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Abstract

Several bodies of economic literature extensively analyze how academic research and universities contribute to society in terms of research, education and third-mission activities, but do not systematically analyze academic activities *per se*, beyond a focus on (measurable) societal interaction and outcomes. This paper proposes the usefulness of studying novel academic activities from an opportunity perspective. An opportunity framework is constructed and applied to the literature in leading journals to investigate how the activities and role of academics are studied from the perspective of how opportunities are identified and exploited, and the sources and targets of these opportunities. A main part of the literature focuses on narrowly selected exploitation activities, such as patenting and firm creation, as well as characterizing university-industry interaction. At the same time surprisingly little seems to be known about what academics *do* and why they do it, as the literature has not analyzed academic activities. Specifically, the literature analyzes university output as if it produces for product markets, rather than analyzing the role and nature of academics as specialized service providers across a range of activities. The paper argues that this is a serious shortcoming, because it contradicts recent theorizing on opportunities and it can hamper our understanding of universities and academics as dynamic actors.

Introduction

There is ample evidence across a range of different bodies of literature that academia and academics, universities and science play a crucial role for technological change and economic growth (Rosenberg and Nelson 1994; Mansfield 1995; Mansfield 1998; Florida and Cohen 1999; Salter and Martin 2001). Accordingly, much research has appeared in the literature on academic entrepreneurship, economics of science/technology/innovation, industrial dynamics, and university-industry interaction, regarding the economic role and impact of science and academic research (e.g. Rothaermel et al. 2007; Dasgupta and David 1994; Rosenberg 1992; Rosenberg and Nelson 1994; Meyer-Krahmer and Schmoch 1998). These bodies of literature focus on the relations of universities and science with the “outside world.” Thereby they identify and explain what universities or science do in relation to industrial and economic progress by adopting a systemic view of academia and universities.

However, while this economic literature extensively analyzes how academic research and universities *contribute* to society, there is no systematic overview of how the literature deals with novel activities of academics. Undoubtedly the actions of individual researchers and formal and informal research groups shape and determine how universities interact with each other and society at large. While individual academics can specialize, academia as a whole can be characterized as conducting research, teaching and supervising students and engaging in various third-mission activities, such as setting up new firms. Therefore academia and universities have three roles: research, education and third mission.

To systematically analyze how the literature deals with novel academic activities, this paper investigates the literature in terms of what empirical studies are undertaken and what assumptions are made about the three roles of academia. Few scholars would dispute that novel academic activities, broadly speaking, depend on how actors identify and exploit opportunities.¹ Indeed, the opportunity concept is useful in that it combines the economic literature with recent theorizing on entrepreneurial activities. Entrepreneurial activities can, for example, include new means-ends relations within existing organizations, and are thus a broader phenomenon than new firm formation (Buenstorf 2007). In line with this, we argue that the opportunity concept is a useful way to analyze academic behavior. Taking this wider view of entrepreneurial activities, an opportunity can be defined as consisting of ideas, beliefs and actions that enable the creation of some sort of outcome having some degree of novelty for the agent (cf. Venkataraman 1997; Sarasvathy et al. 2003).

The introduction of novelty in their work implies that academics act under uncertainty, since in some manner they lack relevant prior experience. Hence there is no pre-existing “formula” for the work: neither the problem to be solved nor the way to reach the solution are fully known to the academic. Instead, academics have to identify and develop “ideas” and “implement” these in some fashion. In practice, an opportunity can be understood as a hitherto unexploited but potentially useful or profitable project (Casson and Wadeson 2007). Consequently, opportunities can be used to characterize all sorts of innovative activities with novel outcomes from the perspective of the “innovator.” Typical novel academic outcomes

¹ For example, Etzkowitz et al. (2000) claim that there are shifts in the way knowledge is created and exploited, indicating that there are new ways to recognize opportunities and for researchers to exploit or even profit from them (Slaughter and Leslie 1997; Ziman 2000).

include innovations, scientific publications, new firm foundations, or setting up new master programs.

Nonetheless, the opportunity concept has not been systematically applied to the activities of academia and academics. This is surprising as much academic work consists of entrepreneurial activities, in that academics provide a set of different stakeholders with knowledge services through the identification and exploitation of opportunities (Shane and Venkataraman 2000; Buenstorf 2007; Deiacio et al. 2009). Therefore, this paper will apply the opportunity concept to the literature dealing with academia and academic roles in the literature on economics of science/technology/innovation, industrial dynamics, university-industry interaction and academic entrepreneurship.

Our aim with this study is threefold. First, we create an opportunity framework for studying academic work and exemplify and highlight its aspects by re-interpreting existing studies in this literature. Second, we show what the literature has studied regarding academic work from an opportunity perspective. Third, we point out the gaps in this literature based on the opportunity framework. Thus, we re-interpret previous research that has different objectives and perspectives than the present paper. To do this, Section 2 constructs an opportunity framework while Section 3 presents our research design and methods. Section 4 presents the results in terms of how the economic and entrepreneurship literature studies academia. To limit the work load, we study papers published from 1995 in a set of leading journals. Section 5 discusses the shortcomings of the existing research and examines some problems from a policy perspective. As this paper shows, there are no works in the selected literature that systematically study the behavior and roles of academia and academics by covering the three roles of the university.

An academic opportunity framework

Opportunity is a multifaceted concept that is present in many bodies of literature, including the entrepreneurship literature, which employs the opportunity concept to characterize what entrepreneurs do and how they behave.² Here the concept is used to characterize academic behavior as it focuses on cognition and actions of individuals.

Opportunities refer to conjectures about how economic ends can be achieved in a profitable way (Shane and Venkataraman 2000; Sarasvathy 2001). More precisely, *entrepreneurial* opportunities, following Casson (1982) and Shane and Venkataraman (2000), consist of the potential introduction of novelty by creatively changing means-ends relations. In principle, a changed end can be viewed as a changed “offer” or solution provided to someone, while a changed means can be viewed as a changed way of delivering the offer or the solution. A combination of these is of course also possible. Thus fundamentally, opportunity entails ideas

² It is beyond the scope of this paper to give the concept full justice. For recent relevant reviews see the special editions in *Small Business Economics* (McMullen et al. 2007), which deals with opportunities *per se*, and *Journal of Management Studies* (Alvarez and Barney 2007a) dealing with the entrepreneurial theory of the firm. Also see the two special issues in *Strategic Entrepreneurship Journal* (Alvarez and Barney 2008a,b) dealing with opportunities, organizations and entrepreneurship, respectively from a theoretical and an empirical point of view.

regarding in what ways value can be created for others, and the means of delivering and leveraging from this created value (cf. Hsieh et al. 2007).

