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Friedrich Dornbusch
Henning Kroll
Esther Schricke

Multiple Dimensions of Regionally-Oriented University Involvement – How Motivation and Opportunity Prompt German Researchers to Engage in Different Ways

Fraunhofer ISI

Contact:
Fraunhofer Institute for Systems
and Innovation Research ISI
Competence Center "Policy and Regions"
Breslauer Strasse 48
76139 Karlsruhe, Germany
Telephone: +49 / 721 / 6809-138
Telefax: +49 / 721 / 6809-176
e-mail: christine.schaedel@isi.fraunhofer.de
URL: www.isi.fraunhofer.de

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Contents Page

Tables and Figures

Abstract: The present paper aims to draw a comprehensive picture of the ways how university scientists in Germany interact with their regional environment. Previous research documented varieties of localised interactions, however, there have hardly been any broad and systematic approaches explaining the different patterns of regionally-oriented university involvement. This study develops a new typology of researchers' regionally-oriented activities and uses a recent nation-wide survey among German professors to test for main influences on those activities. The results highlight the decisive interplay between an individual academic's motivation as well as different opportunities provided by the regional environment.

1 Introduction

Over the course of the last two decades, a major strand of academic literature has developed concerned with the description and analysis of the regional impact of universities. What started as a comparatively technical consideration of demand effects and knowledge spillovers (cf. 2007) has more recently been extended to include the description of not only different forms of university-industry co-operation (Charles 2006; Czarnitzki et al. 2000; Etzkowitz 2003; Kitagawa 2004; Science Marketing 2011), but also universities' role in social participation, empowerment and community building (Benneworth et al. 2009b; Brennenan et al. 2006; Goddard et al. 1994; Hardy 1996). To an increasing extent, therefore, the main question is no longer *whether* universities have a beneficial impact on their regional environment but *how* they do so and how such involvement can be politically fostered and supported (Boucher et al. 2003; Chatterton and Goddard 2000).

From the mid-1990s onwards, the literature has been quite clear that a broad range of "distinct university outputs" from 'human capital creation' to 'regional leadership' (Goldstein et al. 1995) can been identified, and that some of these outputs have a regional character (Hardy 1996; Saxanian 1994; Smith 2007). Most recently, this has been summarised in Uyarra's (2010) classification of different types of the many "beneficial aspects" that universities exert on their regional environment. It is quite evident that the regional role of universities extends far beyond the two areas which are still the usual focus of interest: technology transfer and human capital formation (Gunasekara 2004; Science Marketing 2011).

A certain gap has emerged, not only with respect to which particular patterns of involvement we find in practice ((Benneworth et al. 2009b; Boucher et al. 2003; Kitagawa 2004), but, perhaps even more importantly, why the decisions for certain types of regional activities are taken by individual scientists.

Existing studies provide useful insights into the determinants of selected types of activities, mostly the engagement in entrepreneurial activities and/or knowledge transfer – but do not explicitly focus on the larger picture. Instead, they tend to concentrate on specific dimensions, either the motivation of individuals (see e.g. D'Este and Perkmann 2011; Lam 2010), disciplinary differences, individual, organisational and/or departmental characteristics (e.g. Bercovitz and Feldman 2008; D'Este and Patel 2007; Meyer-Krahmer and Schmoch 1998; Schartinger et al. 2002) or, in general terms, the surrounding region of a university (e.g. Boucher et al. 2003; OECD 2007).

In 2011, a team of German researchers compiled a first broad-based dataset on individual researchers' regional activities, thus creating an additional opportunity to reflect on the "third role" of universities from a novel perspective. This will be used by this paper to conduct one of the first broad-based, actor-level analyses of individual researchers' decisions in the field of regional engagement. Besides the obvious merit of its grass-roots approach, however, such an actor-based perspective also comes with a number of conceptual challenges.

Therefore, two conceptual steps are applied to lay the foundation for the following empirical analysis:

Firstly, there is a lack of experience with broad-based approaches. So far, many analyses of universities' "third role" have been conducted from the perspective of the university's management, focusing on aspects within its control, e.g. large-scale research cooperation, centralised licensing (Perkmann and Walsh 2007) while paying less attention to others (e.g. consultancy, internships for students). Recently, many studies of the role of universities for "their" regions have addressed the different dimensions of engagement using case studies or conceptual frameworks focussing on distinct types of interaction (Benneworth et al. 2009a; OECD 2007).

> *In a first conceptual step*, therefore, this study will take account of and develop a system for the most common forms of regional engagement that have been identified in the literature.

Secondly, most of the current literature tends to discuss universities' regional engagement from a university-level perspective, using strategy level, functional terminology (Uyarra 2010). While this may be a suitable approach to reflect on involvement at university-level – not least from a policy perspective – these categories are not useful on their own to further our understanding of how and why individual scientists make specific choices. Unlike university managers, individual scientists perform actions rather than work to fulfil certain functions. These actions should be viewed as strategic, driven

by individual motives and shaped by personal incentives, occupational requirements and framework influences on multiple levels.

> *In a second conceptual step*, therefore, this paper will outline a set of factors that determine researchers' choices in the field of regional engagement. While taking into account institutional framework conditions, the main focus will be on the interplay between individual motivation and regional opportunities.

The paper is structured as follows. In the next section, the authors will develop the conceptual approach as outlined above. Section three presents the dataset and the methodology. Based on this, section four presents the results and section five comments on them with respect to the research questions. Finally, conclusions will be drawn in section six.

2 Conceptual Approach and Research Questions

For the purpose of this paper, regional activities are defined as activities in different domains of academic relevance *that are performed in co-operation with regional partners*, irrespective of the individual scientist's 'regional commitment'. As a basis for the subsequent operationalisation, 'regional partners' are defined as those that can be reached by car in less than two hours.

2.1 Step 1: A systematic classification of Regionally-Oriented Activities

As outlined above, regionally-oriented activities have to be seen in the context of universities' multiple roles and functions. Additionally, they have to be seen against the background of the constitutionally protected autonomy of academic research which gives individual researchers large freedom of scope with regard to research decisions. Hence, regionally-oriented activities should be analysed from an actor – rather than from a management-based perspective. In the following, this assumption is essential to our conceptual approach as it underlines that there is and can be no such thing as a 'standard' regionally-oriented activity. There may be, e.g. a shared general perception that universities should become 'more regionally engaged' (Power and Malmberg 2008), this does not necessarily imply that the motivation for the diverse actions performed by individual academics was grounded in this abstract perspective. For the individual, much more tangible factors may play a central role, such as access to research funding or reputational factors.

