, they can sell or license their IPRs to existing companies or they can create new spin-off companies to which transfer or license IPRs. Spin-off companies have gained increasing attention since they are a visible case of technology transfer from the University and several studies have confirmed a generalized increase in the number of spin-offs created by European Universities (Clarysse et al., 2007). Both TTOs and spin-off companies have been supported through financing from Universities, national and local governments and from the EU (Clarysse et al., 2007; Wright et al., 2006).

Most of the available studies on the creations of spin-offs are empirical descriptions of the phenomenon and technology transfer offices are often treated as an explanatory variable of the increasing number of new spin-offs (Clarysse et al., 2007; Lockett and Wright, 2005). Alternatively, studies have concentrated on the performance of spin-offs and TTOs as organizations, thus trying to understand why some TTOs are more productive than others (Powers and McDougall, 2005) or how academic spin-offs differ from private ones in terms of managerial capacities (Ensley and Hmieleski, 2005).
As regards academic spin-offs, very little attention is given to their quality and to their chances of surviving after the first round of supported financing; the majority of available studies simply concentrate on the increase in the number of academic spin offs as a

measure of successful technology transfer (O'Shea et al., 2005; Lockett and Wright, 2005). Clarysse et al. (2007) in a study on different European countries (Belgium, Germany, Italy, France and United Kingdom) recall how these countries increasingly attached more and more importance to patents and to IP more in general and how they encouraged the professionalization of TTOs by providing them extra funding to apply for patents and to create new spin-offs. The authors empirically test the hypothesis that spin-offs that received formal technology transfer from the TTO (meaning a transfer of one or more patents or the establishment of an exclusive license agreement) start with a higher capital than those without a similar formal transfer. In addition they test the hypothesis that such spin-offs will not be more successful in raising subsequent funding. The data analysis and the econometric results confirm both hypotheses, after controlling for other potential relevant factors (such as patent stock, stage of new product development, size, country, target market etc.). The authors suggest that these results come from the fact that valuation of patents in the start up phase of spin-offs is often disconnected from real market opportunities. Such a valuation risks to be higher than the market one, due to the support provided by universities and TTOs, which often involves support from the government, with a consequent involvement of objectives that might differ from market commercialization. The way in which TTOs value their IP in the start up phase influences the way spin-offs are created and it constitutes an incentive to which researchers respond. It is important to fully understand the alternatives that the researchers leave aside and how their behavior changes with respect to the counterfactual situation where a formal technology transfer from a TTO does not take place.

With respect to the role of TTOs, Powers and McDougall (2005) investigate the determinants of the productivity of TTOs in terms of selectivity, support and external environment that characterize universities' decisions. The study offers interesting suggestions in the way it measures the degree of productivity of a TTO: on the one hand the number of licenses with private companies that subsequently went public, on the other royalties received on product sale for a university. The authors try to capture the ultimate real contribution of technology transfer: diffusion of innovations to the benefit of consumers. Most studies do not make the attempt to get this far in measuring the ultimate results of TTO activities. However, again the effects of TTOs on technology transfer are not fully assessed since no counterfactual situation is estimated, the issue remaining what would have happened to technology transfer (in particular to the alternative forms) had the TTO not been there?

5. Conclusions

The debate around policies for knowledge transfer and their evaluation together with some relevant case studies at country level shed light on a number of emerging issues that can guide the future development of the research in this field.

The diffusion of an evidence-based approach to policy making differs very much from country to country. In the U.S. the role of social experiments and of applied social research in general has helped the development of an evaluation culture, where the effects of policies are determined with respect to a hypothetical counterfactual situation. In Europe, notwithstanding some exceptions and differences among countries, the counterfactual-based analyses seem to be much less relevant, to the point that while

“policy evaluation” clearly identifies one particular activity in the U.S. the same cannot be said within the European Union. There seems to be much more confusion on the term “evaluation” in Europe.

