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Forms and regional distribution of knowledge transfer by German universities

A representative case study for Jena, Thuringia

by

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Abstract

For the first time the transfer activities of two different German university types – the Friedrich Schiller University (FSU) and the University of Applied Sciences Jena (FH Jena) – were documented in parallel over all departments and channels of technology transfers with regard to their regional significance. Five groups of transfer activities are distinguished in the study: (1) those oriented on human capital, (2) those oriented on classic research and development, (3) those oriented on enterprises, (4) those oriented on direct transfers and (5) informal knowledge transfer channels. The results show that the traditional R&D-activities of the universities for the region are embedded into important supplemental transfer channels. In addition the radii of the external relations of the two universities are complementary: FH Jena has a stronger regional bearing, while FSU is more strongly active supra-regionally and internationally. It is possible that stronger support of the university faculty's activities establishing knowledge transfer could increase the regional economic impact of such activity.

JEL classification: O32; R11; I20

Key words: innovation systems; technology transfer; regional development; Universities; know-how-transfer

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1 Introduction

In economic literature it is indisputable that in the medium and especially in the long-term the production factor knowledge is of paramount importance for economic growth. Knowledge is the basis for production of exacting consumer- and investment goods as well as the basis of the high order supply of services. Knowledge is beyond that the prerequisite of the production of new knowledge – thus the source of product and process innovations. This is the result of the increasing dynamics of technical progress as well as the increasing complexity of the innovation processes.

In the last years thereby two questions moved more strongly into the field of vision. First of all the strongly diverging regional distribution of knowledge production and accompanying with it the concentration of growth of development centers, lighthouses, innovation systems or clusters has been increasingly discussed. Secondly it became clear that universities and public research institutions gain greater significance in these innovation and growth processes. In this context what has been discussed on political and economic grounds above all is how the transfer of the knowledge from the universities and public research institutes can be improved, in order to increase regional and national economic growth.

A representative survey of the professors of the two universities in Jena - Friedrich Schiller University (FSU) and the University of Applied Sciences Jena (FH Jena) - was accomplished in the winter semester 2004/2005. In this empirical investigation the knowledge transfer from the view of the university faculty was documented. The discussion paper at hand places the selected investigation approach in context and shows the first results of the inquiry.

The paper is structured as follows: The second chapter contains a short overview of the results of existing relevant studies and the consequential problem definitions of the survey. Chapter three describes the empirical investigation concept. Some important results of the work are reported in chapter four, and chapter five contains a summary as well as an outlook of further questions.

2 Knowledge transfer from universities

2.1 Knowledge transfer as university performance

Each analysis of knowledge transfer from universities deals first with the problem that the achievements extract themselves from the university because of their multitude and heterogenicity of a simple description. The systematic contained in Overview 1 differentiates between "infrastructure, indirect and direct transfer". "Infrastructure transfer" summarizes forms of transfers that contain no personal contact between the bearers of knowledge and that arise as a "by-

product" of the existence of a university. The "indirect transfer" describes the kinds of transfer that result directly from the primary tasks of a university – research and teaching – but that do not require direct participation of the producer for the reception of knowledge.

These are – as one of the main sources of the transfer – the graduates of a university, who take the knowledge acquired in the university as human capital to their jobs. To this belong also the results of research activity, which results in publications and patents. The latter can transfer knowledge without the producer having to be involved. However, the study at hand confines itself to the types of transfers that are immediately connected with personal engagement by college faculty. These are described as "direct transfers."

- Overview 1 about here -

Common to all three forms of transfer is that they result from the production of knowledge, thus the output of a university. In literature about the economic effects of universities they are also called "supply effects" (Franz/Rosenfeld/Roth 2002).¹

2.2 Knowledge transfer and regional economic development

Local universities and public research institutions as substantial bearers of knowledge production have a fundamental influence on the competitiveness of a region. This became clear with the development of Silicon Valley and the role that Stanford University played in this process (Saxenian 1994, Jaffe 1989). In the framework of regional economic policy, stimulation of industrial growth centers in innovative fields and of regionally-focused public research institutions is attempted in many countries following this model². Independent of the politico-economic relevancy of the Silicon Valley case study, a number of representative empirical studies show that universities are of importance for innovation capabilities and thus for the competitiveness and economic growth of a region.³ The regionally concentrated and mutual co-operation of businesses and public research institutions is thereby discussed in the literature under the term "regional innovation systems" (Fritsch 2003). The theoretical foundation of this observation is seen in spatial external effects – the so-called local spillovers. These local spillovers consist of know-how flows from public research institutions of one region to the firms of this region.

The relevance of a university for firms in its directly surrounding region is theoretically not obligatory (Hall/Link/Scott 2001). Firstly know-how spillovers do not take place automatically but are the result of intentional individual actions (Breschi/Lissoni 2001, Zucker/Darby/Armstrong 1998). Secondly these flows of information with regard to university research through scientific journals and publications are accessible everywhere – nowadays by e-publishing and Internet even in real time. Thirdly university graduates as a central carrier of the knowledge transfer are in principle regionally mobile and this probably with increasing

tendency. Spatial proximity (“Co-location“) might therefore also be of a rather small or decreasing importance (Balconi/Breschi/Lissoni 2001). Empirical studies show that at least the importance of universities for innovation capability and economic growth in one region is very different.

