

CNR-IRCrES Working Paper

Technology Transfer Activities in Universities and Public Research Organizations: A Literature Overview



1/2021

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CNR-IRCrES Working Paper 1/2021



febbraio 2021 by CNR-IRCrES

Technology Transfer Activities in Universities and Public Research Organizations: A Literature Overview

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ABSTRACT

This theoretical paper aims at collecting and reviewing the existing literature on two underexplored topics related to Technology Transfer. In fact, while researchers working on this topic have focused mainly on Universities and on quantitative analysis of Technology Transfer activities, some topics remain underexplored. Among these topics we focus in particular on the scientific works performing qualitative analyses via exploitation of case studies and on those dealing with Technology Transfer activities of non-University Large Public Research Organizations. Aim of the paper is to highlight and put on the spot unconventional topics of research. The paper performs a comprehensive literature review of these fields, introduced by an analysis of literature on University-Industry interaction performed in order to frame the main research topics. A final section resumes the results of the literature review and sets suggestions for further research.

KEYWORDS: technology transfer, literature overview, public research organization, qualitative studies, case studies, universities.

JEL CODES: O32, Q55

DOI: 10.23760/2421-7158.2021.001

HOW TO CITE THIS WORKING PAPER:

Finardi, U., Rolfo S. & Bianco, I. (2021). *Technology Transfer Activities in Universities and Public Research Organizations: A Literature Overview* (CNR-IRCrES Working Paper 1/2021). Istituto di Ricerca sulla Crescita Economica Sostenibile. Disponibile da <http://dx.doi.org/10.23760/2421-7158.2021.001>

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1 INTRODUCTION

Technology Transfer (TT) has had a relevant role in the economics of innovation since the last decades of the 20th century. The exploitation of knowledge produced in public research for commercial and practical purposes, in fact, has led in many cases to the development of many innovations and to relevant chances of financing for universities and public research bodies. Due to this relevance TT is, since the second half of the 1990s, one of the most studied topics in the scientific literature in the fields of Applied Economics, Management of Innovation and High Education Studies (Audretsch et al., 2012; Bozeman, 2000). The analysis of the economic exploitation of knowledge produced in Universities and Public Research Organizations via the commercialization of patents, the creation of startups and the cooperation with firms for technological and scientific purposes has been undertaken by a growing number of scientists and researchers (Mascarenhas et al., 2018). Consequently, also the number of scientific articles and of other research products dealing with this topic has been growing constantly in the last quarter of century. Dedicated journals are nowadays among the most important ones in the categories of Management and of Economics & Business.

Due to the relevance of the field and the high number of published works, some subtopics have been tackled by scholars more frequently than others. Nevertheless, also those topics that have been addressed in a lesser way deserve attention.

In this paper we focus on specific subjects in the TT literature that have received less attention in the past by researchers and which, thus, need further deepening. More in specific, the aim of the present work is to perform a comprehensive literature overview centered on two specific TT perspectives. The first one is methodological. In TT-related literature a large number of studies performs studies based on quantitative methodologies. Qualitative analyses based on case studies, on the other side, are the minority.

The second topic is, instead, linked to the context of studies on TT. An overwhelming fraction of works represents studies on TT activities performed by Universities. Instead Large Public Research Organizations (LPROs from now on) such as the Max Planck Society in Germany, CNRS in France, CSIC in Spain or CNR in Italy are much less considered when describing and analyzing their TT features^{1 2}. However, these institutions were often created in order to allow a

¹ LPROs are defined as those Non-University Public Research Organisations performing research activities in all the fields of knowledge: hard and applied sciences, technology, social sciences and humanities. LPROs are opposed to those small PROs performing research in only one field or in a very limited number of contiguous fields.