Both realities share similar concerns around their future capacity to compete with new emerging countries on the international markets, and they both place efforts on the promotion of a knowledge-based economy as a way forward. Innovation policies and policies for technology transfer from Universities to firms are strategic long-term industrial policies to ensure the future growth of Western economies. Despite a general *consensus* on the strategic goals (promote innovation, promote technology transfer), when looking for the best ways to pursue such goals, the empirical question: “what policy works better?” seems to be overlooked. Reforms in this field are, by and large, not based on empirical evidence on their effectiveness. The Bayh-Dole act was not experimented before its introduction, however several efforts have been done to estimate its effects ex-post, with rigorous methods. These efforts can be, and should be, precious for the EU and for countries that in the EU are trying to promote U.S.-like reforms.

So far there is very little evidence on the effects of reforms in Europe that go in the direction of the Bayh-Dole Act. And this holds true for the specific case of Italy.

Despite the enormous literature on “technology transfer” there is room for further analyses on the evaluation of the effects of industrial policies encouraging technology transfer. First of all, the available literature in this field seems to over-concentrate on the issue of “University-patents”, meaning the number or the share of patents owned by Universities, as a measure to quantify the ability of universities to transfer technology. This over-concentration can be misleading. An increase in the patenting activity of Universities tells very little about the transfer of technology. Patents owned by Universities have to be licensed or sold in order to transfer the technology. Although this is an obvious passage from a theoretical point of view, it is much less obvious in practice, and Universities have to build dedicated structures to this aim. An over-concentration on university-owned patents leads to a diffused perception that “patenting” at Universities *per se* should be encouraged, with the risk to forget the final aim of technology transfer. A first challenge for future research is therefore to concentrate on different and more accurate measures of technology transfer. Licenses and revenues from patents, capture the technology transfer, although the implications of using such measures are not at all obvious. Exclusive licensing for instance can produce higher revenues for the University, but it does not necessarily correspond to a broader transfer of technology. Some authors have suggested concentrating on the revenues coming from new products sold on the market and coming from university licenses, since the final aim of technology transfer is to promote the development of new processes and products to the benefit of consumers. This could work when looking for the effects of a reform, but also when looking at the performance of TTOs.

Looking for more appropriate measures of technology transfer is a first step. A second step, even more challenging and important, is to try to answer to the fundamental research question of “what would have happened to technology transfer had the policy not been there?”. When transferring IPRs from the single professor to the University, as it is happening in several European countries, the question is “what would have happened had the IPR remained in the hand of the professor”?. Evidence suggests that before this kind of reforms professors used to leave to firms the rights to patent inventions coming

from their research collaborations. Universities-industry collaborations are a very important form of technology transfer, and they normally lead to the so-called "University-invented" patents, meaning patents owned by private firms, where the professor appears as an inventor. The technology transfer takes place by definition in this case and when comparing EU and U.S. figures on university-invented patents the differences are much less striking. When studying the effects of Bayh-Dole inspired reforms (although the transfer of IPRs in that case was from federal government to universities) it is necessary to look at the implications not just on university-owned patents, but on other forms of technology transfer such as collaborations (even if they lead to firm-owned patents). In other words, the potential displacement effects on different forms of technology transfer, once Universities own IPRs, should be taken into account. Another form of technology transfer is represented by spin-offs that received a formal technology transfer by the University. Again in this case, concentrating exclusively on the number of new spin-offs does not tell much about technology transfer. A few studies on this point highlight the difficulties of university-supported spin-offs to remain competitive in the long run, with respect to other start-ups. A comparison for instance between the survival rates of university and non-university spin-offs or between their capacities to gather funds in the long run would be much more informative.

Once again, if the aim is to fully understand the effects of policies favouring technology transfer, the "presumption of effectiveness" that often inspires such reforms should be left aside and be substituted with a constructive scepticism to answer to the question "what would have happened without the policy?".