2.3 Problem definition and investigation approach

An analysis of preconditions under which a university generates stimulating effects on the economy for innovations, value added and therefore jobs is – this can be confirmed as a robust result of previous research – only reasonable with a more detailed observation of different types, forms and transmission channels of know-how spillovers (Breschi/Lissoni 2001, Fritsch/Franke 2004). First of all it is necessary to supplement the research so far strongly business-based with an appropriate university-based empirical analysis because for a successful process both sides have to cooperate. For this university-based investigation of know-how spillovers so far only a few examples exist (Hussler/Ronde 2003, Agrawal/Henderson 2002). In the Federal Republic of Germany appropriate research projects for individual regions are just at the beginning (Franz/Rosenfeld/Roth 2002, Rosenfeld/Roth 2004), however not in the region of Jena and eastern Thuringia. Secondly the micro-economic context of knowledge spillovers must be considered as the individual participants are analyzed (Audretsch/Fornahl/Zellner 2005): The actions of individuals underlying the transfer processes result from incentives and restrictions of self-interest-oriented behavior.⁴

The history of the economic region of Jena could serve as a model in terms of the importance of universities in the innovation power and competitiveness of companies in this location. The rise of Carl Zeiss as a leading firm of the optical-precision mechanical industry goes back to the cooperation between the entrepreneur Carl Zeiss and the scientist Ernst Abbe.⁵ Thus the choice of the location of Jena for an empirical survey is of special interest. Different surveys for the region of Jena are accomplished on the level of firms. These surveys confirm the hypothesis of a special relevance of local universities for companies (Cantner/Fornahl/Graf 2003, Cantner/Helm/Meckel 2003). A corresponding analysis on the level of universities has not existed before now.

This research project is concerned with know-how flows from universities to firms for the city and region of Jena. For that reason all relevant knowledge transfers of the Friedrich-Schiller-University and the University of Applied Sciences Jena will be taken under consideration. Under three aspects this approach goes beyond most available investigations. 1) First of all not only know-how transfer relations that are technology-oriented or have innovations to the consequence will be taken into consideration. All faculties and specialist areas are included, not only as often usual those scientifically technical faculties as well as the economic sciences. Newer investigations suggest that a comprehensive analysis in regard to the variety of possible effects is appropriate

(Schartinger/Rammer et al. 2002). 2) Secondly not only businesses but also public research institutions, the public administration and other institutions will be taken in consideration. Recently a set of empirical investigations refer to the importance of the transfer relations between universities and public research institutes (Fritsch/Schwirten 2002). 3) Thirdly in principle a complete inventory of the possible transfer relationships takes place. The restriction in some kinds of transfer, which can be found in the existing investigations, or their aggregation in abstract categories (for example formal - in-formal relations) does not come up to the expectations of variety and complexity of the possible transfer channels (Audretsch/ Stephan 1996).

The empirical inventory is to supply a complete as possible picture of the knowledge exchange for the university town of Jena as the transmitters and the receivers as well as the transfer channels.

Content wise the cognition leading interests for the survey from the briefly reported relevant hypotheses of the literature arise; in addition to the following questions:

- *Which kinds of transfer relationships are maintained between the universities and their environment?*
- *Which radius does the knowledge offer transferred by the universities have?*
More precisely: Is the transferred knowledge offered by the universities tend aimed to a significant extent at recipients in Jena's region?
- *Can significant differences in regard to the radii/scope by the different kinds of transfers be determined?*
- *What types of transfer partners (enterprises, public research institutions, public administrations and so on) are distinguishable?*
- *What were the defining moments for the establishments of transfer relationships?*
- *What differences exist between the university types (University, University of Applied Sciences [Fachhochschule]) regarding to these questions?*

3 Empirical investigation concept

Jena is characterized spatially by a high concentration of public knowledge production, which, beyond a set of research institutions including various Max Planck institutes, facilities of the Fraunhofer and of the Leibniz Society, takes place particularly in the two universities. The Friedrich Schiller University with approx. 20,000 and the University of Applied Sciences Jena with approx. 4,400 students are the largest universities of their type in Thuringia. The investigation differ from existing empirical investigations in so far that the individual independent scientists at the universities represent the investigation unit, thus not

the universities as a whole or the faculties and/or departments. Somewhat simplified, all professors of the two universities were considered as independent scientists, independently of their classifications. They cover therefore the range of the older C2 to C4 as well as the newer W1 to W3 levels. In this demarcation the population in WS 2004/2005 exists altogether of 464 professorships – 340 professors at FSU and 124 lecturers at the University of Applied Sciences. Thereby professorship includes all departments and/or faculties at both universities. For FSU there are ten departments, covering the class offerings of a classic full university. In the case of FH Jena, there are eight departments with an emphasis on the engineering sciences supplement by the subjects of business administration and social work (see appendix 1).

To get a representative picture of this population, a sample was drawn on the scale of a third of all professorships in which a two-step random selection was carried out. The first level of the stratification differentiates according to the two university types. The second level corresponds to the departments and/or subject areas, in order to guarantee their representation in the sample.

The execution of the empirical inquiry took place in the form of personal interviews in the period from November 2004 until March 2005. The individual interviews had a length of approx. 40 to 60 minutes. 174 interviews were able to be carried out and considered, which equals 37.5 % of the population. 27% are allotted from FH Jena with a share of 26.7% in all professorships and 73% from FSU, compared with a share in the total amount of 73.3%, (see appendix 1). The subject areas and schools correspondingly also appear roughly representatively in the sample. An undistorted representation of the professors of a department and/or a subject area was guaranteed in principle by a random sample within the respective institutional unit.⁶

4 Size and intensity of knowledge transfer

In the expert survey of professors from the Friedrich Schiller University (FSU) and University of Applied Sciences (FH) Jena one of the central questions concerned statements about the types of transfers in general. One asked for a broad pallet of possible activities related to transferring knowledge to enterprises and facilities outside of the public science area. The demand transfer activities were not restricted only to *research and development* (R&D) in the classical sense, e.g. the execution of R&D contracts, of test work orders and appraisals as well as the execution of common research and publication projects with external partners. Instead transfer channels of knowledge other than pure R&D were also included:

Activities through which the aspect of the teaching is seen in the sense of the formation of human resources in the foreground: according to the approach the support of extramural internships or seminar and project work as well as of scientific degree work to this *human resources oriented* transfer channel also be-

longs of knowledge. It can also be counted in addition that university teacher – in the sense of contact preparation – intentionally place particularly excellent graduates at qualified jobs or actively support the exchange of talented young scientists with facilities and enterprises outside the public university area.