As highlighted in the introduction, the first central objective of this study thus is to define a suitable classification scheme for regional activities to help structure its main research questions. So far, most papers with an actor-centred perspective have focused on only one or the other specific type of activity and have developed classifications accordingly so that classifications that exist for technology transfer, for example, tend to neglect other relevant aspects such as teaching or community engagement.

To safeguard the intended breadth of its approach, therefore, the authors did not develop this study's on the bases of one drafted within the well-researched fields of regional engagement. Instead, it draws on a concise overview developed by (Benneworth et al. 2009b) to structure the broad range of those activities performed by universities to serve regional communities. Starting from there, they adapted some sub-headings of this scheme to make them more general and complemented by some of the more standard activities that Benneworth et al. (2009b) did not consider (e.g. research co-operation). Hence, the classification scheme presented in Table 1 covers all the different perspectives encompassed by a university's regional activities – including the more classical aspects of technology transfer and 'hard' research co-operation.

In summary, the potential scope of an academic's regionally-oriented activities were classified and subdivided as follows:

- Firstly, *research, development and transfer oriented* activities including R&D co-operations with local partners as well as the provision of consulting and expert reports.
- Secondly, activities related to the *external use of university facilities* including the external use of equipment and laboratories as well as the external use of premises and services.
- Thirdly, *teaching-related activities* including temporary personnel exchanges with regional partners as well as writing graduate theses in co-operation with external partners.
- Fourthly, *activities related to regional engagement and regional leadership* including information events, further education, as well as contributions to social life in the region.

In the next step, the individual sub-headings were further differentiated internally to arrive at a practical, experience-based description which could be easily understood by the scientists who had to complete the questionnaire in the survey. With the same aim in mind, a number of illustrative examples were listed for each of these second level sub-headings to avoid misunderstandings and misinterpretations (cf. Table 1).

Starting from this main reference base, the following sub-sections of this paper focus on the process of decision-making that prompts different academic personalities to decide in favour of certain regional activities rather than others under a particular set of framework conditions. The aim is to consider these different potential factors of influence and use them to illustrate why academics can be expected to perform one type of activity under certain framework conditions, while a different environment may be more conducive to others.

Table 1: Different types of regionally-oriented activities performed at universities

Research, development and transfer-oriented activities	**Research and development co-operations with local partners** • Co-operation projects with joint teams • Research projects that involve mutual learning • Contract research (in the field of development and prototyping)
	Consulting and Expert Reports • Research on regional communities/institutions that involves feedback to those institutions • Consulting with specified objectives • Contract research (in the field of expert reports) • Measures aimed at capacity building in regional institutions and firms
External use of university facilities	**External use of university equipment and laboratories** • External use of laboratories for limited clinical trials • External use of specialist equipment for material testing • External use of specialist equipment for the analysis of samples
	External use of university premises and services • Use of university premises and venues for external events with university sponsorship • External use of general advisory services • Graduate events / Employment fairs
Teaching-related activities	**Temporary personnel exchange between the university and regional partners** • Work experiences and internships for students • Hiring of external readers and lecturers
	Writing graduate theses in co-operation with external partners • Development of practical results that are relevant for a regional firm • Integration of graduates in their future working environment

Activities related to regional engagement and regional leadership	**Information events and further education for diverse groups (pupils, seniors etc.)** • Public lectures or seminars • Applied civic education • Education with respect to viable and suitable forms of community engagement • Further education for disadvantaged groups • Continuing education and lifelong learning
	Contribution to social life in the region / Community engagement in the region • Expert contributions to specific discussions • Contribution to public and media discourses • Improving disadvantaged groups access to university facilities • Contribution to social life in the region

Source: Own compilation, drawing substantially on Benneworth et al. (2009b)

2.2 Step 2: Factors of Influence

As highlighted in the introduction, a second key point in structuring this study's approach is to develop a framework of determinants relevant for the individual researcher.

The first three aspects focus on the influence of the individual academic researcher's scope to perform a certain type of activity. Among them, individual motivation is considered a triggering factor that is then moderated by the researcher's disciplinary background as well as his or her university-related working environment.

Dimension1 - *Individual Motivation*

Due to the basic principle of individual academic freedom, the individual researcher is decisive for the type and intensity of regional engagement. Evidently, academics cannot be 'managed' in the same way than corporate employees. Unfortunately, few empirical papers have so far focused precisely on the role of individual scientists' motivation in making decisions about interactions with the world "outside of the ivory tower" (e.g. Etzkowitz et al. 2000). So far, most of the few existing studies tend to focus on interactions with industry and their "entrepreneurial orientation" (e.g. Lam 2010; Ponomariov and Boardman 2010).

A reasonable point of reference to classify scientists' motives to engage with regional partners might be their different tasks. Despite changing political framework conditions emphasising outreach and co-operation (Schmoch and Schubert 2010), researchers are likely to keep research and teaching, the traditional "norms of science" (Merton 1957), as

a core value system (Jain et al. 2009; Lam 2010). Nonetheless, political trends may indeed induce a re-thinking of the boundaries between the academic working space and the surrounding environment as well as a concrete, increased engagement with this environment (Gibbons et al. 1994).

In brief, individual motivation to engage with wider society can be summarised as follows:

Learning and curiosity: The motivations of scientists to engage with the local community can be driven by the wish to learn from partners and by intellectual curiosity. They will seek regional co-operations in order to *add value to their own research activities* ((D'Este and Perkmann 2011; Perkmann and Walsh 2009). In a similar manner, this also applies to *new input for teaching activities* and a number of studies have indeed found complementarities between scientists' motivations for networking in both teaching and research (e.g. Jensen et al. 2008; Landry et al. 2010).

Research funding and resources: Beyond the learning aspect, studies show that academics aim at generating *additional income for research activities and building networks with partners who can help them to access sources for research funding* and can provide access to key resources like e.g. special laboratory equipment as well as third party funding for PhD students and post-doctoral fellows (Link et al. 2007; Perkmann and Walsh 2008).

Reputation: Striving for scientific *recognition and prestige* is a particularly strong motivational factor. Being recognised as an excellent researcher within the scientific and the local political community forms the foundation for both learning and successfully acquiring funding in the future (Lam 2010; 2011).

Public engagement: Finally, some academics may be *intrinsically motivated to contribute to society* (Andersen and Pallesen 2008). Prior studies indicate that many university staff show at least some affinity for public engagement (Bauer and Jensen 2011) and that this is not restricted to those who are academically less productive (Jensen et al. 2008). Moreover, studies find that academics engage in public dissemination activities not only from a sense of duty, but also because they enjoy it (Wigren-Kristoferson et al. 2011).

In sum, the regionally-oriented activities of academics are shaped by a diverse and overlapping set of motivational factors.

