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KNOWLEDGE TRANSFER ACTIVITIES IN HUMANITIES AND SOCIAL SCIENCES: WHICH DETERMINANTS EXPLAIN RESEARCH GROUP INTERACTIONS WITH NON-ACADEMIC AGENTS?

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Abstract:
Knowledge transfer activities in Humanities and Social Sciences: which determinants explain research group interactions with non-academic agents?

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In the current society, universities and research centers have acquired an important role as agents responsible for knowledge transfer (KT) to the non-academic environment (OCDE, 1996). The different ways in which these collaborations take place have been the subject of many conceptual (Molas-Gallart et al., 2002) and empirical studies (D'Este and Patel, 2007: Landry et al., 2007) in recent years. Many authors have adopted a perspective for analyzing knowledge transfer activities at the level of the university or individual researcher, even if the form of organization in the scientific system is increasingly the research group (Hernández et al., 2009). KT literature has concentrated in the results generated in experimental science disciplines whereas KT in Humanities and Social Sciences (HSS) research has been scarce (Castro-Martínez et al., 2008).

Under these considerations, the aim of this paper is to contribute to KT literature from an area of study generally neglected (HSS) and a perspective (research group) that have received less attention. Thus, the questions addressed in this study are: What are the main mechanisms of KT used by HSS research groups to collaborate with non-academic agents? 2) What are the determinants of these collaborations?

The sample of this study is made up of 79 research groups comprising more than 80% of the population belonging to the HSS area of the Spanish Council for Scientific Research (CSIC), the most important public research organization in Spain. The data were gathered in two phases. In the first phase, between May 2006 and March 2007, two instruments were used for the collection: a) semi-structured face-to-face interview with a representative of each research group identified: b) a questionnaire based on Bozeman s dimension of KT (Bozeman, 2000). The second phase took place in September 2010 by obtaining data related to the leader characteristics from the CSIC corporative database and the ISI Web of Knowledge.

The results show that HSS research groups are very active in some KT activities such as technical advice, consultancy and contract research, whereas their involvement in personal mobility activities is low. Logistic regression analysis shows that the likelihood that researcher groups engage in any KT mechanism is not explained by the same factors. However, we obtain evidence showing that there is a common variable positively related with the engagement of HSS research groups across the

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Knowledge transfer activities in Humanities and Social Sciences: which determinants explain research group interactions with non-academic agents?

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Abstract

In the current society, universities and research centers have acquired an important role as agents responsible for knowledge transfer (KT) to the non-academic environment (OCDE 1996). The different ways in which these collaborations take place have been the subject of many conceptual (Molas-Gallart et al. 2002) and empirical studies (D'Este and Patel 2007; Landry et al. 2007) in recent years. The aim of this exploratory study paper is to contribute to KT literature from an area of study generally neglected, humanities and social sciences (HSS), and from a unit analysis perspective that have received less attention: the research group. Thus, the questions addressed in this study are: what are the main activities of KT used by HSS research groups to collaborate with non-academic agents? Do group characteristics or group' leader profile influence the group' engagement in a specific knowledge transfer activity? Data for this study has been gathered through questionnaires, interviews and databases for a sample made up of 79 research groups (80% of the population) belonging to the HSS area of the Spanish Council for Scientific Research (CSIC). Descriptive and multivariate analyses have been conducted. Results indicate that HSS research groups are very active in some KT activities such as technical advice, consultancy and contract research, whereas their involvement in personal mobility activities is low. Logistic regression analysis shows that the likelihood that research groups engage in any KT activities is not explained by the same factors. However, we obtain evidence showing that there is a common variable positively related with the engagement of HSS research groups for almost all the different activities analyzed: the focus on the social utility of the research.

Key words: Knowledge transfer activities, Humanities and Social Sciences, Research groups, Academic and non-academic interactions, Determinants.

1. Introduction

The relevance given to knowledge for the development of modern society and the rise of knowledge based economy has increased the visibility of those institutions that create and disseminate knowledge (Geuna and Muscio 2009). Public research organisations (PRO) and universities carry out these key functions as entities responsible for the generation and transfer of knowledge issued from their research activities (OCDE 1996). The interest aroused by knowledge transfer (KT) and interactions[1] between academics and non-academic agents has been mostly framed in University-Industry (U-I) interactions. The commercialization of academic research, the exploitation of intellectual property rights (IPR) via patent ownership agreements and the creation of academic spin-off have been a central topic in technology transfer literature (Friedman and Silberman 2003; Jensen et al. 2003; Link et al. 2003; Shane 2004). However, the above activities represent only a small part of the wide range of different collaborations through which academics interact with its external environment (D'Este and Patel 2007; Ramos-Vielba et al. 2010). Thus, a strand of the literature has been devoted to the identification of the variety of KT activities engaged by the academic sphere to collaborate with socio-economic agents (Bonaccorsi and Piccaluga 1994; Molas-Gallart et al. 2002) as well as to the determinants of those interactions (Jacobson et al. 2004; D'Este and Perkmann 2010; Landry et al. 2010).

Despite the extensive literature existing related to knowledge transfer activities, most of the studies undertaken have considered science-industry relations, focusing on the research results aroused from experimental disciplines, such as natural sciences and engineering and academic interactions with industry. Although some authors have considered knowledge utilisation of social science results and how the knowledge produced in these disciplines is used by policy makers (Weiss 1979; Beyer and Trice 1982; Molas-Gallart et al. 2000; Landry et al. 2001; Amara et al. 2004) these studies are still scarce or practically non-existent (especially for the case of humanities disciplines) in comparison with those framed in more experimental disciplines.

Furthermore, Science-Society (S-S) interactions[2] have been covered in the literature from different perspectives. From the point of view of the transfer agent, which is the approach followed in this study, many authors have analyzed the university department (Schartinger et al. 2001; Schartinger et al. 2002) or the individual researcher (Landry et al. 2001; D'Este and Patel 2007; Link et al. 2007; Boardman and Ponomariov 2009; D'Este and Perkmann 2010) as the unit of analysis for explaining academic involvement in KT activities. However, even though research groups[3] represent an increasingly form of organization in the scientific system as producers of

[1] There is a vast terminology used in the literature to define a same concept: mechanisms/channels/forms of interaction, academic and non-academic interactions/relationships/collaborations, third stream activities, etc. To avoid all this amalgam of term, the terms used in the present study are KT activities and interactions.