Activities, by which university teachers become active as managers, mentors or entrepreneurs: thus in the role of managing directors and executive boards, as supporters of the out and reestablishment of enterprises of own students, graduates and scientific coworkers or as founders of own enterprises and facilities. This *enterprise-oriented* channel could have a not underestimating meaning for the knowledge transfer into a region.

Immediate transfer channels transport education and further education performances to a target audience outside of the universities or exist from the offer of workshops, colloquiums and conferences. Personal contract-bound activities such as advisor or referee outside of the university could be part of it.

Not to be forgotten are the *informal* transfer activities of the university teachers, designated in the questionnaire as "Personal activity not bound by contract outside of the university" and covering, for example, participation in workshops etc. as well as distribution of information by telephone, contributions in discussions and honorary and other advisory activities.

4.1 The most important transfer type

After the professors gave detailed information covering the types of knowledge transfers and the level of intensity (based on their actual work expended) they practiced on average during the years 2002-2004, they were asked in summary again if they could mention "the most important transfer activity, i.e. the most time intensive." The following first table presents the answers, in order to focus on the subjective main points of interest, before more subtly differentiated considerations are carried out.

- Table 1: The most important transfer types - about here -

As their most important transfer activity, the professors at universities in Jena named altogether:

- 25.6% joint research and publication projects
- 15.6% research and development orders and
- 11.3% personal activity not bound by contract.

At first an unequivocal emphasis is globally revealed on traditional R&D activities. Another picture arises, however, if the university lecturers of the University of Applied Sciences and Friedrich Schiller University are differentiated.

The support of scientific degree work takes with 25.5% an outstanding position as a channel of knowledge transfer at FH Jena as opposed to FSU. The execution of research and development orders ranks here only in second place with

14.9%, and with 12.8% each the realization of common research and publication projects as well as the supply share third place with further education and education performances as the most important types of transfers.

In contracts, for the faculty of Friedrich Schiller University – as for the entire sample dominated by them – the execution of common research and publication projects is the most important kind of transfer (31%). In second place for them is, as for FH Jena, the execution of research and development contracts, with 15.9%, and in third place with 15.0% is, as already described above, "personal activity not bound by contract," which can be also be classified as informal transfer activities.

Here already an important difference between the university teachers appears between FH Jena and FSU: For the former, supporting thesis work plays an outstanding role, while for their colleagues at the latter classic research and publication projects have a central significance. This is to be explained probably by the fact that at the University of Applied Sciences production and transfer of knowledge are closely connected with the training and application orientation of this university type. Not to be overlooked is the fact that much diploma and bachelor work at FH Jena refers often to the economic, social or technical practice.

4.2 Intensity of the practice of transfer types

Beyond the problem of which kinds of transfers are exercised mainly, to what intensity the survey subjects pursued the transfer activities is also of interest. These details should be consistent with the statements made by them regarding the most important transfer type.

- Table 2: Intensity of the practice of the transfer types -

The picture, delivered by in the answers to the question about the most important kind of transfer, is confirmed in the central points by the data about the intensity with which all sixteen given transfer types are exercised: This yardstick, scaled from 0 to 5, makes clear the outstanding intensity with which the professors of the FH care for the graduate work of their students: 2.8 is here the mean average value, considerably higher than the comparable number of their colleagues of the FSU at 1.0. Therein – apart from the pronounced practice orientation of the FH study – the nearly complete absence of an academic central tract at the Jena University of Applied Sciences is expressed: The professors of the FH are dependent on the diploma thesis of advanced students as an instrument of research. The human resources provided with their professorships permit the professors of FSU to devote themselves to common research and publication projects considerably more intensively, represented in this question with a value of 2.2 (FH: 1.7) as the most time-consuming kind of transfer.

The high rating of informal knowledge transfer channels indicates that at both universities, the "personal activity not bound by contract" is measured by the

time intensity spent on it, and consequently for the sample altogether even with a value of 2.2 stands in first place: Informal activities therefore play a central role in the actual knowledge transfer.

The comparatively high practice orientation of FH Jena will be clear as the support of internships comes directly in third place for the professors there – based on the time intensity of this kind of transfer – while on a comparable rank at FSU the offer of workshops, colloquiums and conferences was mentioned.

4.3 The regional distribution of knowledge transfer

The regional distribution of the transfer activities of the Jena professorate is considered below, first only as a whole and without consideration of the intensity to which the particular kinds of knowledge transfers were exercised. Following, and now with consideration of the intensity to which the particular kinds of transfers were exercised, the profile of knowledge transfers in the individual target areas is represented more exactly.

4.3.1 A first overview

A first overview of the distribution of transfer activities in different regions shows already a remarkable result: a pronounced regional bearing on the city of Jena (on average 26% over all transfer types) and/or on the Free State of Thuringia (altogether approx. 46% over all kinds of transfers) have those kinds of transfers that refer to the area of managing director or executive committee activity, the establishment of one's own business or the support of new and outsourcing of enterprises and other facilities outside of the public science area. Graduates in Jena positively affect the establishment of businesses and enterprise activity in the city and the Free State. Probably this is a momentum that is not to be undervalued that comes from the universities to the benefit of the region's competitiveness and its growth prospects.

- Figure 1: "Regional distribution of the transfer types altogether -

A second, human resources-oriented transfer field of strong regional importance is the support of seminar, project and degree work (considered to be contact with the non-academic area); a third transfer field, with further education and education services as well as workshops, colloquiums, and meetings, is the direct supply for a extramural audience. In a remarkable way doctoral theses also have a strong regional relationship with city of Jena and the Free State of Thuringia.

4.3.2 The intensity of knowledge transfer to region

The special significance of the knowledge that is offered and transferred by the universities on the economic development of a region is in the center of research interests. This time, the individual transfer types were weighted with the time intensity with which they were actually performed. This permits a more

precise statement about what the professorship actually do for the particular target regions and at what effort. In order to determine the specific transfer profiles, beyond that we differentiate the individual university types.