Dimension 2 - *Disciplinary background, nature of academic work*

Different academic disciplines are characterised by different kinds of knowledge bases which differ with regard to the importance of tacit knowledge, the degree to which knowledge can be codified, as well as skill requirements (Asheim et al. 2007). As a result, we would expect the type of interactions required for joint learning to also differ accordingly. For example, researchers from different fields have different proximities to industry which allow them to exchange non-analytical, tacit knowledge on an interactive, co-operative basis. For Austria, Schartinger et al. (2002) found that the natural, technical and, agricultural sciences as well as economics have higher levels of interaction than other disciplines. Likewise, Wigren-Kristoferson et al. (2011) and Jensen et al. (2008) document discipline-specific differences between commercialisation, industrial collaboration, teaching and public dissemination activities.

In sum, the theory and the empirical evidence both suggest that disciplinary differences are likely to have a strong influence on the ways in which researchers perceive and interact with their regional environment. In other words, the disciplinary background of individual professors is likely to be a strong determinant for their choices in the field of regional engagement.

Dimension 3 - *University-related characteristics*

Besides disciplinary differences, the size and research orientation of the employing university might influence a researcher's propensity to engage in regionally oriented activities. Various studies indicate that top-tier universities with higher research intensity are likely to be more attractive to large corporate partners, while those specialising in teaching and community outreach may be more relevant for SMEs (Czarnitzki et al. 2000; Laursen et al. 2011).

In Germany, an important aspect in this regard is the distinction made between universities and universities of applied sciences (*Fachhochschulen*). While universities tend to focus more on basic research and research-based courses, universities of applied sciences have a stronger emphasis on teaching, which results in a much higher teaching load for their professors and they do not award PhDs. As a result, universities of applied sciences have fewer resources for research activities and are less attractive to large corporate partners. Nonetheless, many of them act as important R&D partners for SMEs within their region (Czarnitzki et al. 2000) with whom they engage in applied development, personnel exchanges (e.g. external lecturers) and sometimes consultancy (Beise and Stahl 1999; Kulicke and Stahlecker 2010).

Some studies have hypothesised (though failed to confirm) a correlation between department size and academics' propensity to interact with firms (e.g. D'Este and Patel 2007), an effect that could also be correlated with university size. Schartinger et al. (2002), for example, suggest a U-shaped relationship here and postulate that the propensity to co-operate is augmented by both the greater flexibility of small departments and the access to more resources of large departments.

As a result, we expect to find a modest influence of organisational characteristics on individual researchers' choices of regionally-oriented activities. The most obvious impact is expected to result from the differences in research and teaching orientation or, in more concrete terms, the institutional difference between universities and universities of applied sciences.

Dimension 4 - *Regional environment of the university*

While there are only a limited number of academic studies which directly relate regional environment with individuals' co-operation decisions, there is a substantial amount of distributed and relevant findings. From the proximity debate (e.g. Malmberg and Power 2005), we know that the opportunities for social interaction increase in industrial agglomerations and with the nearby presence of potential collaboration partners. While searching for excellent but distant partners might be a preferred strategy in R&D collaborations (Laursen et al. 2011; Torre 2008), short-term problem-solving or community outreach activities can be assumed to be much more responsive to spatial proximity and local networks (Brökel and Binder 2007; Broström 2010). In line with this, Power and Malmberg (2008) underline that a university's ability to interact with its regional environment depends first and foremost on whether any notable industrial value chain is present in the region. Implicitly, this suggests the stronger regional relevance of universities located in more industrially developed core regions and agglomerations.

On the other hand, Benneworth et al. (2009b) showed that universities can make a contribution to regional development and community building even in peripheral regions. Moreover, it has been demonstrated that the local engagement of mid-range universities (Wright et al. 2008) has substantial relevance for many non-metropolitan regions (Gál and Ptácek 2011). Apart from the opportunity this offers, this wider engagement, e.g. in further education for the local workforce, has become a political request in many disadvantaged regions (Williams and Cochrane 2010). Taken together, these studies seem to strongly suggest that the preferred *type of regional engagement* is likely to vary in line with the surrounding region's degree of techno-economic development and the resulting position of universities in their regions (Boucher et al. 2003; OECD 2007).

In summary, it seems likely that certain regionally-oriented activities will have a higher tendency to occur in central regions, while others will be realised to a greater extent in peripheral environments. While some studies (Tödtling and Trippl 2005) indicate that activities in very peripheral regions may be compromised by institutional thinness and the absence of potential partners, others argue that this might be compensated for by a higher level of certain types of social capital in those regions (Sörensen 2012), which may facilitate the community engagement activities studied by Benneworth et al. (2009b). Consequently, the study will have to consider non-linear, U-shaped relations between the economic development measured by the per capita income in a region and the likelihood of conducting different types of regionally-oriented activities.

Finally, the specific German case requires that the differences between the eastern and western federal states (former GDR vs. former FRG) are taken into account. While "East" or "West" is not a regional characteristic as such, it still remains a strong proxy for institutional and habitual trajectories even now more than two decades after reunification (Fritsch et al. 2007). While the higher education landscape is undoubtedly changing, common practice and established networks still mean that certain activities are more easily realised in the East, or are simply more common there.

Overview of Influencing Factors

In summary, the potentially relevant factors and research dimensions influencing an individual academic's choice of different types of regional engagement can be classified and subdivided as follows:

- Individual motivation
- Disciplinary orientation
- Organisational characteristics of the employing institution
- Opportunities for interaction in the regional environment

Thus, in line with our research proposition, the research question guiding the following analyses is: How and in what way do the multiple-dimensions of influencing factors determine the researchers' decisions to engage regionally?

3 Presentation of Dataset and Methodology

Data collection

The database used to test the above-mentioned hypotheses was compiled to identify and analyse the regionally-oriented activities of German professors. In the course of a

larger project funded by the German Federal Ministry of Education and Research (BMBF)[1], a group of researchers at Fraunhofer ISI developed an online questionnaire with about 20 questions and sent it to every German professor at both universities and universities of applied sciences for whom contact details could be obtained. Of about 40,000 professors, more than 15,000 could be contacted and responses were received from about 2,000 of them after two months. In general, responses were found to be representative with respect to both regional and field-specific distribution. While the exact response figures vary depending on the question, 1,929 questionnaires were sent back with meaningful entries. Of these respondents, 1,519 stated they were working at a university, while 221 were employed at a university of applied science (189 did not indicate an affiliation). Naturally, the survey was predominantly completed by professors engaged in regional activities. As a result, it allows us to draw conclusions regarding the structure of "third role" activities.