References

Balconi M,. Breschi S. and Lissoni F. (2003) 'Il trasferimento di conoscenze tecnologiche dall'Università all'Industria in Italia: nuova evidenza sui brevetti di paternità dei docenti' in Bonaccorsi A. (ed.), *Il sistema della ricerca pubblica in Italia*, Milano: Franco Angeli.

Balconi M,. Breschi S. and Lissoni F. (2004) 'Networks of inventors and the role of academia: an exploration of Italian patent data', *Research Policy*, vol. 33, pp. 127-145.

Baldini N., Grimaldi R. and Sobrero M. (2006) 'Institutional changes and the commercialisation of academic knowledge: a study of Italian universities' patenting activities between 1965 and 2000', *Research Policy*, Vol. 35, p.. 518-532.

Baldini N., Grimaldi R. and Sobrero M. (2007) 'To patent or not to patent? A survey of Italian inventors on motivations, incentives and obstacles to university patenting', *Scientometrics*, Vol. 70, No. 2, pp. 333-354.

Breschi S., Lissoni F. and Montobbio F. (2006) 'University patenting and scientific productivity. A quantitative study of Italian academic inventors', *CESPRI Working Papers*, n. 189, pp. 1-31.

Clarysse B., Wright M., Lockett A., Mustar P. and Knockaert M. (2007) 'Academic spin-offs, formal technology transfer and capital raising' *Industrial and Corporate Change*, Vol. 16, no. 4, pp. 609-640.

Davies, P. (2004) 'Is Evidence-Based Government Possible?', *Jerry Lee Lecture at the IV Campbell Collaboration Colloquium*, Washington (D.C.), February.

Dosi G., Llerena P., Sylos Labini M. (2006) 'The relationships between science, technologies and their industrial exploitation: An illustration through the myths and realities of the so-called «European Paradox»', *Research Policy*, vol. 35, pp. 1450-1464.

Dunn, W. N. (1994) *Public Policy Analysis: An Introduction*, Englewood Cliffs, New Jersey: Prentice-Hall.

Ensley M.D. and Hmieleski K.M. (2005) 'A comparative study of new venture top management team composition, dynamics and performance between university-based and independent start-ups', *Research Policy*, vol. 34, pp. 1091-1105.

European Commission (1999) *The Means Collection: Evaluation Design and Management, Luxembourg*, Office for Official Publications of the European Communities, vol. 1, 2 e 3.

European Commission (2007), *Improving knowledge transfer between research institution sand industry across Europe*, Brussels: Communication of the European Commission.

European Parliament (2000), *Lisbon European Council 23 and 24 march 2000: Presidency conclusions*, Official Document of the European Parliament, available at http://www.europarl.europa.eu/summits/lis1_en.htm.

Furubo J., Rist R.C. and Sandahl R. (2002) (eds.), *International Atlas of Evaluation*, New Brunswick, NJ: Transaction Publishers.

Geuna A., Nesta L.J.J. (2006) 'University patenting and its effects on academic research: the emerging European evidence', *Research Policy*, vol. 35, pp. 790-807.

Handerson R., Jaffe A.B. and Trajtenberg M. (1998) 'Universities as a source of commercial technology: a detailed analysis of university patenting, 1965–1988', *Review of Economic Statistics*, vol. 80, no. 1, pp. 119–127

Haveman P.H. (1987) *Poverty Policy and Poverty Research: The Great Society and the Social Sciences*, Madison, WI: University of Wisconsin Press.

Jerabek, H. (2001) 'Paul Lazarsfeld—The Founder of Modern Empirical Sociology: A Research Biography', *International Journal of Public Opinion Research*, 13, pp. 229-244.

Katz, B. M. (1988) 'Review: The War on Poverty and the Transformation of American Social Science', *Reviews in American History*, 16, pp. 137-143.

Lissoni F., Calderini M., Granieri M. e Sobrero M. (2004) 'Un "privilegio" da respingere', *lavoce.info*, 9 december 2004.