Figure 2 represents the results more exactly for the target area of the city of Jena.

- Figure 2: Knowledge transfer of FH Jena and FSU within the City of Jena -

It reveals a clearly urban reference for the transfer activities of the University of Applied Sciences Jena: these put a unambiguous emphasis in its practice not only on the human-capital-oriented channels of the knowledge transfer in the city (support of extramural practical courses, seminar and work on projects as well as scientific theses) but served also clearly more strongly than the University of the classical transfer channels of the research and development in favor of extramural enterprises and faculties in the city of Jena. The latter applies particularly to the temporary exchange of scientists as well as the execution of contracts. A not surprising exception represents the support of doctorate purposes which turns out to be fundamentally more difficult at FH Jena than at FSU.

On the other hand the university puts a greater emphasis on enterprise-oriented transfer activities. Particularly the foundation of one's own enterprise seems in comparison to the considerably lower such efforts of their FH colleagues, to be their domain.

- Figure 3: Knowledge transfer of FH Jena and FSU in Thuringia without Jena -

Figure 3 reveals a remarkable and relevant profile of the knowledge transfer of universities in Jena – beyond city limits for the entire Free State of Thuringia. Intensive activities are unfolded by the professors in almost the entire spectrum of the transfer channels. The only exception is the foundation of one's own enterprise here, which brings up the rear. At the same time considerable efforts, however, start out from the college lecturers for the support of founding new businesses or outsourcing for their students, graduates and employees.

Also both universities offer a large scale of further education and education services such as workshops, colloquiums and meetings in the Free State.

Also the R&D-oriented transfer activities occur at both universities on a high level, although it is noticeable here that FH Jena carries out the execution of R&D contracts within the borders of Thuringia with particular intensity.

The same applies for the activities of the rather human-capital-oriented FH professorate: the support of extramural internships, seminar and project work as well as of scientific theses with regional regard. In addition, the temporary transfer of scientific staffers into and from extramural enterprises and facilities in Thuringia obviously belongs to the specific profile of the University of Applied Sciences Jena.

- Figure 4: Knowledge transfer of FH Jena and FSU to Germany beyond Thuringia -

Figure 4 shows that, on the other hand, the University dominates obviously at the research- and enterprise-oriented transfer activities within Germany outside Thuringia, although FH Jena also maintains intensive R&D-oriented transfer activities within this region. Remarkable deviations from the general transfer profile in favor of FH Jena are to be observed however with the human-capital-oriented transfer activities "extramural internship" and "final paper".

- Figure 5: Knowledge transfer of FH Jena and FSU abroad -

The central message of Figure 5 is that the international transfer activities of the Jena university faculty concentrate only on a few particular transfer activities. Here the temporary scientist exchange is to be emphasized, which is noticed equally intensively in both universities, as well as the execution of common research and publication projects and of workshops, colloquiums and conferences, two fields of activity clearly dominated by the University. However, enterprise-oriented transfer activities take place in the international frame almost not at all.

4.4 Distribution of transfer activities by types of partners

Knowledge transfer takes place with different types of partners. At first scientists of other universities are to be named as the obvious ones involved in today's complex research business. Cooperation with scientists of other universities, relating to the temporal size of all transfer activities with an average of 45%, has the greatest relevance (see table 3). In the current theoretical and political discussion of transfer activities two other partners have moved into the center of discussion. On the one hand, different publications point to the importance of the transfers with research facilities of other public science areas. For example, the Max Planck institutes, member facilities of the Leibniz Company and Fraunhofer institutes are included. Measured against all of the transfer activities there are such partners involved with 17%. On the other hand, the increased cooperation with business has been brought to the universities as a science political demand. The direct usefulness of universities in their role as knowledge carriers for such "external faculties" refers thereby not only to the accelerated conversion of knowledge of the universities to innovations of the enterprises but also to the co-operation of the universities with other facilities – such as hospitals, the Ministries of Economic Affairs, city administrations or nursing facilities. On the average of 36% of all transfer activities aim at such partners outside the public university and science area.

- Table 3: Partner types and subject groups of the different universities -

A more exact analysis reveals clear differences between the types of universities and subject areas. A particularly high orientation of transfer relationships with enterprises and administrations outside of the public science area shows

the University of Applied Sciences with 53% of all transfer activities. At the University this has a value of 30%. The examination also permits the closer analysis of the question as to whether such differences can be explained alone by the differences in the specialist orientation of the two academy types. Considering the special fields of "law, economy and social sciences" represented at the two universities as well as "mathematics and computer science" there is above all, with 64% of all transfer activities, law -, economics and social sciences at the University of Applied Sciences, which maintains transfer relations with enterprises and administrations. The corresponding value for FSU amounts to 37%. For mathematics and computer science 43% of the transfers are carried out at FH Jena with partners outside the public science area while it is merely 26% at FSU.

Two conclusions are obvious on this basis. Firstly, the results confirm the different orientations of the two university types: The FSU has a dominating emphasis within the range of the scientific research; the FH Jena molds itself by the practical orientation of its activity. Secondly for both universities the altogether quite high external orientation of the university transfers can be rated as an indication for the fact that the classical conception of the "scientific ivory tower" does not correspond (any more) to reality.

4.5 Development of the transfer activities

A rise in the transfer activities of the universities is a professed political-economic aim. To develop suitable instruments for the realization of this aim, at first an understanding must exist as to how transfer relations take place at all. Table 4 contains some fundamental information on this. After this an average of 43% of all transfer contacts go back to the professors' own initiative. Even more important with 48% are direct inquiries from businesses or institutions to the university lecturers. A comparatively small significance with 9 % belongs to indirect inquiries that are passed on to the professors, e.g. about the transfer of technology places. This result applies nearly unmodified when both universities are regarded separately.