With respect to the research questions stated above, the above-mentioned dataset was used to operationalize the motivations behind the activities with regional partners. Additionally, it provides information about the disciplinary orientation of the professor in question as well as the type of employing institution. Data on the institutional environment was taken from the Eumida dataset that was established during the 2008-2009 European Union project "*Feasibility Study for Creating a European University Data Collection*", which had the objective to collect structural data for all European universities including all the German ones. Data concerning the degree of regional development were partly taken from the German Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR) – with respect to urbanisation –and partly calculated by the authors themselves based on Eurostat data. In more detail, NUTS 3 level GDP and GDP per capita figures were processed using the GeoDa tool developed by Anselin et al. (2004) , which allowed the authors to calculate spatially lagged variables (see Anselin 2005). To avoid over- or underestimating the prosperity of the broader regional environment due to singular peaks, regional data were arithmetically averaged with the spatial lag point representing the mean of their immediate environment, i.e. one based on a 100km cut-off point – aiming to reflect the survey's stated definition of 'regional' as 'within two driving hours' (see above).

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1 The survey was conducted for the research project: "Involvement in regional networks and their impacts on internal governance structures at universities", which is funded under the heading of "New Governance of Science" by the German Federal Ministry of Education and Research (BMBF) (www.bmbf.de/foerderungen/13440.php).

Instruments and measures: Measuring the profile of regionally-oriented activities

The study's aim is to contribute to understanding why individual researchers choose to regionally engage and what shapes their decision for a certain type of activity. Thus, the dependent variable is the type of regionally-oriented activity that researchers decide to perform. As the survey allowed respondents to select more than one activity, the analysis has to treat them separately rather than as alternatives.

The operationalization of types of regionally-oriented activities followed the structure developed above. The respondents were asked to indicate on a 4-point scale how often they were involved in one of the types of regional engagement presented in Table 1.

Looking at this table, it is obvious that, from a professor's perspective, these activities have multiple implications and in many cases cannot be unambiguously attributed to one abstract objective such as 'research' or 'teaching'. Nonetheless, it can be assumed that the connections between certain types of regionally-oriented activity and certain fundamental intentions are stronger and more obvious than others. Against this background, it seems helpful to structure the observed activities and define latent dimensions of regional engagement by conducting a factor analysis in order to identify types of regional engagement which reflect a common purpose.

To account for the exploratory nature of the approach, a true principal factor analysis was chosen to extract the factor dimensions, the factorability of the data having been confirmed by the MSA criterion (Cureton and D'Agostino 1983). Following Tabachnik and Fidell (2007), the obtained factor loadings are fair and sufficient for interpretation, while the Cronbach's Alpha proves the appropriateness of the used multi-item scales (see Nunnally 1978). The number of factors is based on theoretical considerations and determined with the help of the Kaiser criterion.

In summary, the factor analysis revealed three main dimensions.

1. *Formal collaborations and personnel exchange:* The largest factor unifies the highest factor loadings of four indicators. On the one hand, it reflects the bilateral exchange of formal and professionalised forms of cooperation and exchange. On the other hand, it reflects the transfer of human capital, especially in the field of education and teaching.
2. *External use of university facilities:* This factor receives two high loadings of the variables "External use of university equipment and laboratories" and "External use of university premises and services". Arguably, these need institutional backing and cannot be initiated by individuals to the same degree as those subsumed under the first factor.

3. *Activities related to regional engagement and regional leadership*: The third factor receives high loadings of those activities which are not realised in co-operation with specific partners, but are directed at broader local target groups (e.g. information events). This factor subsumes those activities which target broader regional engagement.

In the following, these retrieved factor scores (latent variables) are used as the main dependent variables to test the paper's basic assumptions.

Table 2: Results of the factor analysis for types of regionally-oriented activities

	Factor loadings		
Factors	Collaborations and personnel exchange	External use of university facilities	Regional engagement and leadership
Cronbach's α	0.68	0.65	0.60
R&D co-operations with local partners	**0.50**	0.33	0.17
Consulting and expert reports	**0.43**	0.20	0.28
Temporary personnel exchange between university and regional partners	**0.45**	0.32	0.21
Writing of graduate theses in co-operation with external partners	**0.54**	0.17	0.14
External use of university equipment and laboratories	0.20	**0.57**	0.03
External use of university premises and services	0.18	**0.61**	0.25
Information events and further education for diverse groups	0.23	0.18	**0.51**
Contribution to social life / community engagement in the region	0.13	0.15	**0.55**

Extraction method: Principal Factor Analyis. Rotation Method: Varimax
KMO-test = 0.78; N = 1441
Source: Own calculation and compilation

Independent Variables

Table 2 presents the dependent (dV) and independent variables that were analysed as the potential determinants of individual decisions in favour of certain regionally-oriented activities. Due to missing responses for certain items and missing data in the secondary datasets, 671 complete cases formed the basis for the analyses.

Table 3: Summary statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Collaboration (*dV*)[3]	1441	0.00	0.68	-1.20	2.00
University facilities (*dV*)[3]	1441	0.00	0.70	-0.77	2.49
Reg. engagement/leadership (*dV*)[3]	1441	0.00	0.64	-1.39	1.69
Com. Engagement/Reputation[3]	994	0.00	0.80	-1.71	1.57
Research[3]	994	0.00	0.73	-1.27	2.20
Teaching[3]	994	0.00	0.69	-1.91	1.26
Subject dummies	1532	3.40	1.99	1.00	6.00
Total staff[1]	1096	4.44	3.59	0.03	13.96
Research intensity	1108	0.06	0.05	0.00	0.48
Teaching intensity	1096	6.28	4.95	0.43	46.71
FH dummy	1663	0.11	0.32	0.00	1.00
East/West dummy	1571	0.20	0.40	0.00	1.00
Urban structure dummies	1162	1.64	0.90	1.00	4.00
Regional GDP_sum[2]	1112	11.63	10.23	5.51	98.17
Regional GDP_sum squared[2]	1112	239.77	998.13	30.33	9636.65
Regional GDP/cap[1]	1112	26.73	4.68	19.33	53.41
Regional GDP/cap squared[1]	1112	736.36	273.50	373.73	2853.04

Notes: 1 = Units for per head (gdp and staff) are indicated in thousands; 2 = Units for absolute gdp are indicated in millions; 3 = Values of latent variable retrieved from predicted factor scores
Source: Own calculation and compilation