² A wide and reasoned selection of this literature encompasses Galante and Sala (1996); Coccia (2001); Coccia and Rolfo (2002); Harding (2002); Zellner (2003); Lucantoni & Abramo (2003) Coccia (2004); Coccia (2004b); Cariola & Coccia (2004); Tuzi (2005); Albert et al. (2005); Coccia (2005); Coccia (2005a); Abramo (2006); Thèves et al. (2007); Coccia and Rolfo (2008); Jensen et al. (2008); Buenstorf (2009); Krabel and Mueller (2009); Coccia (2009); Azagra Caro and Pablos (2009); de Cheveigné (2009); Göktepe-Hulten and Mahagaonkar (2010); Albors-Garrigos et al. (2010); Kaiser (2010); Jonkers & Cruz-Castro (2010); Coccia & Rolfo (2010); Barge-Gil et al. (2011); Abramo & Pugini (2011); Buenstorf and Geissler (2012); Fritsch and Krabel (2012); Krabel et al. (2012); Della Malva et al. (2013); Coccia and Rolfo (2013); Olmos-Peñuela et al. (2014); Finardi and Rolfo (2016); Betz et al. (2016); Antonioli et al. (2017); Readman et al. (2018); Merchán-Hernández & Valmaseda-Andia (2018); Carrillo & Montesi (2018); Comin et al. (2019); Giannopoulou et al. (2019); Intarakumnerd and Goto (2018); Amara et al. (2019). The list shows that, at least for the Italian case, only few authors have tackled the topic so far.

greater effort towards TT with respect to Universities. In this sense, their role in the National ecosystem can be considered as more focused on innovation than education.

Summing up, aim of the present work is to perform a comprehensive literature overview on the two above described topics of case studies of TT activities and of TT performed by LPROs. In doing so our target is to highlight fields and methodologies whose results could be more easily exploited by policy makers and practitioners than those the most targeted area of quantitative studies on University TT.

Section two of the present paper contains the literature overview. The two subsections on qualitative studies and on LPROs are introduced by a subsection performing a more general literature overview on University-Industry interaction. This specific review has a twofold aim. The first is to frame the main topics of this work, showing that, so far, scientific research in the field of TT has mainly focused on quantitative or semi-quantitative studies on University “third mission” activities. The second is to allow the reader to grasp the main differences between universities and PROs, and between qualitative and quantitative studies. Section 3 concludes resuming the main topics discussed in the reviewed literature.

2 LITERATURE OVERVIEW

This section is divided into three subsections. While the second and the third one present the two literature overviews at the core of the present paper, the first one is an introductory one. In fact, it performs a wide – though necessarily incomplete – overview of literature on University-Industry interaction. The aim of this introductory section is comparative, as it shows that an overwhelming fraction of literature has so far dealt with the problems of Universities using a quantitative or semi-quantitative approach. The topic will be further discussed in the conclusions. At the end of each subsection a table resumes the contribution of the reviewed papers.

2.1 University-Industry interaction and its specific features.

The extant literature on University-Industry (U-I from now on) interactions is wide and multifaceted, exploring several of its sub-topics. For instance, Fontana et al. (2006) show that larger firms tend to collaborate more with Public Research Organisations (Public Universities in this case), and that SMEs tend to screen external knowledge scanning publications of perspective collaborators. Iorio et al. (2017) on their side show the “positive and significant role of funding and mission motivations on scientists’ engagement with the external environment” (p. 497). Also Guzzini and Iacobucci (2017) study this type of interaction, working on a sample of German firms and Universities. Their findings show that collaboration is not correlated with abandonment and delay of innovation projects. On the side of university researchers, a proactive approach to collaborations with industry, as well as the ability to select, pays off also in terms of publications (Callaert et al. 2015).

Skute et al. (2017) have performed a bibliometric review of literature studying U-I interactions. They review 435 publications on this topic, thus surreptitiously offering an evaluation of the dimensions of the phenomenon with respect to, for instance, literature studying LPROs-Industry interaction. Their analysis of the content of the papers offers an interesting insight on the characteristics outlined by the literature, highlighting several mainstream topics. On the individual level, there is acknowledgement of the role of relationships between individuals. Nevertheless, the debate on what individual level characteristics should be present on both sides is still ongoing. Literature focused on academic entrepreneurship focuses on the entrepreneur, while that studying its organization is centered on the characteristics of collaborating universities and firms, rather than on the determinants of reciprocal gains. On the institutional level the focus is on the economic and societal impact of U-I collaboration.