That an opportunity is considered entrepreneurial if it contains the creation of new means-ends frameworks (relations) (see Hsieh et al. 2007; Gaglio and Katz 2001; Eckhardt & Shane 2003) emphasizes radical changes in terms of insights and behavior of individuals. From the perspective of academic novelties, this is too narrow a characterization of opportunities, since many new activities involve more mundane, albeit non-trivial, novelties – such as writing a new paper. In contrast, many academic actions tend to be similar to projects in the sense that empirical investigations, supervision, lectures or firm interaction and other academic work are set up, changed and terminated. This implies that “novelty” must be interpreted quite broadly to capture changes and sources of academic behavior. Thus, a new idea for a publication or setting up a new course are plausible alternatives for what a new opportunity can include.

The mainstream entrepreneurship literature largely deals with opportunities in terms of individual recognition or new firm start-up (Kirzner 1973; Gaglio and Katz 2001; Shane and Venkataraman 2000, 2001). This paper does not dispute the importance of these usages of entrepreneurial opportunities, but for our purposes a more inclusive approach is warranted. Indeed, opportunities can be seen not just from the perspective of individuals, but also from that of groups or constellations of individuals who are organized formally or informally. Although opportunity perception is a cognitive subjective process by a single individual, it is possible to share this perception – with some potential gain, loss or distortion – in a group of people who collectively identify an opportunity. In this manner, we can study processes from the opportunity perspective also on the level of a group.

Shane and Venkataraman (2000) characterize the entrepreneurial process by the sources of opportunities, and the processes of discovery, evaluation and exploitation of opportunities from the perspective of the set of individuals. In this definition, opportunities are forward-looking: value will be created for someone other than the entrepreneur, through entrepreneurial processes, and it is this presumably forthcoming value that allows the entrepreneur to profit from the created value (Lepak et al. 2007). We modify their approach to characterize opportunities in terms of the *sources* and the *targets* of the opportunities, and the processes of opportunity *identification* and *exploitation*.

Opportunities consist of two distinct, though not sequentially determined, processes: *identification* and *exploitation*. This characterization is closely related to the definitions used in previous research on opportunities. The definitions are not entirely consistent between authors, but they comprise the creation or discovery (i.e. identification) of opportunities and/or the development of selected opportunities (i.e. exploitation) (for a review see Short et al. 2010). It should be noted that identification of opportunities are subjective and cognitive processes of the focal actors, whereas exploitation is the actions, i.e. the behavior, of the actor in order to develop and realize the chosen opportunity. To be able to understand and explain opportunities and the role they play, we also include the *sources* and *targets* of opportunities in our characterization. Figure 2.1 presents the developed opportunity framework.

Insert Figure 2.1 here

First, we deal with the opportunity development process which consists of the identification and exploitation of opportunities.³ The term “identification” can denote both the discovery and the creation of opportunities, since also an opportunity created by the focal actor needs to be perceived as an opportunity in order to be exploited. Zahra (2008) argues that creation and discovery tend to play complementary roles, forming a “virtuous” cycle by creation boosting discovery and vice versa. This implies that the creation and discovery of an opportunity are not mutually exclusive (cf. Chiasson and Saunders 2005). Taking an evolutionary perspective, almost all opportunities derive from human actions (Buenstorf 2007), although the opportunity may not be recognized by the actual “creator”. Accordingly, the debates on whether all opportunities are discovered and “objective” or created and “subjective” are not very fruitful (for the different views, see e.g. Sarasvathy et al. 2003; Sarasvathy 2004; Shane and Venkataraman 2000; McMullen et al. 2007; Alvarez and Barney 2007b).⁴ Rather, Buenstorf (2007) sees the real question as “whether or not the opportunity is exogenous to the entrepreneur’s own activity”, i.e. whether it is the entrepreneur or someone else who creates the opportunity.

The concept *opportunity identification* refers to the subjective and cognitive identification of opportunities created endogenously to the individual’s own activities or discovered exogenously to these. Opportunity identification is about (consciously or unconsciously) finding problems, evaluating their potential value and, based on this, making a choice to act on a specific opportunity. Thus, it is about the subjective cognitive processes of actors, and is of importance for understanding the choice of actions.

Opportunity identification entails the finding of “valuable problems” (Hsieh et al. 2007). This refers to the identification of problem-solution pairs, where a problem is found and identified to be valuable because its expected solution will create value or reduce cost for someone in some manner. Problems are found by observing the difference between what something is, or is perceived to be, and what it could or should be (Pounds 1969). Thus, an identified opportunity consists of identified problems with expected, potential or real solutions which will provide value for someone else, which the focal actor potentially can “appropriate”, capture or benefit from. While only a few identified problems are related to opportunities, the discovery or creation of a problem worth investigating is a focusing device for what academics choose to work on. One example of problem-finding includes academics who recognize that the important problem in preventing a disease is how to investigate a certain mechanism. Another example is that academics may recognize or have been told that their nation lacks a certain competence, resulting in a great need to set up a new educational program to help solve the problem.

The identification includes recognizing the potential for the focal actor to capture or benefit from this created value in some manner. For academics, what constitutes “value

³ Note that evaluation of opportunities can take place both when opportunities are identified and when they are exploited.

⁴ In addition to creation and discovery, there is a third type of opportunities dealt with in the existing literature, namely opportunity recognition. This could be viewed as a sort of arbitrage, since the entrepreneur recognizes an already existing unfulfilled demand and responds to it with an existing solution/product (see Short et al. 2010; Miller 2007).

capture” goes far beyond pecuniary measures, as it also includes increased scientific prestige, further access to research resources and the like (e.g. Merton 1973; Dasgupta and David 1994; Stephan 1996).

Opportunity development can be seen as consisting of finding, selecting and undertaking various problem-solving activities to capture the expected future value. Opportunity identification includes the incentives for academics to identify an opportunity and perceive it as “valuable” enough to pursue. Thus, opportunity identification incorporates choices (conscious or not), based on the perceived differences in value, between different identified problems/solutions to develop and exploit. In other words, incentives are about the perceived value of identified problems, and are thereby related to the choice to act. Changes in incentives should be seen as altering the perceived value of different problems, implying potential changes in the choice of opportunities to act on, but not necessarily in which problems are identified to begin with.⁵ Hence, the nature and setting of incentives are one important aspect of opportunity identification. An example is when researchers find out that the tools they have developed have a high market value, so they decide to launch a new firm. The perceived value of different opportunities can also be influenced by “cognitive incentives”, in the form of the focal actor’s subjective wants, feelings, etc. For instance, affect and aspiration levels have an influence on the entrepreneurial process (Baron 2008).