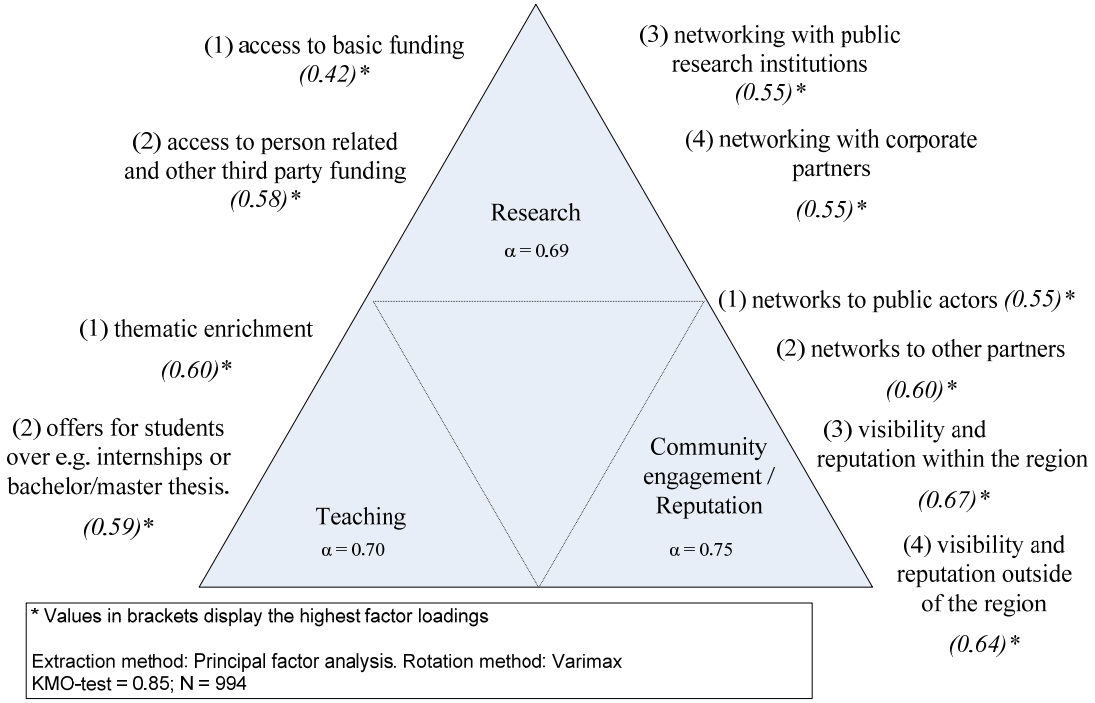
In line with the argument outlined above, the set of independent variables are structured in four sub-fields: individual motivation, disciplinary background, university-based characteristics and regional environment.

The first set of independent variables addresses the *professor's individual motivation* for getting involved in regionally-oriented activities. Again, the related independent variables were constructed from a more complex set of items using factor analysis based on the MSA criterion, the Kaiser criterion, and the Varimax rotation. In detail, the factor analysis subsumed the following detailed questions under three main factors:

1. Enabling *Research* as the basic motivation. Drawing on the conceptual section, these different items can be expected to be mentioned jointly, as university professors seek to engage in research with a view to both learning and funding.
2. Enabling *Teaching* as the basic motivation. Drawing on the conceptual section, it can be expected that teaching-related motivation is separate from the motivations focused on enabling research.

3. *Social Contribution and Reputation* as basic motivations. As suggested in the conceptual section, the commitment to broad engagement is intricately connected to considerations regarding the individual's own reputation.
4. The individual items from which these factors receive high loadings are indicated in Figure 1.

Figure 1: The motivation triangle of academic researchers in regionally-oriented activities



Source: Own calculation and compilation

In addition to individual motivation, the researcher's *disciplinary background* was considered an independent variable. The respective variable was constructed based on information provided in the survey that was subsumed under main categories and later transformed into five dummy variables (engineering, medical sciences, agricultural sciences, social sciences, arts and humanities) against the baseline of the natural sciences.

The analyses also account for *university-based characteristics*. Firstly, the size of the university is considered in terms of the number of staff. Secondly, research and teaching intensity are operationalised by the number of PhD students and postdocs (ISCED6) per total students (ISCED5) at the university and the number of students (ISCED5) per total staff, respectively. Finally, a dummy indicates whether the professor works at a university of applied sciences.

As suggested in the conceptual section, proxies for the degree of local urbanisation and socio-economic development are included as independent variables. Firstly, dummies reflect four different types of urban structure based on an official German classification that distinguishes core regions, urban hinterland, rural hinterland and rural regions. Additionally, since the conceptual section suggests non-linear relations between certain activities and the level of regional development as such, this aspect was operationalised by total GDP as well as per capita GDP while testing for non-linear relationships. Finally, a dummy variable indicates whether the individual works in a region which was part of the former East or West Germany.

4 Presentation of results: Regression models – OLS and Ordered Probit

In order to be able to combine a clear focus on the paper's main argument with a more detailed analysis of the different potential impact factors, two types of model were applied. On the one hand, OLS regressions were implemented for the latent variables derived from the factor analyses. These analyses test the paper's main hypotheses, which, by themselves, are of a rather general nature. On the other hand, ordered probit models were used for the individual types of regionally-oriented activities. These make it possible to identify the underlying individual effects summarised in the OLS models. All models are calculated with clustered and robust standard errors (see Long and Freese 2001).

It is important to bear in mind the nature of the sample. Since our dataset only covers researchers who perform at least one activity, all the dependent variables reflect the researchers' decision to *choose one type of regional activity out of several, hypothetical options*. This sample cannot be used to derive the researchers' propensity to decide in favour of regional activity as opposed to deciding against it.