- Table 4: Origin of transfer activities -

In the next step the circumstances or reasons that led to the professors taking the initiative on their own or to a direct inquiry from businesses or institutions are examined more closely. The corresponding question focuses on the origin of the first contact.

The range of these circumstances on the part of the professors reaches from applications to publications and common professional activity up to private contacts and recommendations by third parties (see table 5). With the relatively largest relevance as a defining moment for the self initiative of the professors aiming at a transfer activity are contacts resulting from conferences, workshops etc. (relevance of an average of 2.7 on a scale from 0 to 5). This result is valid

for both for FH Jena (2.6) and for FSU (2.7). The further reasons show partly differences between the two university types. While the common studies or work is meaningful at FH Jena this plays (2.7) a considerably less significant role (1.4) at FSU. The case lies the other way round with publications. These are more relevant as starting point of the transfer activities for the university teachers of FSU at 2.3 than for those of FH Jena at 1.8.

- Table 5: First contacts on the part of the professors -

Regarding the origins of direct inquiries of enterprises and/or facilities the same reasons as on the part of the university teachers are possible – with exception of the application and with addition of the transfer catalog and/or research report (see table 6). The results confirm nearly absolutely the results on the part of the professors. The category of the conferences, congresses and so on dominates also here with 2.7. Substantial differences between FH Jena and FSU exist, on the one hand concerning the publications (1.7 compared to 2.9) and on the other hand the common study or professional activity (2.3 compared to 1.4). These differences typical of the universities had already been stated by the professors and reflect the stronger research orientation of Friedrich Schiller University, which classically finds its expression in publications once again. Nearly without significance are transfer catalogs or research reports as a defining moment of a direct inquiry with a value of 0.6.

Table 6: First contacts on the part of non-academic firms and institutions -

In summary a conclusive picture arises for the origin of transfer contacts. The technical contact, which occurs however more ideally with a personal contact, is centrally important. The combination of both factors is made possible in the framework by conferences, congresses, fairs and workshops.

5 Summary and view

The work confines itself to the account of a part of the results of the interviews carried out at the universities in Jena -- further detailed evaluations will follow. Furthermore it is a first descriptive evaluation. In following analyses the data set will be used for the statistical check of a number of hypotheses on knowledge transfer.

Important results of the present work refer to the types of transfers, the regional distribution of the transfers as well as the initiation of transfer relations and the transfer partners.

With regard to the types of transfer, five groups of transfer activities are distinguished in the present first study: (1) those oriented on human capital, (2) those oriented on classic research and development, (3) those oriented on enterprises, (4) those oriented on direct transfers and (5) informal knowledge transfer channels. From this the following picture arises:

The entire sample showed a clear emphasis on the execution of common research and publication projects with enterprises and facilities outside the scholarly arena. Furthermore carrying out contracts for external research and development plays a central role in the two universities. Differentiated according to the university type it becomes clear that at FH Jena – as opposed to FSU – the support of scientific graduate work is much more important for knowledge transfer. These results were also confirmed by the details on the temporal intensity of the practice of the different transfer types.

An extremely important transfer channel for the professors at both universities is the informal, personal activities outside the university departments, unrelated to contract work, e.g., participation in workshops and conferences, answering inquiries by telephone, contributions to discussions as well as honorary and other advisory services. Furthermore the university faculty puts very different accents on their transfer activities, which range from human capital-oriented (support of student seminar and project work as well as offers for advanced training) to enterprise-oriented ones (launching one's own company, etc.).

In the case of the regional distribution of transfer relationships, a focus on the transfers to partners who are physically nearer to the universities results. The types of transfers that are performed correspond on the average to about 26% in the city of Jena, with about 46% in a regional orientation around the Free State of Thuringia. This is reflected in the fact that of all professors who exercise certain kinds of transfers, on average 26% are in Jena and 20% in the rest of Thuringia. The focus on the entire Free State Thuringia is particularly pronounced in the research and development activities of the FH Jena professors, while their colleagues at the FSU emphasized supra-regional, national and international activities.

With regard to the accomplishment of transfers it has to be noticed first that the professors in Jena are perceived outside the university as attractive transfer partners: 48% of the transfer activities have their origin in direct inquiries by enterprises and facilities of the university teachers carrying out such activities, and 43% start at colleagues' own initiative, while the procurement of transfer contacts plays a rather subordinated role in technology transfers with the universities at scarcely 9%. As a triggering moment content-wise for the accomplishment of transfers it can be stated that a single major way probably does not exist. Different starting points for the initiation coexist. However, the greatest relative influence belongs – independently of whether the contact originated with the university professor or from the practice – to departmental activities (meetings, conventions, trade fairs, study groups, etc.).

The investigation of the transfer partners showed an altogether quite high external orientation of the universities. Over 36% of all transfer activities were aimed at partners outside of the public university and scientific areas – such as businesses, administrations, social agencies, etc., and non-university research establishments constitute 17% of the transfer relationships. The strong practice

orientation of FH Jena showed up in the question about the partners of the transfer activities outside of the public scientific area: here 54% cooperate with external businesses and institutions while it is only barely 30% at FSU. This picture also is confirmed by a comparison within comparable subject groups. However health professionals at FSU and particularly engineers at FH Jena have a strong a strong practice orientation.

Altogether, it turns out that the results mentioned depend very strongly on the type of university (University of Applied Sciences [Fachhochschule] or University), on the branch and on the transfer type, so that the respective concrete transfer relationship of a college professor is the result of a complex interaction of different influence factors. Clear, however, will be the different yet complementary roles in Jena of the University of Applied Sciences and of Friedrich Schiller University in the arrangement of knowledge transfer in terms of content and region.

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Tables and figures

Overview 1: Forms of knowledge transfer

Infrastructure transfer

- Library

- Patent information centre

- Use of laboratories

- Use of buildings

Indirect transfer

- Graduates

- Publications

- Patents

Direct transfer

- Test work orders/ appraisal reports

- Project work/ diploma thesis

- Advisory activities/ business startups etc.