Finally, the characteristics of academics and their environment influence which opportunities are perceived as valuable enough to pursue. Which opportunities academics identify and recognize as worth exploiting depends to some extent on their personal traits, such as prior knowledge and experiences.⁶ Naturally it is also influenced by the characteristics of the environment in which the academic works. For instance, university policy regarding intellectual property rights, or the existence of support functions such as technology transfer offices (TTOs), affects the perception of opportunities that may involve patenting activities.

The second part of the framework is *opportunity exploitation*. While opportunity identification is a cognitive process only, the exploitation of opportunities consists of problem-finding and problem-solving actions and mental processes aimed at developing the opportunity (Weick 1983).⁷

Opportunity identification is often depicted as preceding the exploitation processes, but in reality the two must be understood as gradually co-evolving. Shane and Eckhardt (2003, p. 177) define the process of opportunity exploitation as “taking action to gather and recombine the resources necessary to pursue an opportunity”. Exploitation of opportunity entails a *commitment* to launch the opportunity so that it can benefit its intended targets. For us, the exploitation is not only the gathering and recombination of resources *necessary* to pursue an

⁵ However, gradually changing incentives may change which opportunities/problems are identified as search patterns.

⁶ This can be related to findings in entrepreneurship literature. Depending on what a firm knows, Shane (2000) shows that previous experiences and accumulated knowledge shape what opportunities are discovered and how they are further developed into a viable business.

⁷ Early work on problem-solving tended to focus on mental activities rather than actions.

opportunity; it is the actual activities conducted to develop the problem/solution in the perceived direction in order to bring it to the envisioned target. Thus, exploitation here refers to means by which the envisioned end (target) for the opportunity is reached.

Opportunity exploitation for an academic concerns the actions undertaken to solve an identified problem or to develop a perceived solution, and the ways employed to reach the perceived *targets*. This entails gathering necessary resources to pursue the opportunity and to conduct the work needed to bring the opportunity to the desired end. This could, for instance, involve conducting a comprehensive research process to find a solution to a perceived and valuable problem, or to search for a problem with a solution perceived in earlier research.

Part of *opportunity exploitation* are the *modes of exploitation*. These consist of the different ways in which the developed opportunities can reach the desired targets. The modes of exploitation are the arrangements through which the focal actor takes steps to realize an opportunity to reach a specific target. Thus, modes of exploitation are the “vehicles” employed to realize an opportunity (the means) and the outcomes of this effort (the ends). Shane and Venkataraman (2000) recognize two such modes for entrepreneurial opportunities: the creation of a firm or the selling of the opportunity to an existing firm. This can be interpreted as a model that only deals with opportunities which entail products or services that can be sold on some sort of “market”. However, for academia there are a great number of potential modes of exploitation, as academics contribute to different types of stakeholders. Examples of modes of exploitation for academics include publishing in journals or books, attending research conferences as another arrangement to diffuse research and access the reward system of science, the transfer of technology and IP rights through e.g. licensing out patents, the creation of firms, lecturing and designing courses for students. For the list of modes of exploitation, see Table 3.1 in the following section.

Third, we will deal with opportunity *sources*. By sources of opportunities we mean the actor’s different activities through which opportunities are identified. From an evolutionary perspective, it is clear that almost all opportunities are based on human activities (Buenstorf 2007). They may be the outcome of conscious creation by an individual, but they are often the unintended consequence of human activities motivated by other, frequently non-economic, objectives. Therefore they are often not recognized by the creator. In this manner, Buenstorf (2007) puts the focus on the entrepreneur’s own activities in regard to the “sources” of opportunities, thus circumventing the whole issue of whether opportunities are created or discovered.

If the focal actor in fact creates the opportunity, then we can characterize *the activities conducted to achieve this creation* as the *source*. On the other hand, if the opportunity is created exogenously to the focal actor’s activities, then *the activities conducted while discovering the opportunity* can be seen as the source. Thus, a source is the result of either serendipity or deliberate search that leads to the identification of an opportunity (Gaglio and Katz 2001). Hence, it is possible to characterize the opportunity from the perspective of the actor and the actor’s behavior if we view activities as sources of opportunities, regardless of where the actual “creation” took place. When we talk about *sources* of opportunities we mean the actor’s different activities through which opportunities are identified. This stands in

contrast to e.g. Eckhardt and Shane (2003) who use sources to categorize different types of opportunities.

In their work, academics can create or discover opportunities across all the missions of universities – research, education and third mission. These three missions can be divided further into more distinct activities. Opportunities originating from research include commercializable research results, the development of scientific instrumentation or methodologies, and identification of potentially important problems while reading scientific articles or listening to other researchers' conference presentations. Examples from education could be the work of students and questions that students or the academic asks during the design and implementation of a lecture. Opportunities stemming from third-mission activities could, for instance, come from identification of a firm-related problem while consulting in industry, or the possibility to get additional funding by participating in industry collaboration or joint research centers.

The concepts of sources and opportunity exploitation are not mutually exclusive. Opportunity exploitation is a subset of sources because the former always entails the exploitation of an identified opportunity, while sources can be any number of actions. Over time as opportunities develop, new problems are found and new knowledge is created. In this manner, exploitation of the initially perceived opportunity can at times lead to the identification of a new opportunity, leading to altered exploitation activities and so on. This implies that opportunity exploitation can be the source of a perceived new opportunity, as is depicted in Figure 1.⁸

The fourth and final aspect of the framework deals with *targets*.⁹ Targets are the intended, expected or assumed recipients – including buyers, users, beneficiaries – for whom value is to be created by the actor by exploiting the perceived opportunity. The target is reached by the exploitation of an identified opportunity and can be seen as the “market segment(s)” aimed at. Not all opportunities are right for all targets, in that the perceived value of an opportunity differs between types of targets. Therefore the target aimed at, and the perceived value of that target, are crucial for which opportunities are identified as worth pursuing.

The stakeholders of the university are the targets of academic opportunities: the scientific community, students, firms and society at large (Deiaco et al. 2009). The outcomes of opportunities, i.e. the “results” of academic efforts delivered to targeted stakeholders, are also broadly categorizable within one of the missions of universities, namely research, education and third-mission activities. For example, an opportunity realizable within education is targeted first at students, providing them with an increase in useful knowledge, and secondly at firms that can access this knowledge by hiring the students. Another example is that an academic exploits an opportunity within research by publishing results, thereby targeting the scientific community, which gives other researchers the opportunity to utilize

⁸ As long as the opportunities under scrutiny are numbered in sequence, the two concepts are distinct.