[2] Science-Society interactions include science-industry, academia-industry, university-industry, university-firms, etc.

[3] The *research group* is defined as a team of researchers working on a common research area within larger institutions and recognized as an entity by their colleagues or partners (Larédo and Mustar 2000).

knowledge (Rey-Rocha et al. 2002; Wuchty et al. 2007; Hernández et al. 2009), studies focusing on research groups as the agent involved in KT are scarce[4].

This study is framed in a broader research aimed to shed light on the characteristics of the knowledge transfer conducted by the humanities and social sciences (HSS) academic community. As evidenced in recent studies, due to the peculiarities of the HSS area, patterns and conclusions drawn from the vast KT literature, centered in results from experimental disciplines, do not always apply for this particular area (Castro-Martínez et al. 2008a; Castro-Martínez et al. 2010). In this sense, previous studies have focused on the organizational factors (policy, management) related with the groups' decision to transfer knowledge (Castro-Martínez et al. 2010; Olmos-Peñuela et al. 2010). This paper represents the continuation of these studies by exploring two directions: first, by distinguishing the different knowledge transfer activities used by groups to transfer their research results; and second, by considering the influence of other characteristics at a lower level of the organization (the research group and the group' leader). Thus, the two questions addressed in the present paper are: first, what is the extent to which HSS research groups engage in different knowledge transfer activities?; and second, do group characteristics or group' leader profile influence the group' engagement in a specific knowledge transfer activity?

The paper is structured as follows. Section 2 starts presenting some particular aspects related to the humanities and social science research context, followed by a review of the main knowledge transfer activities used by academics and its determinants. A description of data, methodology, main variables and descriptive results are presented in Section 3. Section 4 sets out the regression model used in the analysis and the empirical results. The last section of the paper outlines the emerging conclusions and its implications.

2. Literature review

2.1 Humanities and social science context

As mentioned in the previous section, literature has paid less attention to HSS research in the frame of U-I interactions. The valorisation[5] of academic results has been mostly limited to the economic contribution of university through patents, licence of intellectual property, spin-off creation and technology transfer activities, mainly linked to results from "hard" sciences. National research policies take mostly technological needs into account, HSS being relatively neglected when policies are formulated (Cassity and Ang 2006). The emergent definition of universities' societal impact overlooks the arts, humanities and social science potentialities (Benneworth and Jongbloed 2010).

[4] An exception is the recent work of Ramos-Vielva et al. (2010).

[5] Valorisation is understood as making the results from academic research accessible to increase the likelihood of them being used outside the academia as well as the co-production of knowledge (Bryson 2000).

The marginal place accorded to HSS can be found in the particular characteristics of its output. Many authors coincide in the difficulty to evaluate and measure the impact of the research generated within "soft" sciences (Molas-Gallart et al. 2000; Moed et al. 2002; Ibarra et al. 2006; Nederhof 2006) because of its less tangible and measurable results (Benneworth and Jongbloed 2010).

As noted before, most of the transfer literature is centered in academic interactions with industry. Cassity and Ang (2006) state that humanities are generally removed from these interactions as "industry" is a term usually associated to manufacturing and commerce. However, studies focusing in humanities areas have highlighted cultural industry (audiovisual, cinema, music, museums, etc.) as a relevant partnership collaborating with academics. Also public sector (local, regional and national administration) has aroused as one of the main receivers of the output generated in the HSS, as well as international organizations (OCDE, UNESCO), non-governmental organizations (trade unions, associations) and private firms related to bank and tourism sector (Cassity and Ang 2006; Castro-Martínez et al. 2008a; Castro-Martínez et al. 2008b). Moreover, it must be noted that the increasing importance according to culture and creative industries (European Commission2010) highlight the relevance of HSS disciplines because of its direct and indirect impact on the society and the economy.

Because of the heterogeneity in the research carried out by HSS academics, and as their benefits and services are diffuse and hard to enumerate and capitalize (Cassity and Ang 2006), from a quantitative approach, we consider that the most efficient way to analyse S-S interactions in this area is through the analysis of the main activities used by academia to transfer their knowledge outside academic environments, which is the approach followed in the present paper.

2.2 Knowledge transfer activities

Interactions between research organizations and industry have long been a matter of study for academics. In the past, mostly of the studies have focused on patenting, licensing and spin-off to focus on the interaction between these communities, for recent review, see Geuna and Nesta (2006). The above activities (along with R&D contracts) and the income generated derived from them, are commonly used as indicators for analyzing U-I relationships (European Comission 2009). However, several studies have showed that these activities represent only a small part of university-industry interactions and have highlighted the existence of many other activities or channels of interactions used by universities and firms to collaborate (Meyer-Krahmer and Schmoch 1998; Schartinger et al. 2001; Cohen et al. 2002; D'Este and Patel 2007; Bekkers and Bodas-Freitas 2008).

From a conceptual perspective, the identification and classification of the mechanism of interaction between university and industry have been a matter of study and research. Bonaccorsi and Piccaluga (1994) proposed a taxonomy for U-I relationship based on the degree of

formalization of collaborations, its length and the organization resources involved by the university. A report elaborated by Molas-Gallart et al. (2002) evidenced the existence of twelve types of Third Stream Activities[6] used by academics and non-academics to collaborate. It must be noted that not all the activities proposed by these authors can be considered knowledge transfer activities as some of them represent only a source of income (commercialization of facilities) or communication activities (social networking and non-academic dissemination) but not a mechanism of KT.

From an empirical perspective, many authors that have undertaken studies on KT activities coincide pointing that there are differences in the way academics collaborate across disciplines (Landry et al. 2001; D'Este and Patel 2007; Landry et al. 2007; D'Este and Perkmann 2010) and that collaborative activities are more common than commercial activities, such as patenting and academic entrepreneurship to interact with industry (D'Este and Patel 2007; Landry et al. 2007; Perkmann and Walsh 2007).