Table 4: Regression results

	OLS with latent vars			Ordered probit with individual types of regionally-oriented activities							
	Factors of activity types			Research and development activities		External use of university facilities		Teaching related activities		Regional engagement and leadership	
dV =	Collaborations and personnel exchange	External use of university facilities	Regional engagement and leadership	Research co-operations with local partners	Consulting and Expert Reports	External use of university laboratories and equipment	External use of university premises/services	Temp. personnel exchange with reg. partners	Graduate thesis in co-operation with ext. partners	Information events and further education	Social life & community engagement in the region
ComEng/Repu	0,093 ***	0,181 ***	0,304 ***	0,349 ***	0,232 ***	0,190 ***	0,346 ***	0,161 **	-0,014	0,401 ***	0,569 ***
se	0,025	0,035	0,030	0,063	0,059	0,070	0,061	0,067	0,054	0,052	0,069
Research	0,284 ***	0,242 ***	-0,047	0,612 ***	0,365 ***	0,357 ***	0,259 ***	0,317 ***	0,315 ***	-0,101	-0,083
se	0,032	0,038	0,037	0,062	0,074	0,069	0,063	0,063	0,074	0,068	0,068
Teaching	0,375 ***	0,059	0,157 ***	0,432 ***	0,278 ***	-0,028	0,135	0,553 ***	0,901 ***	0,220 ***	0,225 ***
se	0,025	0,042	0,032	0,070	0,076	0,079	0,082	0,071	0,074	0,069	0,063
Engineering	0,168 ***	-0,144 *	0,016	-0,015	0,233 *	-0,259	-0,117	-0,047	0,514 ***	0,002	-0,053
se	0,061	0,080	0,072	0,146	0,121	0,165	0,109	0,140	0,137	0,150	0,149
Medical sci	0,048	0,139	0,156 **	0,249 *	0,305 **	0,027	0,292 **	0,299 *	-0,292 *	0,090	0,260 *
se	0,075	0,091	0,071	0,143	0,146	0,156	0,116	0,166	0,151	0,156	0,135
Agricultural sci	-0,008	-0,139	-0,106	-0,078	0,321	-0,478 **	0,113	-0,170	-0,105	-0,101	-0,722 **
se	0,103	0,145	0,172	0,156	0,318	0,224	0,296	0,201	0,227	0,279	0,360
Social sciences	0,028	-0,339 ***	0,048	-0,266 *	0,196	-1,212 ***	-0,191	-0,163	0,178	-0,243 **	0,022
se	0,067	0,062	0,063	0,148	0,137	0,171	0,117	0,147	0,139	0,120	0,136
Arts/humanities	-0,133 **	-0,202 **	0,249 ***	-0,283 *	0,121	-1,122 ***	0,091	0,001	-0,479 ***	0,038	0,422 ***
se	0,064	0,081	0,046	0,161	0,133	0,199	0,144	0,140	0,132	0,102	0,117
Totalstaff[1]	-0,002	-0,006	0,005	0,019	-0,029 **	0,001	-0,017	-0,020	0,005	0,024	0,002
se	0,008	0,009	0,007	0,016	0,012	0,017	0,020	0,019	0,015	0,017	0,013
Res_intensity	-0,336	0,617	0,139	-0,941	1,215	0,382	1,176	1,259	-1,709 *	0,046	-0,331
se	0,458	0,694	0,495	1,003	1,202	0,866	1,041	0,877	0,972	1,095	0,994
Teach_intensity	0,004	0,002	0,015 **	0,015	0,000	-0,019	0,014	0,012	0,003	0,038 ***	0,006
se	0,008	0,009	0,007	0,016	0,013	0,017	0,019	0,020	0,016	0,013	0,013
FH dummy	0,002	0,034	-0,047	-0,622 ***	-0,194	0,356 *	-0,060	0,257	0,416 **	-0,133	0,049
se	0,082	0,101	0,094	0,190	0,168	0,182	0,204	0,199	0,204	0,169	0,205
East/West_dum	-0,032	0,170 **	0,052	0,029	0,041	0,181	0,345 ***	0,143	-0,137	-0,017	0,139
se	0,054	0,082	0,059	0,098	0,081	0,138	0,127	0,104	0,148	0,116	0,104
Core region	0,032	-0,081	-0,089 *	0,116	0,022	-0,115	-0,138	0,045	-0,101	-0,003	-0,308 ***
se	0,040	0,054	0,050	0,115	0,080	0,116	0,106	0,099	0,107	0,099	0,106
Urban h-land	-0,035	0,031	-0,174 *	-0,003	-0,164	0,089	0,012	-0,116	-0,001	-0,086	-0,436 **
se	0,062	0,090	0,090	0,138	0,141	0,195	0,151	0,172	0,124	0,171	0,187
Rural region	0,038	-0,408	-0,130	-0,283	0,290	-1,252 ***	-0,512	-0,078	0,017	-0,571 **	0,020
se	0,268	0,373	0,101	0,635	0,228	0,348	0,663	0,229	0,470	0,239	0,343
gdp100_sum²	0,007	-0,008	0,004	0,013	0,030 **	-0,022	-0,013	0,002	-0,010	0,005	0,002
se	0,007	0,008	0,010	0,011	0,012	0,014	0,015	0,020	0,018	0,018	0,019
gdp100sq²	0,000	0,000	0,000	0,000	0,000 ***	0,000	0,000	0,000	0,000	0,000	0,000
se	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000
pk100_avg[1]	0,006	-0,099 **	-0,085 **	0,047	-0,091 **	-0,186 **	-0,156 **	-0,036	0,014	-0,153 **	-0,140 *
se	0,029	0,046	0,036	0,071	0,037	0,088	0,073	0,053	0,073	0,070	0,083
pk100sq[1]	0,000	0,002 **	0,001 **	-0,001	0,002 **	0,004 **	0,003 **	0,001	0,000	0,003 **	0,003 *
se	0,001	0,001	0,001	0,001	0,001	0,001	0,001	0,001	0,001	0,001	0,001
N	671	671	671	671	671	671	671	671	671	671	671
LR chi2				418,8 ***	603,8 ***	285,1 ***	166,6 ***	254,3 ***	467,4 ***	220,4 ***	229,1 ***
F	47,7 ***	8,6 ***	77,7 ***								
p	0,000 ***	0,000 ***	0,000 ***	0,000 ***	0,000 ***	0,000 ***	0,000 ***	0,000 ***	0,000 ***	0,000 ***	0,000 ***
adjusted R²	0,423 ***	0,191 ***	0,243 ***								
Pseudo-R²				0,158 ***	0,082 ***	0,134 ***	0,069 ***	0,094 ***	0,198 ***	0,052 ***	0,102 ***

level of significance: *** = 0.01; ** = 0.05; * = 0.10;

Notes: 1 = Units for per head (gdp and staff) are indicated in thousands; 2 = Units for absolute gdp are indicated in millions

Source: Own calculation

Individual Motivation

The results show that the motivation of researchers has a strong influence on their propensity to perform certain types of interaction, since many of the respective relationships are significant and positive. Moreover, there is a clear link between certain dimensions of motivation and certain general and/or specific types of activities.

For *formal collaborations and exchange of personnel,* the strongest influence is exerted by the wish to improve teaching skills followed by the wish to contribute to research activities. In contrast, the impact of the motivational dimension related to public engagement is significant, but notably less strong. As expected, the individual probit models reveal that research co-operations are based on research-related motivations to a greater extent, while the – often teaching-related – exchange of personnel is based on teaching-related motivations to a greater extent.