⁹ There is an “opportunity push” bias in the literature, as it does not deal directly with for whom the opportunity is intended.

this new knowledge (or methodology or the like).

In this section we have presented a simple opportunity framework, leading from the source(s) to the target(s) by the processes of opportunity identification and exploitation. In Section 4, we apply this framework to the relevant existing university literature to analyze what has been studied and what is known about what academics do, from our opportunity perspective. In the following section, the method for doing this is presented.

Method

We started with a brainstorming session, during which a rough outline of the overall sampling process and the relevant journals and search terms to be employed was decided upon. We performed key word searches in a set of key journals, rather than in overall databases (such as ProQuest or Science Direct).

This approach was chosen since database searches would yield an overwhelming amount of results if narrowly defined search strings are not used. So as not to constrain the scope of the analysis, we therefore chose to focus on a subset of ten journals.¹⁰ The journals were chosen as being relevant in terms of the fields of the economics of science / technology / innovation, industrial dynamics, university-industry interaction, and the academic entrepreneurship literature, dealing with topics or methods related to studies of universities as being intrinsic parts of the “economy” and having high impact factors. The search was limited to include only literature published from 1995 onward.

To capture important publications found in journals not addressed in our initial search, we also employed a snowball technique, searching for relevant references in the collected papers. For the same reason, a general key word search was conducted in the databases ProQuest, ScienceDirect and JSTOR, using the broader set of search terms described earlier. During this search a handful of articles in six additional journals were collected. All in all, 212 articles in 16 journals have been analyzed. Literature fully focused on educational aspects has been omitted from our sample since we are interested primarily in specific types of literature, but also to decrease complexity.

The data analysis was conducted during three phases. First, a random subsample of the collected articles was read closely to provide a deeper understanding of the literature at hand. Second, a content analysis in relation to the opportunity framework was conducted. All collected articles were coded according to a set of dimensions and categories, seen in the coding schedule in Table 3.1. The coding schedule is made up of the four dimensions in the opportunity framework. The table illustrates the coding schedule in that *the presented categories are bundles of related subcategories*. For instance, the category “Research services” contains a range of subcategories related to (research) activities formally “purchased” by firms, such as “Contract research” and “Consulting”.

¹⁰ These are Research Policy, Journal of Technology Transfer, Journal of Business Venturing, Management Science, Small Business Economics, International Journal of Industrial Organization, Industrial and Corporate Change, The American Economic Review, Journal of Economic Behavior and Organization, and Journal of Evolutionary Economics.

Insert Table 3.1 here

While closely reading a subsample of the articles, during the first phase of the review, we noted which parts of the framework that the literature studied explicitly (i.e. the “manifest” content). The first version of the coding schedule was constructed on the basis of the dimensions and categories in the opportunity framework that the pre-reading found to be manifest content. Moreover, some categories, related to education, were added to “Opportunity exploitation” to make the dimension complete in relation to the three roles of academia. The categories were coded according to a coding manual with related rules, by reading method sections and abstracts of all articles. A pilot test was conducted, followed by revision of the manual and coding rules. Table 3.1 displays all aspects of the four dimensions of opportunities that were searched for during the analysis. In contrast, Table 4.1 in the following section presents only the aspects which we have found during the analysis.

In the third and final phase we randomly chose a new subset of papers, which we read closely in an attempt to discover any potential “latent” content related to our opportunity framework. Latent content refers to underlying meanings of the content not explicitly stated.

We employ a quantitative approach, but we do so in a “qualitative” manner, meaning that the coding was not automated and the coder had to make qualitative judgments from case to case with the support of the developed coding rules. The reason is that in this context an automated coding process would not be possible; we cannot simply search for a term corresponding to a coding category in the article database and count the number of times it appears, since any term used in a specific article could be referring to previous research, rather than being part of the study at hand. Likewise, some terms might be part of more than one dimension and category.

Results

This section presents what the analyzed literature studies in each of the opportunity dimensions, i.e. *identification, exploitation, sources* and *targets*.¹¹ The section will also demonstrate the “holes” in the literature, especially regarding novel behavior and changing activities of academics. In particular, there is no investigation of what academic researchers do from the perspective of opportunities. We will come back to this issue in the discussion in Section 5.

Much of the recent literature on industrial dynamics and economics of innovation focuses on the role of universities as contributing directly to economic growth and industrial innovations and how they do this (e.g. Salter and Martin 2001). Other studies deal with how university ideas and inventions are exploited, particularly in terms of university spin-offs and patents (e.g. Geuna and Nesta 2006; Rothaermel et al. 2007) and the interaction between universities and firms (e.g. Cohen et al. 2002; Laursen and Salter 2004; D'Este and Patel

¹¹ The references in this section are examples of articles from our literature analysis. Due to lack of space, the references found in the bibliography are not complete. The comprehensive list can be requested from the authors.

2007). There is also a small but increasing amount of “economics of universities” literature, mainly in book form and therefore outside our scope here, which deals with the organizational structure and behavior of universities, studying the on-going changes and their effects on the European university sector by drawing on cross-country micro-data (Geuna 1999; Bonaccorsi and Daraio 2007; McKelvey and Holmén 2009).

Table 4.1 presents results in terms of the share of papers that in our analysis have been interpreted as dealing, explicitly or implicitly, with the different categories in the four dimensions of our opportunity framework. The sum for each dimension exceeds 100 percent since any paper in principle can deal with more than one category per opportunity dimension.

Insert Table 4.1 here

One notable feature of Table 4.1 is how the dimensions progressively become more detailed. However, this apparent bias is created by the nature of the literature, since it partly reflects the coding schedule which was created following an extensive reading of the literature. In contrast to Table 3.1, it is clear that several categories have not been coded at all in our analysis, and thereby many issues related to our framework seem to be missing in the literature. For example, a striking feature of the study is that no articles viewed education as a source or target of opportunities.

Also notable is that the majority of studies deal with technology transfer, e.g. through human capital movement, and commercialization of academic research. This finding is based on the fact that a majority of articles address third-mission activities with firms as the targets, and are in line with the general characterization of the literature presented above.

Figure 4.1 presents three common types of relationships between the dimensions in the opportunity framework.