- Consulting

Table 1: The most important transfer type

Types of transfers	University of Applied Sciences Jena	Friedrich Schiller University Jena	<i>In total</i>
	N=47	N=113	N=160
(1) Internships	4,3	0	1,3
(2) Student Projects	8,5	1,8	3,8
(3) Final papers	25,5	1,8	8,8
(4) Ph. D. Theses	0,0	5,3	3,8
(5) Contact initiation between graduates and future employers	0,0	0,0	0,0
(6) Temporary transfer of scientists	2,1	0,0	0,6
(7) Research and/or Development assignments by firms or institutions	14,9	15,9	15,6
(8) Inspection orders and/or advisory opinions by and for firms or institutions	0,0	7,1	5,0
(9) Joint research and/ or publication projects with firms and institutions	12,8	31,0	25,6
(10) Activity as general manager and/or chief executive	2,1	1,8	1,9
(11) Founding of one's own firm/institution	0,0	4,4	3,1
(12) Promotion of start ups/spin offs	2,1	0,0	0,6
(13) Education services for firms or institutions	12,8	5,3	7,5
(14) Offering Workshops/colloquiums/conferences	0,0	5,3	3,8
(15) Personal activity bound by contract	10,6	3,5	5,6
(16) Personal activity not bound by contract	2,1	15,0	11,3
(17) Other	2,1	1,8	1,9

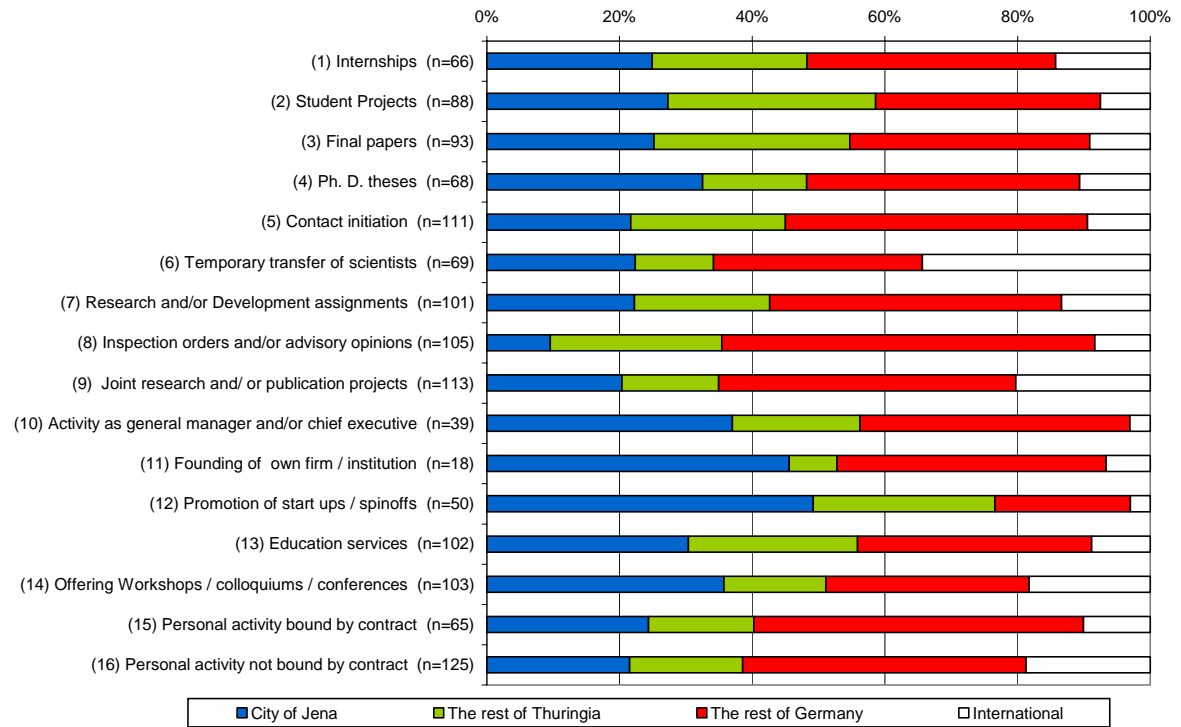
Source: Gerlach/Sauer/Stoetzer Expert survey FH and FSU Jena 2004/2005, frequency.

Table 2: Intensity of the practice of the transfer types

Kinds of transfers	University		
	University of Ap-	Friedrich Schiller	<i>In total</i>
	N=46-47	N=125-126	<i>N=171-173</i>
(1) Internships	2,0	0,7	1,0
(2) Student Projects	1,7	1,0	1,2
(3) Final papers	2,8	1,0	1,5
(4) Ph. D. Theses	0,4	1,4	1,1
(5) Contact initiation between graduates and future employers	1,8	1,3	1,4
(6) Temporary transfer of scientists	1,1	1,2	1,1
(7) Research and/or Development assignments by firms or institutions	1,8	1,8	1,8
(8) Inspection orders and/or advisory opinions by and for firms or institutions	1,1	1,6	1,5
(9) Joint research and/ or publication projects with firms and institutions	1,7	2,2	2,1
(10) Activity as general manager and/or chief executive	0,4	0,8	0,7
(11) Founding of one's own firm/institution	0,1	0,3	0,3
(12) Promotion of start ups/spin offs	0,5	0,5	0,5
(13) Education services for firms or institutions	1,4	1,6	1,6
(14) Offering Workshops/colloquiums/conferences	1,2	2,0	1,8
(15) Personal activity bound by contract	1,2	1,0	1,1
(16) Personal activity not bound by contract	2,0	2,2	2,2