As a result of our review, the following five forms of collaborative activities represent the focus of this paper as they have aroused as KT activities often considered in the literature. Academic *consultancy*, (for a detailed study see Perkmann and Walsh (2008)) is defined as services of technical advice and consultancy work commissioned by the non-academic agent that don't necessary involve academics' original research but the use of their accumulated knowledge; that is, to those activities where academic staff uses their existing knowledge to provide advice outside academia (Molas-Gallart et al. 2002). *Contract research* is understood as the research activities carried out by academic institutions under contract from non-academic organizations (Molas-Gallart et al. 2002). They usually imply more applied research than joint research arrangements (Van Looy et al. 2004). *Joint research* are formal collaborative arrangements aimed at cooperation on R&D projects (Hall et al. 2001), commissioned by non-academic agent and undertaken by both parties: academics and non-academics. Joint research is "curiosity-driven" and carried out primarily to foster knowledge addressing issues of theoretical nature (Molas-Gallart et al. 2002). *Training* activities are referred to courses and other activities offered by the academic community (or demanded by non-academics) which are tailored to socio-economic agents needs (industry, government, professional groups). They are usually short in time and targeted to deal with a limited range of issues. This activity is separated from the traditional and formalized courses such as degree or master courses (Molas-Gallart et al. 2002). *Personal mobility* (flow of academic staff, scientists and technicians between universities and other social agents) represents a way to further developed expertise generated in the academic sphere in a context of application to societal or economic problems (Molas-Gallart et al. 2002). It must be noted that contract and joint research can be considered as more traditional academic activities that involve the generation of new knowledge whereas consultancy, training and personal mobility are characterized by the utilization of accumulated knowledge.

[6] Third stream activities, defined as those concerned with "*generation, use, application and exploitation of knowledge and other university capabilities outside academic environments"* (Molas-Gallart et al. 2002: 2).

To know the extent to which academia engages in a specific type of interactions with industry has been among the objectives of many studies carried out in different contexts. Meyer-Krahmer and Schmoch (1998), based on data coming from surveys at German university, found that the most relevant type of interactions for in technological fields were collaborative research and informal contacts, whereas publications and committees were ranked in the last position. In the study carried out by Schartinger et al. (2002), authors evidenced that joint research activities were "*used predominantly by natural and technical sciences (engineering, chemistry, physics) but of minor relevance in economics and social sciences*" (Schatinger et al. 2002:317), However, for economic disciplines, personnel mobility and training courses arise as the most important KT activity; and for social sciences disciplines training activities are the most engaged by university departments to interact with private firms in the Austrian context." Schartinger et al. (2001), found that supervision/financing of PhD activities and lectures by firm members at university were the firstly ranked (38%) followed by contract and joint research (31%). Personal mobility (temporary movement to the business sector) was the last ranked activity with less than a 10% of Austrian department engaged at least once in the considered period. Similarly, the study followed by D'Este and Patel (2007) about UK researchers belonging to engineering and physical sciences conclude that almost two thirds of the researchers have participated at least once in meetings and conferences (65%), followed by consultancy and contract research (56%), joint research (44%) and training activities (42%). Commercial activities such as creation of physical facilities (i.e. spin-offs and new laboratories) ranks in the last position with less than a 21% of academics engaging at least once in the considered period.

Similarly to the studies presented above, the aim of this paper is, among others, to know to what extent research groups belonging to HSS disciplines engage at least once in the five knowledge transfer activities considered. Based on the results obtained in other context (countries and disciplines) we can expect that consultancy, contract research and joint research to be the most used KT activities. However, focusing on the results concerning social and economic sciences, it is reasonable to expect that personnel mobility and training courses have a relevant role as activities for knowledge transfer in HSS. It must be noted that we do not find conclusive results across the considered studies analyzed. However, based on the results obtained for social and economic sciences disciplines (Schartinger et al., 2002), we expect the groups to participate mostly in training and personal mobility activities, and less in joint research activities. For contract and consultancy activities, even if we have not evidence for the HSS area, we expect a high participation of groups in these activities according to the more recent results analyzed.

2.3 Determinants of knowledge transfer activities

Research groups collaborate with non-academic environment through a variety of knowledge transfer activities, each one presenting particular characteristics. Therefore, the decision to engage on these interactions can be influenced by different determinants. As mentioned in the

introductory section, previous studies have considered organizational aspects related to the research institution (Castro-Martínez et al. 2010). However, in the present study we focus on exploring other characteristics belonging to a lower level of the organization: the research group and the individual. The inclusion of the individual characteristics in this study is done through the analysis of the group' leader profile, which is an approach that we have not found in KT literature.

2.3.1. Group characteristics

As mentioned in the introduction section, academics are being increasingly organized in research groups for carrying out their scientific activities. Research groups differ in composition, size and level of heterogeneity. Previous studies show that organizational characteristics could affect the extent to which researchers interact with industry (Tornquist and Kallsen 1994; Feldman et al. 2002; Schartinger et al. 2002; Belkhodja et al. 2007) . Similarly, these considerations can be indirectly used as a start point to hypothesize that groups engagement in KT activities are influenced by groups' characteristics. From the approach of the "Mode 2 of knowledge production" (Gibbons et al. 1994), size, transdisciplinarity and problem-focused research arise as relevant elements for groups' knowledge production. These characteristics are taken into account as significant explicative determinants for groups' knowledge transfer.