Insert Figure 4.1 here

The relationship most commonly found among the sampled articles concerns how an opportunity for transfer of intellectual property rights to a firm, commonly in the form of patents, is recognized while conducting research activities. Most of these articles investigate the determinants and characteristics of university patenting and licensing (e.g. Baldini et al. 2006; Thursby et al. 2001; Saragossi and van Pottelsberghe de la Potterie 2003; Shane 2004).

The second type relates to a recognized opportunity for creating a firm to exploit some research result. This usually includes the transfer of IP rights from the university (or academic inventor(s), depending on the country) to the start-up. The firm is the target for the transfer, while society at large can be interpreted as being the target of the opportunity leading to a spin-off. There are many of this type in our sample, studying for example the determinants of university policy and/or characteristics and the degree of firm creation at different universities (e.g. Landry et al. 2006; Lockett et al. 2003; Link and Scott 2005; Nicolaou and Birley 2003; Rothaermel et al. 2007; Wright et al. 2004).

The third type is about opportunities leading to publishing and patenting, the first mainly targeting the scientific community and the second mainly targeted at firms (through potential licensing). Typical articles here are those that investigate the relationship, and potential trade-off, between traditional academic work (publishing) and commercialization of research results (patenting) – commonly using characteristics of the academic, such as experience and scientific productivity, as explanatory variables (e.g. Calderini et al. 2007; Czarnitzki et al. 2009; Fabrizio and Di Minin 2008; Van Looy et al. 2006).

Opportunity identification

In the sample, incentives for pursuing opportunities are the most commonly studied aspect of opportunity identification. Many articles also look at the characteristics of academics; but a substantial number do not, either explicitly or implicitly, investigate opportunity identification in any way.

The majority of the articles deal with various forms of incentives, such as receiving funds or gaining access to research instruments, in relation to how opportunities are discovered (see Table 4.1). However, for many of these papers, incentives are used as control variables rather than being the unit of analysis *per se*. Note that no studies are found that explicitly deal with “internal” cognitive incentives, such as the aspiration and affect of academics.

There is also a non-negligible amount of papers dealing with the characteristics of academics that discover opportunities. Many of these use these characteristics as explanatory variables for the likelihood of success in terms of starting a new company or being an “over-performer” in terms of publications or patenting. For around one-third of the papers, we cannot find any content, manifest or latent, that allows us to infer anything concerning how opportunities are identified. Finally, one neglect of the literature in relation to our framework is that while the issue of “value” in opportunity identification is dealt with in terms of incentives, not much effort has been spent in dealing with how problems – worth investigating further – are found, beyond general debates on the motivations of researchers.

Regarding incentives for the academic to recognize opportunities as valuable enough to exploit, the literature studies for instance the general reward system found in science. The reward system gives academics incentives to openly and readily disclose research results through the principle of priority, for which the reward is prestige (e.g. Merton 1973; Dasgupta and David 1994; Stephan 1996). What this means for opportunity identification is that in general only research opportunities that are perceived as publishable will be conceived as worth pursuing. It should be noted that the norms of publishing differ between scientific fields – implying that this incentive influences fields differently. Also, some have raised concerns about the potential demise of this “open science” due to the increased focus on “applied” and commercializable research, which have fueled literature studying such potential trade-offs (see e.g. Agrawal and Henderson 2002; Breschi et al. 2007, 2008; Fabrizio and Di Minin 2008; Stephan et al 2007; Meyer 2006; Van Looy et al. 2006).

As a more specific case of incentives, Meyer-Krahmer and Schmoch (1998) found that the largest advantages of engaging with firms were perceived, by German academic

researchers, to be to access additional funds and to exchange knowledge. This means that the largest incentives for academic researchers to pursue opportunities, perceived to involve industry interaction, are to get more funding and to exchange knowledge. These can both be seen as resources to be used for other subsequent opportunities. Additional funding can be used to pursue other, perhaps more “scientific” or “basic” opportunities in research, while the exchange of knowledge can provide solutions or new problems.

Incentives can also come from the structural setup of the environment, in the form of deregulation, funding regimes and the like. For the Swedish case, it has been claimed that academic researchers lack proper incentives to act as so-called academic entrepreneurs (i.e. to patent or to create spin-out firms) (Henrekson and Rosenberg 2001). From our perspective, this could be interpreted to imply that the Swedish academic environment does not provide incentives for academics to recognize opportunities that include patenting and firm creation as valuable enough to pursue.

Likewise, funding regimes, and their incentive mechanisms, can provide skewed incentives, influencing which opportunities academics find worthwhile to pursue. For instance, at the level of the university, Geuna (1998; 2001) studied the consequences of the on-going introduction of more competitive and performance-based funding. He highlights the risk that universities will focus more on the short-term needs of industry, especially for those with weak finances, at the expense of long-term academic research.

Intellectual property rights in general and the patenting system in particular are another important provider of incentives (see the literature on “Economics of science”, e.g. Stephan 1996; Dasgupta and David 1994). A research opportunity that is perceived as having patentable results may be perceived as valuable in that patenting can ease the transfer of the research results to industry, thus making it more attractive, and may provide economic gain through e.g. out-licensing and/or creation of spin-offs to exploit the opportunity.

In regard to characteristics of academics identifying “valuable” opportunities, we can turn to the literature studying university-industry interaction. For example, D’Este and Patel (2007) found in a recent study of UK researchers that the individual characteristics of academic researchers, such as number of joint publications, age and professor status, influenced the variety and frequency of industry interaction more than the characteristics at the university and industry level. This can be taken to imply that your experience, in this case of industry interaction (joint publication) and/or of academic research at large (age and professor’s status) to some extent influence what opportunities are perceived as valuable enough to act upon. In other words, at the general level, it means that who you are, who and what you know will influence which opportunities are presented to you and which ones you find worth exploiting.

A number of studies have been conducted exploring the impact of patenting on scientific production in terms of publications or citations, thereby investigating whether industrial work, reflected by patenting, is a substitute for or a complement of scientific research (e.g. Agrawal and Henderson 2002; Owen-Smith and Powell 2003; Meyer 2006; Van Looy et al. 2006; Breschi et al. 2007, 2008; Stephan 2007; Fabrizio and Di Minin 2008). Although using slightly different methods and putting forward different explanations, most of

these studies show that industrial research is complementary to scientific research rather than a substitute. Pursuing opportunities targeted at third-mission activities does not necessarily alter academics' perception of scientific activities and publishing as valuable enough to pursue.

In a study of a French university, Carayol (2007) found that younger academic researchers patented less than older ones. He attributes this difference to the fact that incentives to patent, such as monetary rewards, might seem more important at an older age when the academic incentives to conduct traditional academic research (i.e. publishing) are known to be lower. Put differently, the aspiration of academics change with age – meaning that Carayol bases this explanation implicitly on “internal” cognitive incentives of academics.