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

Lotz P., Lissoni F., Schovsbo J. And Treccani A. (2009) 'Academic patenting and the professor's privilege: evidence on Denmark from the KEINS database', *paper presented at the Druid Summer Conference*, Denmark, Copenhagen , 17-19 June.

Meny, Y. e Thoenig, J.C. (1991) *Le Politiche Pubbliche*, Bologna, Il Mulino.

Mowery D.C., Nelson R.R., Sampat B.N. and Ziedonis A.A. (2001) 'The growth of patenting and licensing by U.S. universities: an assessment of the effects of the Bayh–Dole act of 1980', *Research Policy*, vol. 30, pp. 99-199.

Mowery D.C. and Ziedonis A.A. (2002) 'Academic patent quality and quantity before and after the Bayh-Dole Act in the United States', *Research Policy*, vol. 31, pp. 399-418.

Mowery D.C. Sampat B.N. (2005) 'The Bayh-Dole Act of 1980 and University–Industry Technology Transfer: A Model for Other OECD Governments?', *Journal of Technology Transfer*, vol. 30, no. 1-2, pp. 115-127.

O'Shea R.P., Allen T.J., Chevalier A. and Roche F. (2005) 'Entrepreneurial orientation, technology transfer and spinoff performance of U.S. universities', *Research Policy*, vol. 34, pp. 994-1009.

Oliva, D. e Pesce, F. (2001) 'Aggiungi un Posto a Tavola', in Stame N. (a cura di) *Valutazione 2001: lo Sviluppo della Valutazione in Italia*, Milano: Franco Angeli.

Powers J.B. and McDougall P. (2005) 'Policy orientation effects on performance with licensing to start-ups and small companies', *Research Policy*, vol. 34, pp. 1028-1042.

Rossi, P. H. e Freeman, H. E. (1989) *Evaluation: A Systematic Approach*, Newbury Park: Sage Publications.

Sampat B.N., Mowery D.C. and Ziedonis A.A. (2003), 'Changes in university patent quality after the Bayh–Dole act: a re-examination', *International Journal of Industrial Organization*, vol. 21, pp. 1371–1390.

Sampat B.N. (2006) 'Patenting and US academic research in the 20th century: The world before and after Bayh-Dole', *Research Policy*, vol. 35, pp. 772-789.

Sanderson, I. (2003) 'Is it «What Works» that Matters? Evaluation and Evidence-Based Policy-Making', *Research Papers in Education*, 4, pp. 331-345.

Scriven (1973) 'Goal-free Evaluation', in House E.R. (ed), *School Evaluation: the Politics and Process*, Berkley: McCutchan.

Shadish, W. R., Cook T. D. e Leviton, L. C. (1991) *Foundations of Program Evaluation: Theories of Practice*, Newbury Park, Sage Publications.

Shane S. (2004) 'Encouraging university entrepreneurship? The effect of the Bayh-Dole Act on university patenting in the United States', *Journal of Business Venturing*, vol.19, pp. 127-151.

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

Stame, N. (1998) *L'Esperienza della Valutazione*, Roma: Edizioni Seam.

OECD (2003), *Turning Science into Business: Patenting and Licensing at Public Research Organisation*, Paris: OECD.

Valentin F. and Jensen R.L. (2007), 'Effects on academia-industry collaboration of extending university property rights', *Journal of Technology Transfer*, vol. 32, pp. 251-276.

Von Ledebur S. (2009) 'University-owned patents in West and East Germany and the abolition of the professor's privilege', Working *Papers on Innovation and Space Phillips-Universitat Marburg*, pp. 2-21.

Von Ledebur S., Buenstorf G. and Hummel M. (2009) 'University Patenting in Germany before and after 2002: What Role Did the Professors´ Privilege Play?', *Jena Economic Research Papers*, n. 68, pp. 1-38.

Wright, M., B. Clarysse, A. Lockett and M. Binks (2006), 'Venture capital and university spin-outs', *Research Policy*, vol. 35, pp. 481–501.