Size of the group

The scale of the resources, in terms of research personnel, is a necessary condition to attract and collaborate with non academic agents. The idea behind this assertion is that big research units would have sufficient resources to participate in different activities other than the traditional research and publications. Also, for small research units, their higher flexibility and their specialization in particular topics of research can also represent an attractive element for non-academics looking for a specific specialized service. For medium-sized research units, it is argued that, being less flexible than the small ones and having fewer resources than the big ones, their interactions with non-academics would be lower. Thus, from this theory, it is expected a U shape curve for the relation between research unit size and its interactions outside academic environment (Schartinger et al. 2001; Schartinger et al. 2002). Some studies have analyzed the influence of department size (measured in terms of academic staff) in academics interaction with industrial partners. Schartinger et al. (2001), found a positive relation between the department size and the likelihood to engage in joint research and research mobility activities, but not with contract research activities. Schartinger et al. (2002) show that the size is significant and positive to explain science-industry interactions through contract research, joint research, personal mobility and training activities. Landry et al. 2010, show that research unit size positively influence researchers engagement in consulting activities. However, D'Este and Perkmann (2010) introduced department size as a control variable for the analysis of UK researcher's frequency of interactions in consulting, contract research and joint research, and did not found a significant

relation for any of the considered activities. In view of the results got in previous analysis, our hypothesis is that there is a positive relationship between a higher groups' size and their engagement in KT activities.

Multidisciplinarity of the group

Multidisciplinary arise as a relevant factor in knowledge production (Gibbons et al. 1994) and knowledge management (Dahlin et al. 2005). Indeed, as noted by Dahlin et al. (2005), educational diversity may affect on the range and depth of the ability of the group to manage knowledge. However, as far as we know, the relationship between multidisciplinarity and engagement in transfer activities has not been widely considered in transfer literature. As relieved by some descriptive studies, academics believe that multidisciplinarity facilitates knowledge transfer (Castro-Martínez and Pérez-Marín 2007; Castro-Martínez et al. 2008a). In this sense, more heterogeneous groups, in term of diversity of educational background of its components, face up to research problems from a broader perspective. In the humanities and social science context, where many of the socio-economic problems must be solved by putting in common different disciplinary approaches, multidisciplinary groups can be more attractive to collaborate as they have a more diversified and rich knowledge to address socio-economic issues. Another aspect to consider is that it is more likely that academic results obtained from a multidisciplinary group reach a broader range of potential non-academic users. Due to the scarcity of studies including multidisciplinarity as an explanatory variable, we consider that is interesting to analyze the influence of this group characteristic in groups' engagement in knowledge transfer. From this argument, we expect that more multidisciplinary groups will engage more in KT activities because they will have a greater diversity of knowledge to offer to non academic agents, and a great probability to have the accumulated knowledge to solve socio-economic problems.

Group utility-focus

Literature related to knowledge production has noted that there are different ways to produce knowledge: Mode 1 and Mode 2 (Gibbons et al. 1994) While the Mode 1 refers to the traditional way of producing knowledge (research agenda defined without considering external needs, disciplinary research, uni-directional transfer of knowledge), the so-called Mode 2 of production is characterised by the production of knowledge in the context of application (the social utility of the research is taken into account in the research agenda, research is context driven and focused on problem solving strategies). Empirical studies have shown that to focus on user needs and socio-economic utility of the research explain a higher participation in knowledge transfer activities (Landry et al. 2001; Landry et al. 2003). The logic behind this result is that, as academia take into account socio-economic problems which need to be solved, research and new knowledge generated in this direction will be more required by non-academics, so it could lead to more interactions between these two spheres. In this sense, as found by Landry et al (2007) focus on users needs has a significant and positive impact on natural sciences and engineering researchers' engagement on knowledge transfer activities. Based on the foregoing, we expect that

those groups whose research is focused on its socio-economic utility will be more willing to engage in knowledge transfer activities as, from the beginning, in their research' objectives they consider to get their academic results to their socio-economic environment.

2.3.2 Individual characteristics of the leader:

Some studies have analyzed the influence of researchers 'characteristics in their decisions to engage in knowledge transfer activities through different mechanism of interaction (D'Este and Patel 2007; Boardman and Ponomariov 2009; Landry et al. 2010). Even though there is no direct evidence of the influence of leader's group characteristics on the research group participation in knowledge transfer activities, results aroused from these studies covering the individual characteristics (such as their academic status and the quality of their research) stand for indirect evidence for the formulation of our hypothesis

Academic status:

The reward system in the academic environment is traditionally linked to scientific results and publications in peer-reviewed journals as output valued to be promoted. Thus, other activities such as transfer and commercial activities can be perceived by researchers as time consuming as they do not directly contribute to their academic career advancement. According to the theory of time allocation (Rosen 1974), to invest time in knowledge transfer activities is more costly for academics that have not reached the top of their academic career (Diamond 1993; Braxton and Del Favero 2002), so they prefer to concentrate their effort in more valued activities allowing them to climb in their academic career. In this sense, compared with non consolidated researchers, more established scientists that have already achieved a tenured position don't have the pressure to publish and may be less motivated by traditional academic incentives and more motivated by participating in commercial activities (Louis et al. 1989). Previous studies conclude that academic status has a positive and significant impact in the variety of interactions (D'Este and Patel 2007). Researcher's status appears to positively determine their interactions with industry (Boardman and Ponomariov 2009) and moreover, D'Este and Perkmann (2010) found that tenure is positively related with the frequency of researchers interaction through consultancy, contract research and joint research. However, Landry et al. (2010) didn't find any significant relationship between seniority and consultancy activities. From literature review, we expect groups whose leader holds the highest status to engage more in knowledge transfer activities.

Research Quality (citations of academic publications)

The scientific reputation of the researcher can affect its engagement in interaction activities. Previous researches have highlighted the existence of "star scientists", that is, academic scientists that publish substantially more, and also produce more papers with a greater impact than their peers. It is believed that these stars have also a significant effect on the commercialization of results. Empirical works has noted the positive relationship between scholarly success and commercial success (Zucker and Darby 1996; Zucker et al. 1998; Zucker et al. 2002). Thus, the

existence of a star scientist' group leader can attract the attention of non-academic agents as they would be interested in collaborating with groups whose scientists have a high academic reputation or research quality level recognized. Some empirical studies have introduced variables related to the quantity of publications as an explanatory for U-I interactions. Schartinger (2001; 2002) introduced the "international publications per researcher" variable which appears positively related with a higher engagement in joint research activities but not with contract research or personal mobility. Another approach is that followed by Landry et al. (2010) who analyzed complementarities between researcher's activities, concluding that researchers publications and consulting activities were positively related. However, the variables related to publications mentioned so far are mainly constructed based on quantitative criteria (number of publication) without considering qualitative criteria (number of citations received). A measure of research quality of scientists based on citations (Abramo et al. 2010) is an interesting approach to identify "star scientist" in terms of their academic impact (citation received from peers) instead of only considering the number of publication. So, according to the existing studies and focusing more on quality rather than on quantity to identify star scientist, we would expect that groups whose leaders are star scientists will be more visible among non-academic agents and their likelihood to engage in KT activities will be higher.