In their work de Wit-de Vries et al. (2018) present a further review of the literature on knowledge transfer in University-Industry research partnership. Their aim is to exploit the review in order to identify practices that can facilitate the partnership, including only those works that

discuss theory practices or factors connected to knowledge transfer (and thus not only to commercialization) (p. 4). They consequently arrange literature according to a framework organized around the categories of cognitive differences (ambiguity and absorptive capacity), institutional factors (cultural differences and shared goals) and social capital (tie strength and trust) (pp. 6-7). These categories can help the analysis of at least part of the literature on the topic.

Regarding cognitive differences and cognitive distance, a survey performed by Muscio and Pozzali (2013) on almost 200 Italian University departments tackles this specific topic. With their analysis, the authors try to understand how communication with firms is affected by values, norms or mindsets that exist in Universities. Their findings show that cognitive distance can hinder the frequency of collaboration (thus possibly reducing the chance of establishing continuous relations between university and industry). Nevertheless, generally, cognitive distance is not per se a barrier against collaboration. Instead, Rolfo and Finardi (2014) highlight more institutional factors when comparing a generalist University and a technical one. In doing this, they compare “third stream” activities, showing how the differences between the two universities in terms of research fields and teaching topics have an effect on the “attitude” of the Professors towards collaboration.

The strength of ties *à la Granovetter* (1973) is explicitly recalled by Arza and Carattoli (2017) who address the problem of the different interaction channels in TT³. The strength of ties explicitly drives the use of these channels, as “strong ties” drive towards the use of bidirectional channels, while weak ties drive the relation towards the use of a “service” channel. Thus, the type of relation drives the engagement and the commitment of the counterparts. Trust is instead the topic of the work of Oliver et al. (2019). It is noteworthy that the presence of strong trust both at individual and at institutional level is perceived as a relevant factor of success of collaborative projects. Individual characteristics, as also Filippetti and Savona (2017) affirm, are too often overlooked when studying the (degree of) collaboration between academics and researchers outside academia. More in general, as also Callaert et al. (2015) highlight, “the role of individual academics in their interaction with firms has received somewhat less attention” (p. 990). Coherently D’Este & Patel (2007) demonstrate that the individual characteristics of single university researchers have a stronger effect in explaining variety and frequency of interaction than those of institutions do have.

Other factors are also deepened in the analysis of U-I collaboration. One of the most studied topics is geographical proximity. D’Este et al. (2013) show it has an influence towards collaboration, as it makes it more likely. The topic of similarity, involving technological similarity together with prior collaboration ties and geography, is instead studied by Petruzzelli (2011). His work shows that some similarity is a basic asset needed in order to successfully collaborate, while too much similarity can be an obstacle, as there is not enough complementarity between the knowledge of the two partners. A very recent study of Carloni et al. (2020) shows, through an analysis involving geolocalization, that Italian innovative start-ups tend to geographically localize within a short distance from Universities.

A part of the literature related to this specific topic starts its analysis from the point of view of firms, rather than of universities. For instance Veugelers and Cassiman (2005) show (on a Belgian sample) that large firms, as well as those operating in specific sectors (chemical and pharmaceutical industry) are more likely to cooperate, but that collaboration agreements are basically an instrument to share costs. A wide sample of German firms shows that firm employees are typically “instrumental in instigating consulting relationships with Universities” (p. 521) while University researchers have less difficulty in contacting small firms rather than large ones, basically because of more informality (Goel et al., 2017). The relational capabilities of firms in fact have an influence on how they source knowledge from Universities. Communication capabilities in fact are important for both acquiring and co-creating knowledge (De Silva & Rossi, 2018).

A relevant point that can help our examination of University-industry relation in order to better frame LPROs-industry relations is that of obstacles to collaboration perceived by university

³ Surreptitiously it must be noted there that the authors, though referring since the beginning of the paper to “PROs”, perform their analysis exploiting a (small) Argentinian university as a testbed.

researchers. A study of these obstacles is performed by Muscio and Vallanti (2014) on an Italian sample of departments. Results shows that there are four types of problems: “conflicts with companies; [...] academic networking problems; [...] conflicts with academic goals; [...] nature of research” (p. 425, *passim*).