Finally, some studies indicate that the perception of opportunities as valuable enough to pursue depends to some extent on the different career paths which academics are following. For instance, Calderini et al. (2007) in a study of Italian university researchers found that “for [scientists doing “applied” work], more academic research results in more exploitable results, hence in more chances to patent; for [scientists doing “basic” work], more academic research makes it just more unlikely that they will find the time to produce industrial applications”. Hence, *opportunity identification* can be interpreted as being path-dependent, in that the characteristics of the academic in terms of prior knowledge and experience limit the ability to perceive certain opportunities as worthwhile to pursue.

Opportunity exploitation in universities

The university literature present in our sample is concerned with *opportunity exploitation* exclusively in the form of a few modes of exploitation, mainly in relation to commercialization and transfer of academic research. Thus, the literature focuses on the vehicles used by academics to reach targets, but ignores study of the actual work conducted by academics to develop identified opportunities.

The articles in our sample are mainly focused on studying aspects of the commercialization of academic research and the interaction with industry. Thus the sampled articles capture only a few modes of exploitation, especially patenting and firm creation (for a review see Rothaermel et al. 2007). This can be seen in Table 4.1 – almost half of the articles study the transfer of intellectual property rights (e.g. licensing out) or other types of technology transfer. As can be seen in the table, the three most commonly studied modes are related to technology transfer and commercialization of academic research. We can see that publications are studied by approximately twenty-five percent of the articles. Most of these articles analyze the role of publications as a channel for university-industry interaction, as a control for the scientific productivity of academics regarding e.g. firm creation, or as evidence concerning the potential trade-off between patenting and publishing (see e.g. Balconi and Laboranti 2006; Shane and Stuart 2002; Breschi et al. 2007). Thus, the focus is not on publication as a mode of exploitation *per se* but rather as a way to assess e.g. how specialization affects the “societal relevance” or entrepreneurial success of researchers.

One widely studied aspect of modes of exploitation is the frequency, or perceived importance, of different channels for knowledge transfers between universities and industry.

Studies have shown, for instance, that neither academics nor industrialists consider patenting as an important mode of exploitation (e.g. Meyer-Krahmer and Schmoch 1999; Cohen et al. 2002; D'Este and Patel 2007).

Other work has studied the influence of different characteristics on the propensity for interaction (e.g. Scharinger et al. 2001, 2002; D'Este and Patel 2007; Link et al. 2007; Ponomariov 2008) and on patenting or licensing (Jensen and Thursby 2001; Elfenbein 2007; Jensen et al. 2003; Stephan et al. 2007; Carayol 2007); the determinants and other aspects of university start-ups (Shane 2001; Di Gregorio and Shane 2003; Djokovic and Souitaris 2008; Powers and McDougall 2005); the impact of university science parks on new technology-based firms; the productivity and characteristics of technology transfer offices in facilitating knowledge transfer and other aspects pertaining to academic entrepreneurship and the entrepreneurial university (e.g. Klofsten and Jones-Evans 2000; Carlsson and Fridh 2002; Siegel et al. 2003a, 2003b; Clarysse et al. 2007; Martinelli et al. 2008; Markman et al. 2004; for a review, see Rothaermel et al. 2007).

In many ways, opportunity identification and exploitation are interdependent. For example, regulations and policy initiatives may indirectly influence the incentives provided by the patent system. The Bayh-Dole Act gave American universities the possibility to patent research conducted by public funding in the USA. In our framework this can first be seen as affecting the *exploitation* side, by introducing patents as a possible mode of exploitation. However, thereby it also affects the opportunity *identification* by enhancing the incentives to pursue such opportunities. Other regulations tend to act in a similar manner. Examples include the recent introduction of the professor's privilege in Italy and the removal of the same in Denmark, the latter having already been shown to have consequences in the form of a decrease in academic inventions transferred to industry (Valentin and Jensen 2007).

Sources of opportunities in academia

Table 4.1 shows that all articles in our sample are coded to indicate research as the source of opportunities. In addition, some of the papers are interpreted as having third-mission activities as the source of new opportunities. At the same time, the literature neglects education as a source of opportunities. This is an inference, since the papers do not explicitly study the processes leading to opportunity identification in this manner, and therefore do not deal directly with "sources". We interpret the sampled articles to implicitly study research as opportunity source because the subjects studied in all articles are related to research, such as technology transfer. With few exceptions, the standard assumption in the articles seems to be that research is the source for new opportunities. The "exceptions" refer to third mission as a source, where this can be inferred mainly in papers investigating the outcomes of technology transfer. For instance, Palmberg (2008) shows, among other things, that a large share of academics working in nanotechnology in Finland perceive the identification of new research questions as being an important outcome of technology transfer. In other words, these academics can be interpreted as perceiving technology transfer, which is a third-mission activity, as a potential source of new research opportunities.

One area of discussion regarding sources of opportunities includes the emergence of

biotechnology that offered new technology opportunities for academics to pursue (e.g. Mowery and Ziedonis 2002; Saragossi and van Pottelsberghe de la Potterie 2003; Geuna and Nesta 2006; Zucker et al. 2002; Jong 2008). This is interpreted as showing that the emergence of a new field (here, biotechnology) provides a new set of opportunities that academics can identify during their research activities. Thus, change in *sources* can generate an increase in the size of the potential opportunity space. The characteristics of the emerging biotechnology field not only provide new opportunities for scientific research, but are also conducive of industrial applications, thus providing opportunities exploitable through patenting and *targeted* at third-mission activities. Hence, at a general level the characteristics of the *sources* can be said to influence the scope and paths of identifiable opportunities.

Targets of academic opportunities

A majority of articles (implicitly) deal with firms, while none of them deal with students, as the targets of academic opportunities.

More than three quarters of the sampled articles study firms as a target of opportunities. This is related to the fact that a majority of articles study different types of technology transfer, university-industry interaction and commercialization of academic research results (see Table 4.1). Around one-third of the articles study society at large as a target (denoted Society in Table 4.1). Such studies are primarily concerned with university spin-offs. This comes from viewing spin-offs as created by the university/academic to target consumers (including other firms) in the “society” with some product or service. Roughly the same amount of studies deal with research opportunities targeted at the scientific community. These articles mainly study different aspects of academic publishing. Articles studying targets in terms of society or the scientific community also tend to look at firms as targets. Students are not present, explicitly or implicitly, as targets in any article in the sample.