3. Data and main variables and descriptive statistics

3.1 Sample and data collection:

The population of the present study consists of 97 research groups belonging to the area of HSS of the Spanish Research Council (CSIC). The population is distributed as follows: 73 from humanities (75.3%) and 24 belonging to social sciences disciplines (24.7%). Groups were identified through the web pages of the institutes and by consulting the directors' of each research institute. The data were gathered in two phases. The first phase was conducted between May 2006 and March 2007 by using two instruments for the data collection:

1. A *questionnaire* composed of 23 open questions to guide semi-structured face-to-face interviews. The answers of the questionnaire provide information related to the identification and description of the group: components of the groups, their status and their studies background. The interview also addressed the capabilities of the group, its research activities and its knowledge transfer experience. The transcripts of the interview were sent to the interviewee for validation.

2. A questionnaire with 48 questions was provided at the end of the interview. It was organized as a *checklist* using a four point likert scale for most of the items and questions were referred to the last two years. Questionnaire structure was based on Bozeman's dimension of KT (Bozeman 2000) including, among others; information related to the characteristics of the research group or the knowledge transfer activities carried out by the groups (media for transferring knowledge).

From the first phase, we obtained 94 validated questionnaires from the face-to-face interview and 86 checklist questionnaires. So, for 83 groups we obtained information from both questionnaires. However, when the group leaders were identified, we found that 4 of them were part of the university staff as they belong to a "joint" institute (CSIC institutes with the participation of a public university). Thus, to obtain a more homogeneous sample, these leaders who do not belong to CSIC staff were discarded from the final sample.

A second phase for data collection was carried out in September 2010. Information about the academic production of group' leaders (publications and citations) were gathered from the Thomson Reuters' ISI Web of Science (WoS), Social Science Citations Index (SSCI) and Arts & Humanities Citation Index (A&HCI). We use lifetime citation data (Linmans 2010) to consider all the citations received by a paper published until 2007.

Thus, the final sample of the study is composed of the 79 research groups from which we have information at a group level and at an individual level (see Table 1)

Table 1 Research groups covered in the data collection phases

		Humanities	**%**	**Social Sciences**	**%**	**Total**
Total number of research groups (whole population)		73	75.3	24	24.7	97
PHASE 1	Questionnaires received	72	76.6	22	23.4	94
	Checklists received	64	74.4	22	25.6	86
Number of research groups with information after phase 1		63	75.9	20	24.1	83
PHASE 2	Leader's information	59	74.7	20	25.3	79
Sample (%) Number of research groups with information after phase 2		80.8		83.3		81.4

3.2 Main variables

We consider five binary dependent variables, one for each specific type of knowledge transfer activity:

- Technical advice and consultancy
- Contract research
- Joint research
- Training
- Personal mobility

Each dependent binary variable takes the value of 1 if the research group has been engaged in this specific knowledge transfer activity or interaction with non-academic agents in the last two years, and 0 otherwise.

The two independent continuous variables included in our analysis refer to research group characteristics: size and degree of multidisciplinarity. The size of the group has been measured as the number of equivalent full time research personnel (excluding administrative support and non-PhD staff). The degree of multidisciplinarity has been measured as the number of different disciplines related to the studies' background of the PhD composing the group. Disciplines were identified and distinguished according to the UNESCO classification (with four digit of disaggregation). For these two continuous variables, we used the probability plots to determine whether their distributions matches with a normal distribution. More specifically, we used the Q-Q plots procedure which plots the quintiles of variable's distribution against the quintiles of a normal distribution. We found that the observations were not clustered around the straight line corresponding to normal distribution for any of the variables. A logarithmic transformation applied to both variables results in two continuous variables named *LnSIZE* and *LnMULTIDISC,* both matching with a normal distribution.

Furthermore, three binary independent variables were also included in the analysis, one referred to the research group' characteristics (focus on socio-economic utility) and two corresponding to the leaders' characteristics (status and research quality). For measuring the variable *utility focus*, respondents were asked to which extent their group considers, within the objectives of the research undertaken, the social utility and / or economic of their capabilities and their results. Answers, originally measured as a categorical variables using a four likert scale (very seldom, a little, fairly often, very often) were transformed in a binary variable taken the value one if the research group considers very often socio-economic utility in their research objectives, and 0 otherwise. The reason behind this new variable is to highlight those groups who strongly consider the utility of their research from the beginning (that is what Gibbons and his colleague's labelled "mode 2" of knowledge production) from those who don't.

The binary variable corresponding to the *status* of the groups' leader takes the value 1 if the leader is a "research professor" and 0 otherwise. In the CSIC there are three categories corresponding to PhD holding a permanent position being, from the lowest to the highest: "scientific tenured", "scientific researcher" and "research professor". The decision of considering on the one hand those researcher that are already in the highest position from those that can already climb in their academic rank responds to the objective of differentiate those leaders who still can climb in the academic career (in terms of the status achieved) from these who already hold the top academic position.