Some further works address specifically the features of Italian TT and U-I interactions. An insight on Knowledge Transfer Offices shows that the different models of KT activities are basically steps of the evolution going from an “Open Science” one to a more integrated “Innovation” approach. Universities are in different steps of this evolution depending on the time devoted to KT (Cesaroni & Piccaluga, 2016). Also, the internal regulations of Universities (for instance those on spin-off creation) have an effect on the motivation of academics, in specific in creating a new venture. For instance, spin-off activity is primarily promoted by monetary incentives (Muscio et al. 2016). Moreover establishment of spin-off firms is, in Italian University, detrimental to publication and to co-publication with firms, while it promotes patenting (Barbieri et al., 2018). An inverted U-shaped relationship exists with number of publications and citations; medical sciences on the contrary show an effect depending on the amount of funding (Muscio et al. 2016). Inverted U-shaped effects is also present, in Italian academy, between past co-patenting with firms and further development of co-patents (Murgia, 2018).

Topic and contribution	Authors
Dimensions of firms	Fontana et al. (2006) Veugelers and Cassiman (2005) (Goel et al., 2017)
Funding	Iorio et al. (2017) Guzzini and Iacobucci (2017)
Proactivity of researchers	Callaert et al. (2015)
Cognitive distance	Muscio and Pozzali (2013)
Research and teaching topics	Rolfo and Finardi (2014)
Channels of interaction	Arza and Carattoli (2017)
Trust	Oliver et al. (2019)
Characteristics of the individuals	Filippetti and Savona (2017) Callaert et al. (2015) D’Este & Patel (2007)
Geographical proximity	D’Este et al. (2013) Carlioni et al. (2020)
Similarity	Petruzzelli (2011)
Communication capabilities	De Silva & Rossi (2018)
Obstacles to collaboration	Muscio and Vallanti (2014)
Features of KTOs	Cesaroni & Piccaluga (2016)
Effects of spin-off creation, patenting and publishing	Muscio et al. (2016) Barbieri et al. (2018) Murgia (2018)

2.2 Organization, activities and Technology Transfer of LPROs

This section reviews a selection of relevant literature discussing the cases of some of the most studied European LPROs: The National Research Council of Italy (CNR), Max Planck Society and Fraunhofer Society (Germany), CNRS – Centre National de la Recherche Scientifique (France), and CSIC – Consejo Superior de Investigaciones Científica (Spain).

A seminal contribution on TT activities of LPROs (and more in specific of CNR) is that of Coccia and Rolfo (2002) who, analyzing a local regional context, show the effect of geographical distance on TT activities. Nevertheless, there is an important role of specific dynamic areas, entailing a tight network of communications between researchers and firms. An analysis

performed on a wider, national context shows by one side a positive impact of TT activities on scientific production, and on the other side a crowding-out effect of patenting on publication (Coccia & Rolfo, 2008). These effects are ascribed to the Italian government's policies on research, and are partly confirmed by Tuzi (2005) who demonstrates a positive correlation between patenting and the quality of scientific production. In the same years the patenting and licensing activities of CNR have been analyzed by Abramo (2006) concluding that both activities suffer of a gap with respect to US universities. Thus, public research excellence was not enough to sustain industrial competitiveness. A more recent work deals with the specific topic of spin-off creation, showing the absence of deliberated planning of such activities inside CNR, though Italian evidence shows a more general lack of qualified demand of technology (Finardi & Rolfo 2016).

Max Planck Society (MPS) is probably the most widely studied LPRO. Yet Zellner (2003) did exploit the case of MPS scientists moving to the commercial sector as "embodied knowledge", showing the relevance of their contribution to innovative activities. More recent results show that the level of attractiveness of MPS researchers towards working in the private sector and starting one's private business are rather high (28% of the sample) and depend on the perceived commercial nature of the research and on prior experience in firms (Fritsch and Krabel, 2012).

Buenstorf (2009) performed an analysis at individual level on the TT activities of MPS Directors (invention, disclosure, licensing, spin-off) to show that the relationship between inventive activities and performance in research are positively correlated, while the opposite is true for spin-off creation. Licensees tend to license in domestic (national) environment rather than abroad, while spin-offs do not present competitive advantage related to patenting (Buenstorf & Geissler, 2012). Also prior existing strong connection with industry (such as those established through joint research projects, patenting or prior founding) positively influence the will of starting a new business (Krabel & Mueller, 2009). Again individual expectations on personal patenting activities, studied by Göktepe-Hulten & Mahagaonkar (2010), show that MPS scientists prioritize "classic academic motivations" (reputation and visibility) over financial ones when patenting. MPS has a high level of internationalization: foreign-born and foreign-educated scientists are more likely to become entrepreneurs than those with a sole domestic experience (Krabel et al., 2012).