The existing university literature that explicitly analyzes the targets of academic efforts is, in our opinion, limited. For example, notions such as users or buyers more or less do not exist in this literature. Thus we have been forced to infer the targets in many papers. One example where we can indirectly infer a target is the research policy literature, studying e.g. the effects of regulatory changes. In particular, regulatory changes combined with changes in what types of opportunities academics identify and act upon imply that the types of targets can radically change. Indeed, many papers deal with the effect of potential or existing regulations such as the Bayh-Dole act in the USA (e.g. Henderson et al. 1998; Mowery et al. 2001, 2002; Mowery and Sampat 2001; Mowery and Ziedonis 2002; Rafferty 2008; Sampat 2006; Shane 2004) or the professor’s privilege in some European countries such as Denmark (e.g. Valentin and Jensen 2007).

Discussion and concluding remarks

This section discusses the present lack of research on academic behavior from an opportunity perspective. This paper has investigated what academics do from an opportunity perspective by analyzing the literature on economics of science/technology/innovation, industrial dynamics, university-industry interaction and academic entrepreneurship, in terms of how it

studies universities and academics. As shown in section 4, this literature has predominantly studied universities as static actors providing firms, and to some extent also society at large, with research outcomes through the employment of a few modes of exploitation, mainly in terms of academic entrepreneurship and industry interaction. Such work, occupying a significant part of the university literature studied in the paper, has provided a comprehensive understanding of the characteristics, determinants and incentives of a handful of modes of exploitation, mainly in the forms of patenting and firm creation, targeted at third-mission stakeholders. However, it follows that there are gaps in the studied literature in relation to our opportunity framework. This is evident if the coding schedule in Table 3.1 is compared with the results in Table 4.1, as the latter does not include *education as source of opportunities; students as targets; and modes of exploitation not related to commercialization of academic research and industry interaction*.

In many articles we cannot find any content, manifest or latent, from which we can infer anything regarding opportunity identification. Thus, a gap in the literature relates to the process behind how academics identify valuable problems, beyond incentives and characteristics of researchers. This leads to a predominantly static and scattered understanding of the university and of academic work. Hence, a shortcoming of the existing literature is a lack of a comprehensive account of academic work, studying and explaining the *processes* in going from source to target through the processes of opportunity identification and exploitation. The applied opportunity framework was a first step towards a more dynamic and process-focused account of the university, taking the actor and the actor's behavior as central.

Opportunity exploitation is only studied as different modes of exploitation. The modes of exploitation studied in our sample are primarily related to the commercialization of academic research and technology transfer, i.e. third-mission activities. Hence, there are hardly any modes targeted at the scientific community and none aiming at students.¹² In the same manner, the focus in the literature is on modes related to technological fields, such as patenting, but there is nothing relevant in terms of, for example, human sciences.

Thus, the current university literature leaves huge holes by focusing mainly on *a subset of activities and being mainly "output"-focused*¹³, generally in terms of quantitative measures, rather than analyzing the actions of academics and research groups. The logic behind the current literature can be said to be "product"-based, treating the university as a (static) knowledge provider for industry and society at large. The main interest lies in studying the "importance" of academia and its third-mission activities, while academics and universities are seldom treated as actors in their own right.

The opposite standpoint would be to study the university from an action-oriented or service-logic perspective. In so doing, the university is seen as providing a diverse set of knowledge services to students, firms, government (society) and the scientific community. Using a service logic would mean studying the interactive processes where academics

¹² Note that the movement of human capital, despite being the product of education, is a mode targeted at firms.

¹³ There are exceptions, mainly found in books and thus outside our article sample, where the emerging literature on 'economics of universities' studies university-level behavior using micro-data. Investigated phenomena include the emergent strategies of universities (see e.g. Geuna 1998, 2001; Bonaccorsi and Daraio 2005, 2007, 2008; McKelvey and Holmén 2009).

intervene in the user/buyer/customer processes regardless of whether these services relate to students, firms or society. Starting with a service logic thereby puts a focus on the underlying processes rather than on the measurable results, and provides the possibility to deepen our understanding of academic work.

There were no articles that explicitly studied *processes or activities* in such a way that they could be directly recognized as sources of academic opportunities.¹⁴ Instead, we inferred that all articles assume research to be the source of opportunities, although in some instances it is not the only source. We have found no articles, explicitly or implicitly, studying education as a source of opportunities.

The targets are not directly addressed in the studied literature. They are indirectly addressed as intended, assumed or “obvious” receivers of academic efforts. Most studies concentrate on studying academics who target firms where the opportunities are derived from research activities but exploited in terms of third-mission activities. Studies of academics targeting the scientific community or society at large are less frequent, and usually investigated in combination with firms as targets. At the same time, there are no studies analyzing students as targets.

This lack of attention to sources and targets is a problem, since the present focus on a handful of modes of exploitation sorely neglects how, why and to what extent academics combine sources and targets of opportunities over time. Indeed, academics can, and do, change their behavior by addressing new opportunities and targets. For example, they can shift from research aimed at publishing into setting up a firm based on that research, then use insights from the firm to change education, and finally go back to use the newly gained knowledge to conduct research. Thus, in principle any of the three university roles – research, education and third mission – can contribute to each other. This is an experimentally organized approach that we suggest is not atypical. However, the phenomenon is presently not well understood, which is a very serious shortcoming because academics are not mindless robots, automatically adjusting to changes in incentives.

In line with this argument, we suggest that the notion of “academic experimentation” can be more useful than the currently widely employed notion of academic entrepreneurship, in that it (a) can take all activities of the university into account, and (b) involves the (dynamic) processes of the actors involved. In terms of our framework, experimentation can be defined as the instances when not only do opportunities involve the perception of a valuable problem/solution, but also the exploitation consists of the utilization of a new means-ends framework to bring this opportunity to the perceived target. In practice, this implies that the academic pursues an opportunity by employing new (combinations of) activities and resources, aiming the opportunity at a new target segment, or both.

By using this definition, we can distinguish between individuals or groups of academics who act in an “experimental” or “business as usual” manner. “Experimental” implies an actor who constantly changes the way opportunities are pursued and the target aimed at, using broad searches for opportunities. “Business as usual”, on the other hand,

¹⁴ To explicitly study the sources of opportunities would mean investigating, for instance, how the emergence of a new scientific field affects the behavior of academics by providing a new set of (potential) opportunities.

involves repeating similar activities over and over again (such as publishing the same or very similar research in a few similar journals) and letting the resources at hand set the limits.