Finally, the variable corresponding to the quality of the research undertaken by the leader has been measured by computing the number of citations per year per publication received by the group' leader from their first publication until 2007, by using the Thomson Reuters' ISI WoS, SSCI and A&HCI database as source of information. In a first stage, we defined a continuous variable measuring the average number of citations received by the leader per paper and per year:

$$Quality\ research = \sum\left(\frac{N^{\circ}\ citations}{2007 - publication\ year}\right) / N^{\circ}\ publications$$

The distribution of the continuous variables created from the application of the above formula did not match with a normal distribution as more than half of the observations take the value of 0 (50.6%). Thus, a second stage consisted in dividing the continuous variable in three categories: null value of research quality, medium value of research quality and high value of research quality (the last corresponding to "star scientist"). The distinction from medium and high value has been done by analysing the distribution of the continuous variable and establishing the threshold ($\alpha = 0.7$)[7]. A binary variable has been created for each of the categories. *QualityNull* takes the value of 1 if the research quality is zero, and 0 otherwise. *QualityMedium* takes the value of 1 if the research quality is between zero and less than α, and 0 otherwise. *QualityHigh* takes the value of 1 if the research quality is more than α, and 0 otherwise.

Finally, the correlation matrix between the independent variables used in the regression model (Appendix 1) indicates that the highest correlation between the independent variables is 0.649 and corresponds to that between the binary variables [QualityNull] and [QualityMedium]. The second column of Appendix 2 reports the tolerance statistics values (reciprocal of variance inflation factors, VIF) for these variables, indicating whether an independent variable has a strong linear relationship with another independent variable. As showed in the table, all the tolerance statistic values are much higher than 0.2 which ensures that no multicollinearity problems can arise in the regression model.

3.3 Descriptive statistics

The descriptive analysis of the variables used in this study is reported in Table 2. The two knowledge transfer activities with the highest proportion of research group engaging at least once during the two years period considered in the questionnaire are: technical advice and consultancy (51.5%), contract research (47.0%). About a 50% of the research group stated to collaborate with no-academic agent through these activities whereas more than a third of the groups have engaged at least once in joint research (39.4%) and training activities (34.8%), and only a 13.6% have participated in personal mobility activities.

For the level of seniority in the academic rank, of the 79 groups' leader identified, 27.8% are research professors. For the leaders' quality research (based on ISI WOK), 50.6% have not received citations on their publications , 29.1% have a *medium* level of their quality research and 20.3% are "star scientist" as they have a *high* level of quality research.

[7] The value chooses for establishing the threshold allows differentiating "medium citation" from "high citations". A "jump" can be observed in the variable distribution from 0.067 to 1.33, so 0.7 is the threshold value applied.

About the group characteristics, more than a quarter of the sample (26.6%) often considers socio-economic utility of their research when they establish the objectives of their research. The average number of equivalent full-time PhD researcher personnel that make up the group is 6.01, with a standard deviation of 4.52. The range of the variable size goes from 1 to 30 PhD belonging to the group. As for the multidisciplinary of the group, the average is 2.66 and the range of the values obtained goes from 1(monodisciplinar group) to 8 for the most heterogeneous group.

Table 2: Descriptive statistics

Variables	Type of variable	Minimum	Maximum	Mean	St. deviation
Continuous Variables:					
SIZE	Continuous number	1	30	6.01	4.52
MULTIDISC	Continuous number	1	8	2.66	1.48
Binary Variables:					
CONSULT	51.5 % (Yes)				
CONTRACT	47.0 % (Yes)				
JOINT	39.4 % (Yes)				
TRAINING	34.8 % (Yes)				
MOBILITY	13.6 % (Yes)				
UTILITYfocus	26.6 % (Socio-economic utility of capacities and results generated by the group is very often considered when they established their research objectives)				
STATUS	27.8 % (research professor)				
RESEARCH QUALITY	50.6 % QUALITYnull	29.1% QUALITYmedium		20.3 % QUALITYhigh	

4. Determinants of knowledge transfer activities

4.1 Regression models

The engagement of the research group to collaborate with non-academic agents through a specific knowledge transfer activity was measured by binary variables, one for each transfer activity considered, as explained in the previous section. To identify the determinants explaining the likelihood of research group to engage in knowledge transfer activities, the basic model that has been estimated is:

$$Log\left(\frac{Pi}{1-Pi}\right) = \beta 0 + \beta_1 \text{LnSIZE} + \beta_2 \text{LnMULTIDISC} + \beta_3 \text{UTILITY}_{\text{FOCUS}} + \beta_4 \text{STATUS} + \beta_5 \text{QUALITY}_{\text{NULL}} + \beta_6 \text{QUALITY}_{\text{MEDIUM}} + \varepsilon$$

Where βi (i = 0... ...6) are parameters to be estimated, and ε is an error term.

Log (P*i*/1−P*i*) is the ratio of the probability that a research group *i* has engaged in a specific type of knowledge transfer activity *i* relative to the probability that the same research group has not been engage in a specific knowledge transfer activity *i*.

This study presents five binary logistic regressions[8], one for each knowledge transfer activity considered. The number of observation used in the regressions is N=66 because of the missing data (N=13) of the dependent variable.

As observed in the descriptive analysis, a low proportion of research group engage at least once in personal mobility activities (less than a 20% of "yes") in the covered period. In absolute values, only nine groups assert to have participated at least once in personal research activities. As noted by Peduzzi et al. (1996)[9], if binary variables (specially for dependent variables) have not at least ten observations in each of the possible values, estimation are not reliable. To overcome this debility, we ran Rare Events Logistic Regression (Relogit)[10] to estimate parameters for the regression explaining groups' engagement in "personal mobility" activities. As noted by King and Zeng (2001), logit analysis is suboptimal in small samples of rare-events data, thus biased coefficient obtained from binary regression can be corrected using relogit regressions.

The operational definitions of the dependent and independent variables introduced in the regression model are presented below.

4.1.1 Dependent variables

[CONSULT]: Technical advice and consultancy. It is introduced as a binary variable coded '1' if the research group has engaged at least once in technical advice and consultancy activities with non-academic agents during the past 2 years, and 0 otherwise.
[CONTRACT]: Contract research. It is introduced as a binary variable coded '1' if the research group has engaged at least one in contract research activities with non-academic agents during the past 2 years, and 0 otherwise.
[JOINT]: Joint research. It is introduced as a binary variable coded '1' if the research group has engaged at least once in joint research activities with non-academic agents during the past 2 years, and 0 otherwise.
[TRAINING]: Training. It is introduced as a binary variable coded '1' if the research group has engaged at least once in training activities with non-academic agents during the past 2 years, and 0 otherwise.
[MOBILITY]: Personal mobility. It is introduced as a binary variable coded '1' if the research group has engaged at least once in personal mobility activities (in both directions) with non-academic agents during the past 2 years, and 0 otherwise.