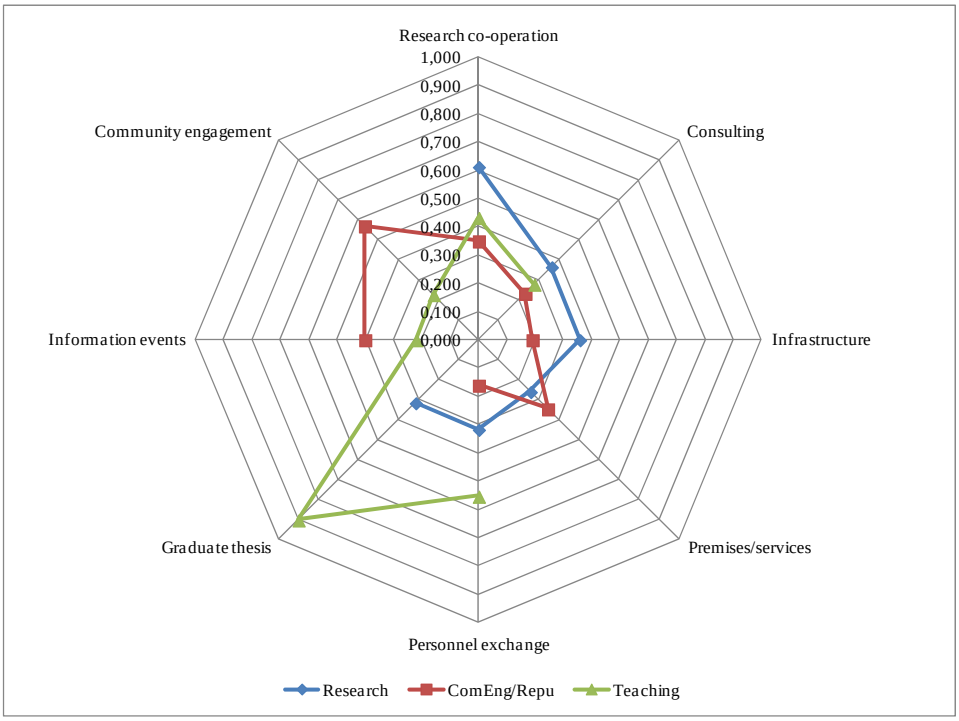
The *external use of university facilities* and its two distinct subcategories are influenced by a mix of research-related motivations and motivations related to community engagement and reputation. Motivational aspects focused on teaching, in contrast, display no significant effect.

As one might have expected, the professors' decisions to *regionally engage and contribute to regional leadership* are most strongly influenced by the social contribution and reputation dimension. Additionally, teaching-related motivations may prompt them to decide in favour of such activities, while research-related motivations do not play a significant role.

One appealing finding is that each of the three dimensions of regionally-oriented activities seems to be driven – to a different extend – by the general wish to contribute socially and gain reputation.

The individual probit models show that the choice of distinct activity is in most cases based on a mix of motivations, typically dominated by one key motivation which is more closely related to the specific type of engagement, e.g. research-oriented motivations for research co-operations with local partners. A detailed account of all these different motivational mixes is given in Figure 2.

Figure 2: Motivations driving the decision for a certain type of activity by significant coefficients (displayed in probits)



Source: Own calculation and compilation

Disciplinary Background, Nature of Academic Work

The data confirms the assumption that the disciplinary background influences the way in which the subjects interact with their environment albeit with a certain ambiguity.

Compared to the reference category of natural sciences, it is found that academics with an engineering background tend to prefer *formal collaborations and personnel exchange.* Those with a background in the arts and humanities are significantly less likely to engage in these activities than their colleagues in the natural sciences. The tendency to select the external *use of university facilities* as a form of co-operation is less prevalent among academics in engineering, the social sciences, arts and humanities than among their colleagues in the natural sciences. The tendency to choose *regional engagement and leadership*, finally, is positively affected by working in the arts and humanities or medical sciences. On an aggregated level, other disciplines show no significant differences when compared to the reference category of natural sciences. One notable *detailed finding* is that professors in medical science are prone to focus on research co-operations, consulting activities, allowing external users access to university premises and services and community engagement. Unlike engineers, however,

they seem hesitant to encourage co-operative theses, similar to their colleagues in the arts and humanities.

University Characteristics

On the aggregated level of factors (type of engagement), the university's organisational environment does not seem to have a strong impact on the choices of individual academics.

When differentiated by type of concrete activity, the models for *collaborations and personnel exchange* reveal a number of specific relationships. The size of the university shows a negative influence on the likelihood to engage in consulting. Research intensity displays a strong negative impact on the decision to have graduates write theses in co-operation with external partners. Moreover, it is shown that being employed at a university of applied sciences has a highly significant negative effect on the propensity to engage in research co-operations, whereas this is positively associated with having students write their theses with external partners. Likewise, none of the independent variables displays any visible impact on the *external use of university facilities*. Looking at single forms of interaction, a positive but weakly significant effect indicates that those employed at a university of applied sciences display a higher tendency to allow local partners access to their infrastructure. Finally, the tendency to decide in favour of *regional engagement and leadership* is indeed dependent on one university-based characteristic - teaching intensity - for which a significant and positive effect was identified. Not surprisingly, this can be explained by the impact of teaching intensity on the propensity to organise information events and further education courses.

Local Environment

Regarding the influence of the local environment, no significant effects can be observed on the general tendency to decide in favour of *formal collaborations and personnel exchange*. In detail, however, consulting-related activities show a significant sensitivity to local conditions in terms of wealth, namely GDP per capita. Unlike the control variable of GDP total, GDP per capita displays a positive squared (i.e. U-shaped) relationship, indicating that *consulting activities* are a prominent choice for regions with either a high or a low level of wealth.

The e*xternal use of university facilities* depends on GDP per capita in a similar manner. A U-shaped relationship can be found for both of the two underlying distinct types of activities. This factor also displays the only significant influence of the East/West

dummy, which is driven by the higher external use of university premises and services characteristic for regions in the former East Germany.

Finally, the professors' tendency to *regionally engage and take on regional leadership tasks* is negatively influenced by their university's location in a core region or urbanised hinterland compared to the reference category of rural hinterland. The separate models identify the source of this effect in the substantial impact of urbanisation on social life and community engagement, while it seems irrelevant for information events and further education. Finally, the level of local GDP per capita displays a U-shaped relationship.

5 Discussion of regression results

Research Dimension 1 - Motivation

In general terms, the findings support this paper's assumption that the researcher's individual motivation is one of the most important drivers of their preference for certain forms of interaction with regional partners. As suggested in the conceptual section, few motivational dimensions occur in separation so that there is a substantial empirical overlap between them. Empirically, three main dimensional fields can be identified: teaching, research and social contribution and reputation. One notable finding is the co-occurrence of motivations related to research and teaching, i.e. those based on the traditional 'norms of science'. As the regressions clearly indicate, each of these main motivations has a characteristic impact on a researcher's preference for certain types of activities. In doing so, the study firstly contributes to the current discussion by proving that expected impacts on teaching and research are complementary drivers for local collaborations and personnel exchange. Thus, there is a clear indication that those academics who wish to do so take advantage of opportunities provided by the region to enhance these dichotomised tasks via local network engagement. Secondly, we provide empirical evidence that an individual's motivation to contribute socially and to gain reputation constitutes a rather general basis for almost every kind of regional activity. In summary, this underlines the decisive role that individual researchers' motivations play in the development of a university's third role.