Also Fraunhofer Society has been studied widely. Yet Harding (2002) did advocate the relevance of its role for TT and more in general for the innovation system in Germany. Also Betz et al. (2016) support its important role in the connection between industrial development and university research. The measure of the effects of its interactions through contracts on firm performance shows a strongly positive effect in both sales and productivity (Comin et al., 2019). Fraunhofer served also as a testbed for considerations on the Intellectual Property management (Kaiser, 2010).

The French case was studied, since the half of the 1980s, by Picard (1990) and by Gonard (Gonard & Durand, 1994; Gonard, 1999a; Gonard, 1999b). In the last one of these works, in specific, the author analyzes 32 overall cases of partnerships between French firms and two LPROs, CEA and CNRS. In doing this he identifies five groups of strategic behavior. The approach exploited in the analysis is the typical strategic management approach, aiming at identifying the success conditions of the partnership through a deep analysis, also using the instruments of the PCA (Principal Component Analysis).

Thèves et al. (2007) deepen the case of CNRS in the context of the French system of research. They show that French research system has changed in the 20 years prior to the publication of the paper, following a trajectory based on the restructuring of the existing and thus moving towards a system that is more similar to other European Countries. Later on, CNRS has also been studied (together with French universities) under the profile of gender issues by Mairesse and Pezzoni (2015). Their results show that – after considering external factors – CNRS female physicists are more productive than their male peers, as well as their colleagues from universities.

Coming to CSIC Albert et al. (2005) show that biologists from this LPRO are highly productive in journals with lower Impact Factors, while they do not perform enough TT. Social Sciences and Humanities researchers from CSIC, on the other side, collaborate through different

types of activities depending on different factors (Olmos-Peñuela et al., 2014). More in general most (more than 50%) CSIC researchers belong to the Stokes' (1997) "Bohr quadrant" (Amara et al., 2019; Fernández-Esquinas et al. 2009).

Finally, we must highlight the fact that LPROs must not be confused with other research institutions like Research and Technology Organizations (RTOs) or Technology institutes. Such institutions have been studied for instance by Albors-Garrigos et al. (2010) (Basque Country RTOs), Barge-Gil et al. (2011) (Spanish Technology Institutes and their collaboration with universities), Readman et al. (2018) (UK Research and Technology Organizations), Vivas (2016) and Giannopoulou et al. (2019) (Technology Institutes from several European Countries).

This section shows that many aspects of TT in LPROs haven't be tackled by research to date.

Topic and contribution	Authors
Geographical distance	Coccia and Rolfo (2002)
Effects of TT on scientific production and patenting	Coccia & Rolfo (2008) Tuzi (2005) Abramo (2006)
Spin-off creation in LPROs	Finardi and Rolfo (2016)
Role and characteristics of researchers	Krabel and Mueller (2009) Krabel et al. (2012)
Relations between inventive activity and performance	Buenstorf (2009) Buenstorf and Geissler (2012) Göktepe-Hulten and Mahagaonkar (2010)
Relevance of LPROs for TT	Harding (2002) Betz et al. (2016) Comin et al. (2019) Kaiser (2010)
Strategic behaviour of LPROs	Gonard (1999b)
Gender issues in LPROs	Mairesse and Pezzoni (2015)
Scientific engagement of LPROs researchers	Albert et al. (2005) Olmos-Peñuela et al. (2014) Amara et al. (2019) Fernández-Esquinas et al. (2009)

2.3 Case studies of Technology Transfer activities

To the best of our knowledge only a minor, though relevant, number of works uses qualitative methodologies in order to analyze firm-research interactions for TT. We must note that also in this research stream most contributions discuss cooperation of Universities with firms, while those discussing the cooperation of LPRO are scarcer. A relevant contribution in enucleating the features of qualitative literature is the work of Cunningham et al. (2017) who performed a review of qualitative literature on TT research encompassing 107 articles. Their final statement highlights the need, as well as the opportunity, for qualitative case methods research⁴.