[8] Logistic regression has been ran with SPSS Statistical Package Version 15.
[9] In Silva-Ayçaguer and Barroso-Ultra (2004)
[10] Relogit was implemented in STATA Statistical Package Version 11.

4.1.2 Independent variables

Group characteristics

[LnSIZE]: Size of the research group. It is measured as the number of equivalent full time PhD research personnel (excluding administrative support and non- permanent staff) composing the research group. This variable was matched with the normal distribution using a logarithm transformation.
[LnMULTIDISC]: Multidisciplinarity of the research group. It is measured as the number of different disciplines (based of UNESCO classification with 4 digits of disaggregation) of the PhD research personnel of the group (excluding administrative support and non-permanent staff) of the research group. This variable was matched with the normal distribution using a logarithm transformation.
[UTILITYfocus]: Research group considers, within the objectives of the research undertaken, the social utility and / or economic of their capabilities and their results. It is introduced as a binary variable coded '1' if socio-economic utility where very often considered when they establish research objectives and "0" otherwise.

Leader'group characteristics

[STATUS]: Seniority in the academic career. It is introduced as a binary variable coded 1 if the group leader is a professor (research professor), and 0 otherwise.
[QUALITYnull]: Quality of the research is null as the average of citations per year per leader's publication is 0. It is introduced as a binary variable coded '1' if the value of the citations per year per publication received by the group leader is null and "0" otherwise.
[QUALITYmedium]: Quality of the research is medium as the average of citations per year per leader's publication is positive and inferior to the threshold mentioned in the previous section. It is introduced as a binary variable coded '1' if the value of the citations per year per publication received by the group leader was superior to 0 and inferior to 0.7, and "0" otherwise.
[QUALITYhigh]: Quality of the research is high as the average of citations per year per leader's publication superior to the threshold mentioned in the previous section. Leader considered and star scientist. It is introduced as a binary variable coded '1' if the value of the citations per year per publication received by the group leader was equal or superior to 0.7, and "0" otherwise. QUALITYhigh stands as the reference category of the logistics binary regressions.

4.2 Results

The results of the binary logistic regression for each of the knowledge transfer activity considered (column two to five) and the rare even logistic regression for the variable "personal mobility" (last column) are summarised in Table 3.

Table 3 shows that equations formulated for the regression models are a good predictor about whether or not research group has engaged in a specific knowledge transfer activity with the

exception of joint research, which model is not globally significant thus suggesting that variables included in the regression do not capture adequately variation occurring in groups' engagement in this joint research activities. For the rest of the regressions, that is, for technical advice and consultancy, contract research, training activities and personal mobility, the values of the correct predictions go from 90.9% to 63.3%. Moreover, values of the Nagelkerke R^2 (Pseudo R^2) range from 37.3 to 21.8 which are acceptable for qualitative dependent variable models (Landry et al. 2006). The global significance of these four models is assessed through the computed value of the likelihood ratio, which are significant at 1% except for training activities which is significant at 5%.

The analysis of the capacity of the different independent variables to explain research group probability to engage in the different knowledge transfer activities is presented as follow.

Group characteristics

The size of the group is revealed as a significant variable to explain groups' engagement in contract research activities. The likelihood of groups to participate in contract research activities increases as the size of the group increases.

However, groups' multidisciplinarity does not have statistically significant influence to explain groups participation in any of the five KT activities considered in our analysis.

The variable named [UTILITYfocus] significantly explains research group engagement in all the knowledge transfer activities analyzed with the exception of personal mobility (which is the activity in which fewer groups have participated at least once). Thus, groups that very often considers the socio-economic utility of their research when they establish their objectives are more likely to engage in technical advice and consultancy activities, contract research and training activities.

Leader'group characteristics

Leader' status arises as significant in two of the five regressions. Groups whose leader holds a research professor status of are more likely to participate in technical advice, consultancy and personal mobility activities than those whose leader has not reached the highest academic position

The variable of research quality arises relevant for explaining groups' participation in three of the five activities. Group whose leader has a "null or medium quality research" are less likely to engage in technical advice and consultancy, and contract research activities than those groups whose leaders have a high quality research (or is a star scientist). For personal mobility, we found that the likelihood of groups to engage in personal mobility activity is higher when their leaders have a null or medium quality research compared to those groups with a star scientist leader.

Table 3. Binary logistic regressions' results explaining the research groups' engagement in different types of knowledge transfer activities and rare event logistic regression result.

	Technical advice and consultancy		Contract research		Joint Research		Training		Personal mobility (Relogit)	
Independent variables	Coefficient (β)	*p*-value	Coefficient (β)	*p*-value	Coefficient (β)	*p*-value	Coefficient (β)	*p*-value	Coefficient (β)	*p*-value
Intercept	-0.88	0.196	-1.03	0.170	-0.22	0.403	-1.81	0.046	1.14e+7	0.000
Group variables										
Nº of researchers [LnSIZE] [c]	0.76	0.104	0.87	0.075*	0.00	0.496	0.61	0.124	-0.40	0.265
Nº of disciplines [LnDISCIP] [c]	-0.11	0.441	0.76	0.154	0.09	0.442	-0.70	0.157	0.88	0.151
Focus on research socio-economic utility [UTILITYfocus]	1.73	0.005***	0.84	0.099*	0.73	0.097*	1.58	0.005***	0.69	0.164
Individual variables										
Leader status [STATUS]	1.27	0.042**	0.56	0.230	-0.28	0.331	0.61	0.189	1.95	0.006***
Quality Research Null [QUALITYnull] [a]	-1.12	0.080*	-1.59	0.027**	-0.57	0.213	-0.01	0.493	1.14e+7	0.000***
Quality Research Medium [QUALITYmedium] [a]	-1.26	0.073*	-2.18	0.008***	-0.58	0.219	0.27	0.372	1.14e+7	0.000***
Number of observations	66		66		66		66		66	
Chi-square (d.f.)	18.246 (6)	0.003	19.469 (6)	0.002	2.268 (6)	0.893	11.344 (6)	0.038	15.123[c] (6)	0.005 [c]
Nagelkerke R^2 (pseudo R^2)	0.322		0.341		0.046		0.218		0.373 [c]	
Percentage of correct predictions	71.2		63.6		59.1		74.2		90.9 [c]	

*. * and *** indicate that the coefficient is significant. respectively. at the 10%. 5% and 1% thresholds.