Research Dimension 2 – Disciplinary background

Although the conceptual considerations and the literature suggest the individual researcher's disciplinary background should have a substantial effect on their choice of regionally-oriented activities, the analysis documents a lower impact. Nevertheless, the

results do corroborate the gap between scientists in the more technically-orientated sciences versus the social sciences, arts and humanities that earlier studies suggested. In more detail, researchers in the latter subjects are less likely to focus on allowing external partners to use university facilities, supporting co-operative graduate theses or engaging in local research co-operations. Instead, academics in the arts and humanities tend to be more active in regional engagement and leadership which, interestingly, is not the case for those in the social sciences.

Research Dimension 3 – University's mission

Overall, the results indicate that the university environment seems to exhibit a more limited influence on professors' decisions for or against different types of regionally-oriented activities than the literature suggests. To some extent, the finding that professors in bigger universities are less likely to engage in consulting activities seems to confirm the hypothesis that smaller units may be more flexible, i.e. more receptive to or more dependent on their environment's needs. That the higher research intensity of a university seems to lower the likelihood that its staff focus on supporting graduate theses outside the university seems plausible because they probably have ample opportunities to integrate graduates in their own research projects. Professors in teaching-oriented institutions, in contrast, do not display the opposite tendency. Instead, they tend to focus on information events and further education. This may be partially due to the control for institutional differences between universities and universities of applied sciences. As their mission and earlier studies suggest, researchers at the latter are more likely to focus on co-operative graduate theses and renounce local research collaborations. Therefore these findings highlight the role played by small and teaching oriented universities for the emergence of local knowledge pools and networks.

Research Dimension 4 – Opportunities in the local environment

With respect to the role of the regional environment, the results confirm the assumption that the opportunities provided by the regional environment do indeed exert a significant influence on German researchers' choices concerning different types of regional activities.

Firstly, some differences in the historical trajectories between eastern and western Germany appear to persist, as suggested in prior studies. This is evident in the external use of university laboratories and equipment which is still more easily, or simply more commonly, realised in the East.

Secondly, the structure of urban development is found to substantially influence the likelihood of engaging in activities directed towards regional engagement and leadership. Compared to their colleagues in the rural hinterland, professors working in core regions and the urban hinterland are less likely to choose community engagement and activities contributing to the social life in the region. This result seems to be in line with the relevance of mid-range universities for the periphery suggested by prior case studies. In some of these regions, universities constitute major employers and drivers of local economic development and are highly relevant for the regional community.

Thirdly, the general level of socio-economic development or, more precisely, the wealth of the surrounding region was found to have a non-linear influence on the choice of certain types of activities. The types of activity found to be most sensitive to the socio-technological development stage of the surrounding region are the external use of university facilities as well as activities in regional engagement and leadership. Additionally, a similar relationship could be determined for consulting activities. So far, we find few precedents for these results in other studies, at least in a comprehensive sense. When combining the case study-based findings summarized in section 2 one can assume that we are witnessing the overlap of two different effects – supply and demand for regionally-oriented activities as well as two different types of social capital generation. Firstly, highly developed regions with local networks, communities and complementary value chains provide the seedbed for regional engagement, enabling researchers to choose out of a set of local engagement opportunities. Secondly, in weakly developed and lagging regions communities and local institutions rather call for engagement and activities of their local faculties. Thus regionally-oriented activities emerge as a result of both socio-economic necessity and individual researchers' motivation to support the local community.

The propensity to focus on local research co-operations or personnel exchange is not found to depend substantially on any aspect related to the regional environment's characteristics. Previous findings show that the choice of partners in research co-operations is not in first line driven by local availability of partners, but rather by partner characteristics and complementarities between each others R&D profiles. Arguably, the availability of regional research partners depends on factors other than mere economic well-being or centrality of urbanisation.

6 Summary and Conclusions

This study is the first approach to integrate a broad concept of regionally-oriented activities with a multi-dimensional perspective on influences on scientists' decisions between those. In doing so, it aims to advance the discussion on the role played by universities within their local communities. The findings highlight the interplay between autonomous academics intentions and the opportunities provided by the local environment as main drivers for regionally-oriented activities.

In more detail, this paper finds that personal motivations do play the expected clear role in explaining the decisions of individual researchers to engage in a certain type of regionally-oriented activity. The individual researcher's disciplinary background, in contrast, seems to play a less clear-cut role than expected, as does the organisational background of the university. Whereas most general trends suggested by the literature were confirmed, substantial variation remains within academic fields and similar university types.

The nature of the university's regional environment, in contrast, seems to play a more relevant, albeit more complex role than generally acknowledged. By taking a broader view of regional activities than previous studies, we confirmed that many opportunities for regional engagement are by no means limited to central or economically well-off regions. On the contrary, the results clearly indicate that consulting and regional engagement plays a central role in both peripheral and economically less well-off regions. The tendency to get involved in research co-operation, which might have been expected to depend on a well-developed environment, does not appear to depend on the regional environment at all.

In short, this study seems to confirm the general validity of its two main assumptions: the relevance of the range of opportunities and the factors influencing academics' choices between them. Overall, the analysis provides evidence of a highly individualised and idiosyncratic process of decision-making about regionally-oriented activities. It underlines the assumption that independent researchers make opportunity-based decisions, while the influence of their organisational and disciplinary backgrounds is less obvious than expected. What really seems to matter is the extent to which their individual preferences resonate with both the challenges faced or the opportunities provided by their local environment.

Consequently, this study's findings underline that the manifestation of a university's "third role" is based to a large degree on the prevalence of certain individual motivations. In contrast, the association between a specific disciplinary background and the

preference for specific types of activities is more tenuous than sometimes assumed. As a result, even the effects of managerial actions in a specific faculty become difficult to predict – so that no type of "third role" can be developed in a straightforward manner by means of top-down management.

Additionally, this study highlights the prominence of regionally-oriented activities at teaching colleges (and other universities) in peripheral and economically less well-off regions. In these regions, academics develop a pronounced tendency to publicly engage, offer consultancy and contribute to the social life of the region, a finding which has so far received far too little academic attention.

To conclude, it should be mentioned that this study was conceived to explore an area not yet empirically charted. As such, it can at best form the basis for more detailed considerations of individual impact factors in future studies.

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