In this paper we have extended the opportunity concept, by creating a framework taking also the sources and targets of opportunities into account. This – together with a rephrasing of the definition of an opportunity, as enabling the creation of some outcome having some degree of novelty for *any* agent – has moreover allowed us to widen the use of the concept beyond the current focus of the entrepreneurship literature.

Remarks on policy implications

As we have stressed earlier, the existing university literature is mainly output focused in that it to a large extent studies characteristics, determinants and incentives of academics and universities regarding a few modes of exploitation, mainly patents and firm creation. If taken alone, this kind of literature provides policy with a “narrow” as well as “shallow” perspective of academia and academic work.

The present literature is narrow in the sense that the focus is mainly on the commercialization and industrial use of academic research, thus leaving out large parts of academic work, such as education-related activities. A shallow perspective in that the focus is on outcomes of academic work, and the determinants and incentives that (may) brings these about, thus ignoring the actual work behind these outcomes.

From a traditional economic point of view, the main goal of policy could be argued to be about efficiently allocating a limited set of resources in a manner that maximizes the differences between societal benefits and cost (Bellinger 2007). In a broader sense, we argue that policy’s role is to identify and formulate societal problems and to manage resources and knowledge on the meso-level in order to rectify these problems. Does this stand in contrast to the literature? The economics of innovation and innovation systems stress knowledge creation from a (dynamic) systems perspective. In this way, this literature shows that the role of academia and universities cannot be understood in isolation. However, to understand, and “influence”, the role universities play in the “system” we need to open up the “black box” of academia, in particular novel academic activities across their different sources towards different targets. That is, we must understand the inner workings of academia and universities (i.e. academic work). To create useful and appropriate policy, the literature needs to have a deeper understanding of academic work to understand, evaluate, and “influence” the role academia and universities has in society and economic growth.

Policy regarding academia and universities would thus have to be about more than just allocating resources in an effective manner, trying to realize some currently desirable outcomes. We do not question the usefulness of the existing university literature for policy, in that such perspectives can be used to legitimize actions and directives. What it can do is to clarify what can possibly be done here and now to promote certain outcomes from academia. However, it is unlikely that it can provide policy-makers with a deeper understanding of universities and academia and the role it has in society and economic growth.

Future research

We suggest two broad areas for future research. First, empirical studies of the processes at work in academia from the perspective of opportunities should provide us with new insights regarding the role and characteristics of universities and academics as dynamic providers of knowledge services. One possibility here is that by studying the actors and their behaviors in relation to perceived opportunities, we can map the processes, sequences of opportunities and problem identification/solving. To do this, with a service-based perspective on universities and academics, we must start from the activities of academia and academics, in order to understand and explain the role of universities. Our framework was a first step towards a more dynamic and process-focused account of the university, taking the actor and the actor's behavior as central. Second, empirically testing our interpretations of the existing university literature can offer interesting new perspectives on existing topics. Research on these two broad areas can not only shed new light on the topics of universities and academics, but also provide valuable insights in the study of entrepreneurship.

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Figures and tables

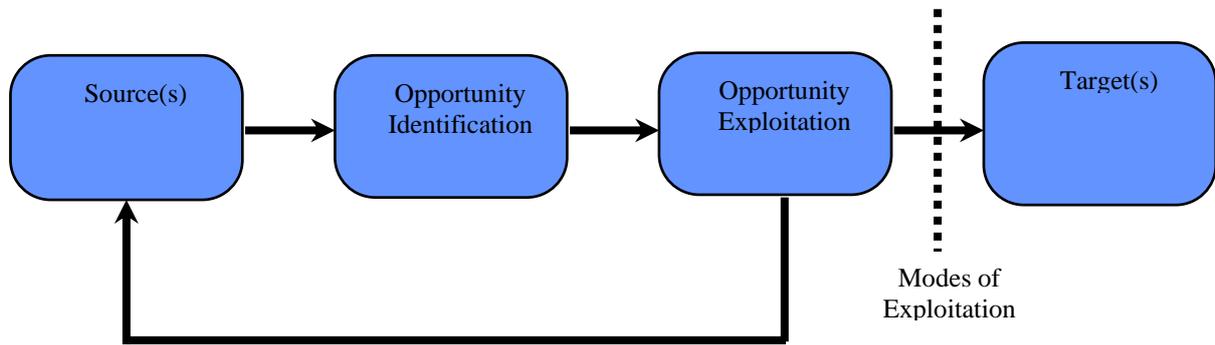


Figure 2.1 Illustration of the opportunity framework

Source(s)	Incentives/Characteristics	Modes of exploitation	Target(s)
Research	N/A	Transfer of IP/Patents	Firms
Research	Policy/Characteristics	Firm creation/Trans	Society Firms
Research (Third mission)	Characteristics	Publications/Patents	Firms Scientific com.

Figure 4.1. Illustration of relationships between dimensions in opportunity framework, common in the studied literature

Table 3.1. The coding schedule

Source(s)	Target(s)	Opportunity identification	Opportunity exploitation
	<i>Research; Education; Third mission</i>	<i>Incentives; Characteristics</i>	<i>Modes of exploitation</i>
Research	Students	Funding	Transfer of IP rights
Education	Firms	Private reward	Patents
Third mission	Scientific community	Access to research instruments etc.	Firm creation/Spin-off
	Society	Test and spread research results	Research services
		University Policy	Publications
		TTOs/Support functions	Human capital movement
		Characteristics of academics/universities	Meetings, conferences, informal interaction
		Attitudes of academics	Collaborative research projects
			Commercialized product
			Invention disclosure
			Publications with firm employees
			Academic collaboration
			Research conferences and other meetings
			U-I research centers
			Internal research group workshops
			Lectures
			Supervision
			Courses
			Programs
			Science Parks

Table 4.1. Descriptive statistics

Source		Target		Opportunity identification		Opportunity exploitation	
		<i>Research; Education; Third mission</i>		<i>Incentives; Characteristics</i>		<i>Modes of exploitation</i>	
Research	100%	Firms	77%	N/A	31%	Transfer of IP rights	42%
Third mission	20%	Society	38%	Characteristics of academics	29%	Patents	39%
		Scientific community	31%	Funding	26%	Firm creation/Spin-off	34%
				University policy	9%	Publications	26%
				TTOs/Support functions	12%	Research services	19%
				Private reward	9%	Human capital movement	15%
				Access to research instruments etc.	8%	Academic collaboration	11%
						Collaborative research projects	11%
						Meetings, conferences, informal interaction	8%
						Publications with firm employees	8%
						Commercialized product	5%
						Invention disclosure	5%
						Third-party U-I research centers	5%
						Science Parks	4%