[a]The reference category is high quality research that is star [QUALITYhigh].

[c]Ln indicates a logarithmic transformation.

[c] These results come from the basic logistic regression (the relogit regression do not give this information)

5. Conclusion and discussion

This paper presents evidence on how humanities and social sciences research groups transfer knowledge outside the academic community through a diversity of KT activities. Results obtained in the descriptive analysis are not in line with what could be expected with the theoretical review. Contrary to Schartinger et al. (2002), personal mobility is, by far, the activity in which few groups have participated, followed by training activities. An explanation of these results is that Schartinger's study analyzes economics and social sciences disciplines, and instead, our sample is made up of more than three quarters of groups belonging to the area of humanities, thus, behaving differently with respect to KT activities. Surprisingly, our results are more aligned with those framed in more experimental disciplines (D'Este and Patel 2007), with technical advice and consultancy and contract research the activities most used, followed by joint research and training.

Regarding the determinants of the knowledge transfer activities, as expected (Landry et al. 2007), we found a positive relationship between groups that consider the socio-economic utility of their results in their research objectives and their engagement in technical advice and consultancy, contract research and training activities; however, personal mobility is not explained by this variable. The reason behind this result could be the tacit knowledge associated to this activity which does not necessary respond to a specific planning of the research. For example, we can note the case of scientists moving to governmental public institutions to help politicians join formal discussions to develop policies or to participate in commissions drafting laws and regulations (Castro et al. 2010). In this situation, the scientist moves outside the academic environment to meet policy-makers for a specific aim and for a determined period, and the knowledge transfer is mostly "know how" and the scientists' experience.

Findings corresponding to the size and the multidisciplinary of the group are not what we would expect (D'Este and Perkmann 2010) for the positive relationship between groups' size and their engagement in contract research activities. Contract research is a long term activity in which research activities are developed and a critical mass of human resources is necessary. Consultancy, training and personal mobility are short term activities based on individual capacities and on the researchers' expertise11; no considerable additional research must be undertaken by the group and human resources does not appear as a critical factor to engage in these activities. On the other hand, the fact that the groups' multidisciplinarity does not influence the group's engagement in any of the KT activities can be explained by the multidisciplinary variable distribution. 78.5% of research groups are multidisciplinary, so the homogeneity of the data for this variable does not allow the necessary variability to observe differences in their engagement in specific knowledge transfer activities.

[11] As observed from the interviews with HSS groups, for sociology and archeology disciplines, these activities based on accumulated knowledge and expertise are mostly jointly carried out by more than one researcher.

The inclusion of the individual characteristics through the figure of the group leader is an attempt to explore if the leader's profile can orientate or influence the group's engagement in specific KT activities. The status of the leader is positively related with technical advice and consultancy (D'Este and Perkmann 2010; Landry et al. 2010). We would have expected also a significant relationship with contract research, as it is an activity that usually involves more resources than the other and where the reputation of the leader outside the academic community should be a demand for socio-economic agents; however, the results do not support this hypothesis.

Reputation within the academic environment has been measured through the Thomson Reuters' ISI WoS, SSCI and A&HCI databases. Although for technical advice and consultancy and contract research activities results are consistent with what we expected, it does not apply for personal mobility. In this case, some limitations arise associated to the "quality research" variable. Standard citation indicators are usually questioned as it has been developed for science, thus an unsatisfactory result for humanities disciplines (Nederhof 2006; Linmans 2010), due to the following reasons: a) most of the publications in humanities are not contained in ISI WoS; b) they are written in a language other than English; c) they are usually published in books. Therefore, the construction of bibliometric indicators for humanities is also a matter of study in the recent literature (Linmans 2010). In our sample, there are significantly more star scientists in social science than in humanities, results that support the hypothesis of this measure penalizing humanities researchers. Thus, as our sample is mostly made up by humanity groups, further research will be carry out to elaborate an indicator able to capture research quality for this controversial area.

Unlike the empirical studies found in KT literature, this paper is focused on the research groups as agents involved in KT activities. Thus, as the unit of analysis is the group, we have few observations and it becomes difficult to apply multivariate analysis for such a small sample. However, even if in absolute terms the number of observations is be small, it represents more than 80% of the population which is a very high proportion that balance the disadvantages of the quantity of observations.

hese limitations notwithstanding, we believe that this exploratory study helps to lay the first foundations that shed light on knowledge pattern for the area of humanities and social science. Thus, the findings of this paper are preliminary results that must be supplemented through the inclusion of new explanatory variables and by conducting qualitative interviews to allow further understanding of the particularities of the study area.

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Appendix A

Correlations between explanatory variables

Appendix 1: Correlations between explanatory variables

Non-parametric correlations between independent variables [a]

Variables	Tolerance statistics	QUALITY null	QUALITY medium	Ln SIZE	Ln MULTIDISC	UTILITY focus
STATUS	0.864	-0.234	0.037	0.081	-0.069	0.138
QUALITYnull	0.511		-0.649	-0.112	-0.113	-0.036
QUALITYmedium	0.544			0.011	0.003	0.119
LnSIZE	0.570				0.639[a]	-0.063
LnMULTIDISC	0.567					-0.070
UTILITYfocus	0.957					

[a] Correlation between LN_SIZE and LN_MULTIDISC has been calculated with Pearson Correlation.

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