In recent years the use of qualitative case-study methods has allowed to explore several dimensions of TT. A first topic is that of social capital, in terms of geographical, social, cognitive, organizational proximity. Social capital is a strong influencer of the relations of firms with research (Universities and PROs) (Steinmo & Rasmussen, 2016). In specific, firms with low level of experience rely on individual relationship when approaching the research environment. Also

⁴ "Our paper highlights essential necessities and opportunities for qualitative case methods researchers to further contribute to the advancement of knowledge in the field of technology transfer research and qualitative case methods in general" (Cunningham et al. 2017, p. 942).

Korff et al. (2014) highlight the relevance of experience, as well as its exchange, in their case study on the mechanisms of university-industry linkages, and on the way to support them.

Trust is another relevant driver in collaboration of academia with firms, though the results of the analysis of Rajalo and Vadi (2017) show that it is perceived as a limit when it lacks, at least by so-described “modest” collaborators. At the level of individual University researchers, initial trust in terms of reputation and background proves relevant to start collaboration (Oliver et al. 2019). This, at least on this Israeli-based case study, proved important also at institutional level. Qualitative literature has further explored the personal side of (university-industry) collaboration, showing that coordination based on mutual adjustment, for instance, results being more relevant than coordination by plans does (Morandi, 2013).

Case study-based works analyzed also more institutional topics. For instance Motoyama (2014), studying two University-firm collaborations in the field of nanotechnologies, highlights the fact that such collaboration should aim at a scope larger than the mere patenting and spin-off creation. A wider, UK-based dataset of firms shows that SMEs are very often able to capitalize the results of collaboration, which make them able to explore new opportunities of business (Rosli et al. 2018). Embeddedness in a network of the partners proves important in the set-up and initial phase of a collaboration, notwithstanding the fact that such collaboration are not straightforward in terms of evolution from similar conditions (Thune & Gulbrandsen, 2014).

Other authors presented case studies using qualitative analysis methodologies. For instance Jefferson et al. (2017) perform a qualitative study over the Technology Transfer offices of five research institution across the Americas. The study highlights common traits and differences existing between the five high profile institutions. Another, more peculiar use of qualitative analysis is the work of Resende et al. (2013) who present a (qualitative) tool aimed at being used by technology transfer offices to improve their efficiency and effectiveness. An even more particular case is that of Azagra-Caro et al. (2017) who follow an highly cited academic patent across a long time period, to discover that “local economic impact can be achieved only after a complex, temporally unfolding sequence of interactions between formal and informal channels of knowledge transfer” (p. 463).

Topic and contribution	Authors
Role of social capital and of experience	Steinmo & Rasmussen (2016) Korff et al. (2014)
Mutual trust	Rajalo and Vadi (2017) Oliver et al. (2019) Morandi (2013).
Effect of collaborations on firms	Motoyama (2014) (Rosli et al. 2018)
Role of networking on collaborations	Thune & Gulbrandsen (2014).

3 CONCLUSIONS

The literature overview at the center of the present paper shows that a large number of topics have been dealt with in TT research, thus confirming the relevance and complexity of TT.

The first part of our literature review is relative to the specific features of the U-I interaction. Quantitative or semi-quantitative studies of U-I interaction are with no doubt the most frequently performed ones. This is the reason why we have performed a wide – though forcedly incomplete – review of literature on this topic prior to introduce the two sections at the center of the present work. In this way we show that the two main topics of our analysis are still underexplored. Moreover in this way we are able to highlight some of the main topics of this literature, that will be discussed in the following part of this section.

Our overview shows that recent literature has highlighted several features of U-I interaction that deserve being resumed. The role of individuals and of relations is the most stressed topic, on both sides of the interaction. Features of individuals have an effect on cooperation, as well as relations, communication, strong ties between counterparts, mutual trust, relational abilities and similarity. Strength of ties in fact is for instance able to drive different channels of interaction, while trust can be a success factor. Cognitive distance may not be a strong barrier (though it may hinder frequency of relations), while geographical proximity can be more relevant; nevertheless research topics influence modalities of TT, and good (but not too much) similarity (in terms of technology, geography, prior collaboration) can be an important factor of success. Finally, dimensions and sectors of firms also influence the relations, as well as the relational abilities of employees.