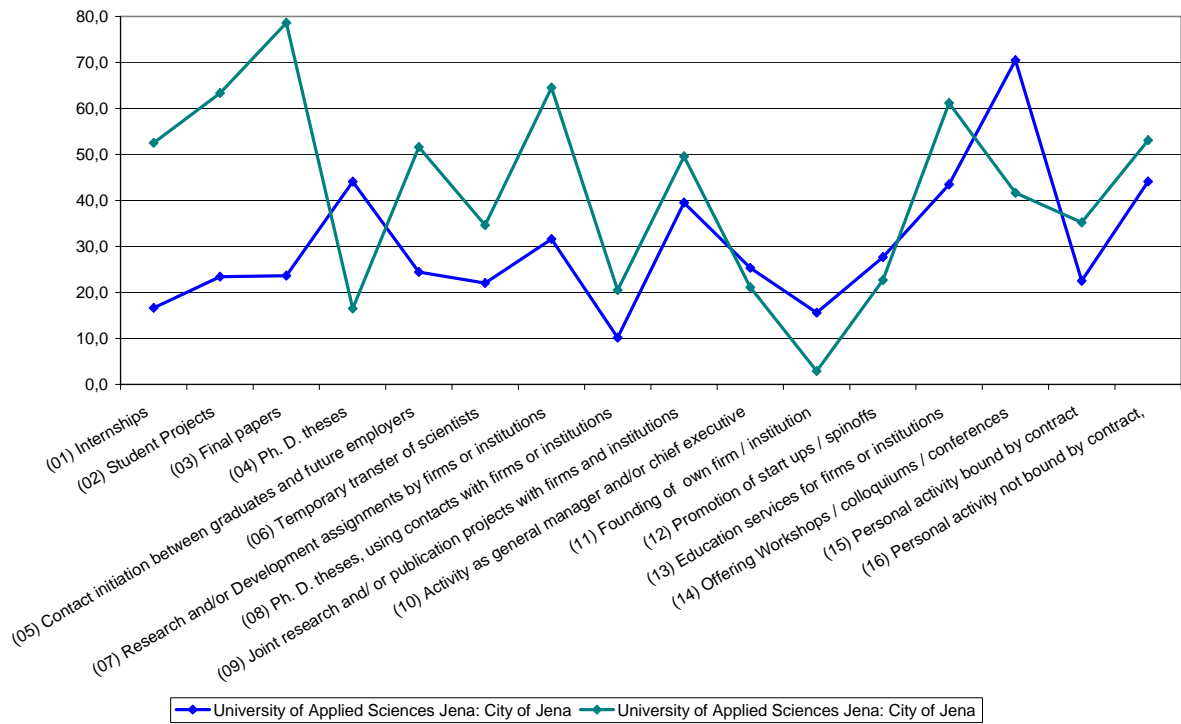
Source: Gerlach/Sauer/Stoetzer Expert survey FH and FSU Jena 2004/2005, Average value representation.

Figure 1: Regional distribution of the transfer types



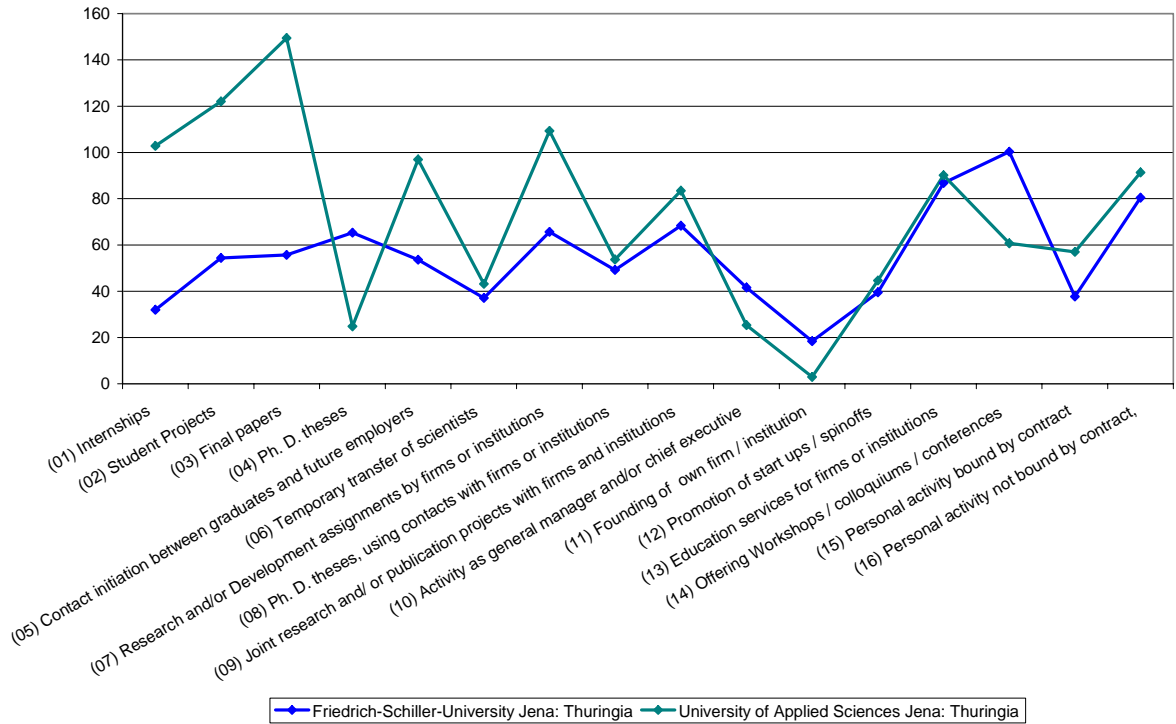
Source: Gerlach/Sauer/Stoetzer Expert survey FH and FSU Jena 2004/2005, in percent

Figure 2: Knowledge transfer of FH Jena and FSU within Jena



Source: Gerlach/Sauer/Stoetzer Expert survey FH and FSU Jena 2004/2005, Data weights with the practice intensity:
 Note: The correct wording for transfer type (08) is: "Inspection orders and/or advisory opinions by and for firms or institutions".