When addressing the review of literature on TT in LPROs one can notice that many studied topics are very similar to those presented for Universities. In fact, literature on CNR stresses the effects of distance between the counterparts, as well as the positive impact of TT activities on research performance of the researchers, and the internal problems in TT performance and organization. Studies on MPS show the relation between personal features of researchers and TT activities and, again the correlation between research performance and TT. Literature on Fraunhofer society shows its relevance for the development of the Country. Studies on CNRS are more original under this point of view, either exploring managerial features, evolution or specific case of personal features (gender in specific). Finally, CSIC has been studied mostly under the profile of the productivity and of the research interests of its personnel.

The comparison of the literature on LPROs with that on Universities can tell us a simple lesson. The interest of researchers on the two types of organizations is very similar, and thus the studied topics are in many cases overlapped or at least parallel. This fact tells us that it would be important for researchers to dedicate more time and effort towards the study of TT in LPROs rather than replicating research on Universities as it often happens. LPROs in fact present peculiar features in terms of organization, idiosyncrasies of research activities and collaboration with external customers that are different from those of Universities. Thus research should orient its efforts towards studying such particular features, rather than only replicating the studies performed on Universities and their characteristics.

Coming to the last one of the topics addressed in our literature overview, we see that many scientific works based on case studies – besides being mostly devoted to Universities, as above described – tackle topics not-so-distant from those studied with more commonly used quantitative or semi-quantitative methodologies. On the other side it is possible to notice the presence of original topics that are less common in quantitative studies literature. This specific stream of literature in fact tackles topics going from the study of social capitals of firms and universities in terms of proximity (geographical, social, cognitive, organizational) to those addressing experience of researchers, mutual trust and personal involvement in collaboration, to more institutional topics. These are related to the scope of collaboration, the ability of SMEs to capitalize result, the embeddedness of partners in a network, the features of TT offices and the effects of patenting on the local economy.

This last section of our review again can teach us a lesson. Qualitative studies of TT activities are still nowadays the minority. This fact is detrimental to the full understanding of the nature and features of TT and of their relapses on the social and economic life. We can see in fact that qualitative studies are able not only to tackle topics that are studied via quantitative analyses, but also those peculiar topics, features, activities etc. that can't be deepened with the sole use of numbers. This fact should push researchers to undertake more often research using this specific methodology, both alone and in combination with quantitative or semi-quantitative studies, in order to better clarify the nature of modern TT in all kinds of research institutions.

Summing up, we must highlight that a relevant link between the three discussed topics exists. The literature reviewed in the present work tends to identify TT itself (as a concept), as well as its main features – such as institutional factors or the various types of proximity – under a very general point of view, and – what is more relevant – not in a specific context. This is mainly a claim of quantitative studies, which – aiming at the generalization of results – often loose

specificity. This low specificity, in turn, makes results less “transferable” to policy makers, due to the fact that generalized and out-of-context indications are less exploitable. Under this point of view the results deriving from qualitative research and case study analysis offer a relevant added value, that makes the produced knowledge more easily transferable. In fact these methodologies allow to identify, study and describe practices and initiatives that are rooted in a specific context and that can be more easily transferred, adapted and applied in other context. This is why, after a general introduction on the U-I interactions, we have oriented our analysis on the smaller, but equally relevant, qualitative/case study literature. Finally, the analysis on LPROs has been performed with a similar aim, as we have tried to highlight the literature on this subject in order to raise the interest on a field that might describe practices and initiatives that are more easily transferable and exploited by practitioners and policy makers.

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ABSTRACT

This theoretical paper aims at collecting and reviewing the existing literature on two underexplored topics related to Technology Transfer. In fact, while researchers working on this topic have focused mainly on Universities and on quantitative analysis of Technology Transfer activities, some topics remain underexplored. Among these topics we focus in particular on the scientific works performing qualitative analyses via exploitation of case studies and on those dealing with Technology Transfer activities of non-University Large Public Research Organizations. Aim of the paper is to highlight and put on the spot unconventional topics of research. The paper performs a comprehensive literature review of these fields, introduced by an analysis of literature on University-Industry interaction performed in order to frame the main research topics. A final section resumes the results of the literature review and sets suggestions for further research.