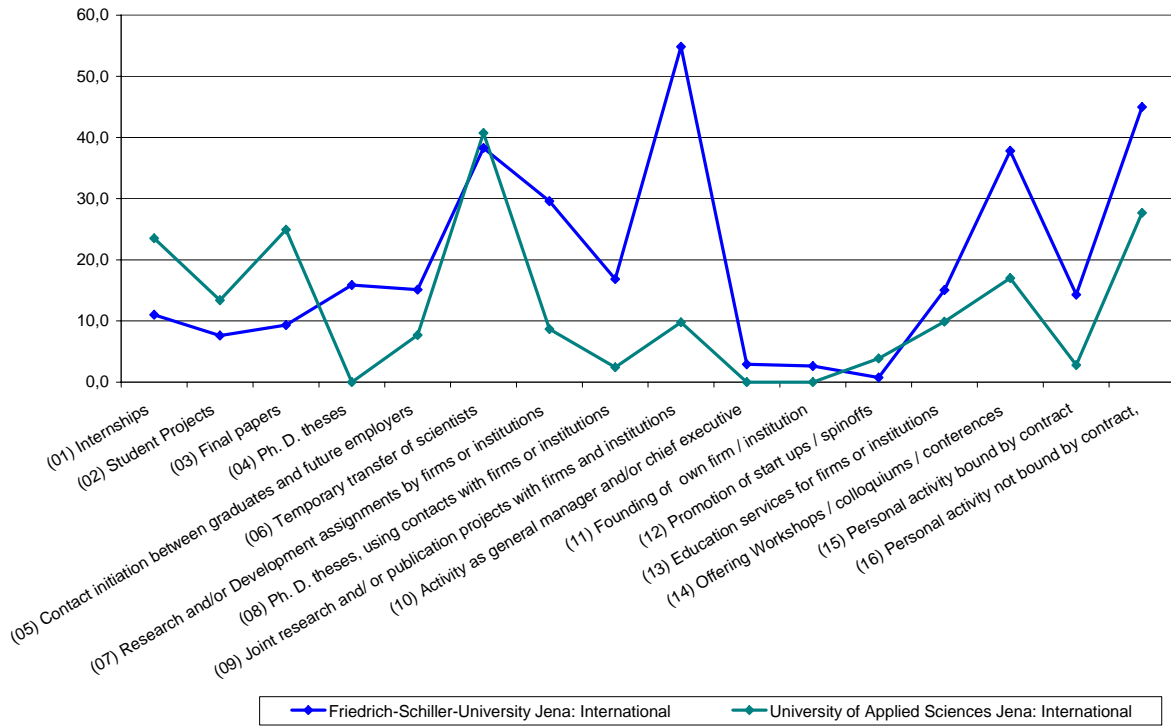
Figure 3: Knowledge transfer of FH Jena and FSU Jena in Thuringia beyond the city limits



Source: Gerlach/Sauer/Stoetzer Expert survey FH and FSU Jena 2004/2005, Data weights with the practice intensity:

Note: The correct wording for transfer type (08) is: "Inspection orders and/or advisory opinions by and for firms or institutions".

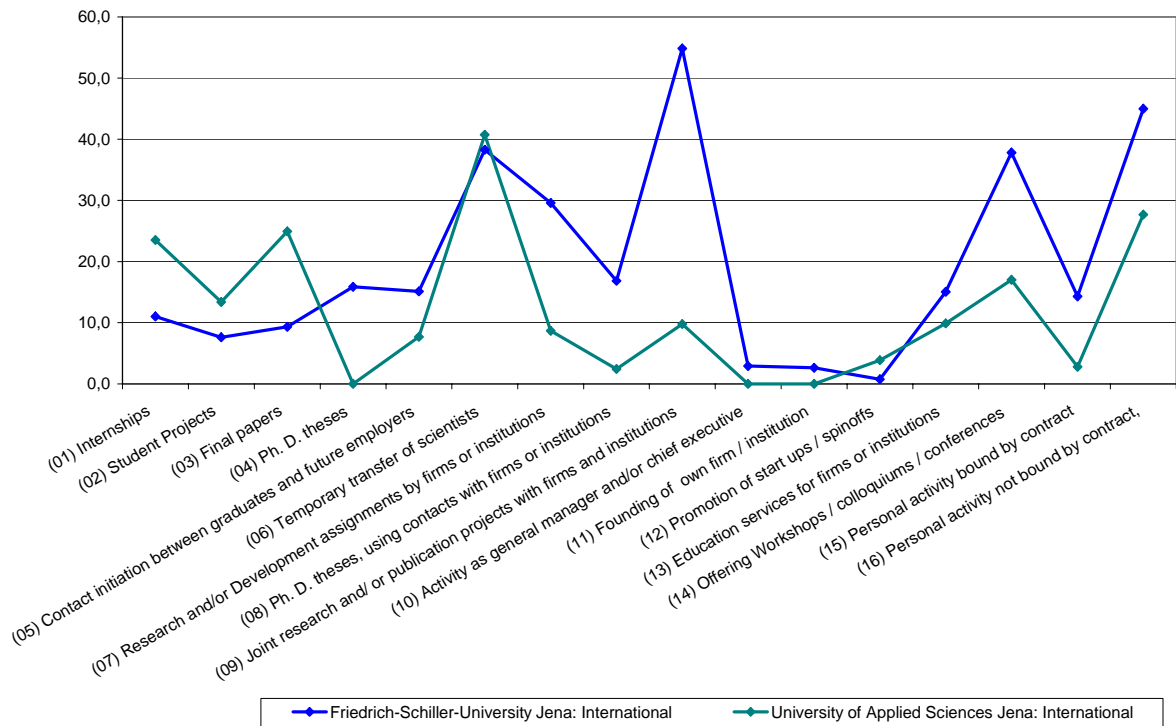
Figure 4: Knowledge transfer of FH Jena and FSU Jena to Germany beyond Thuringia



Source: Gerlach/Sauer/Stoetzer Expert survey FH and FSU Jena 2004/2005, Data weights with the practice intensity:

Note: The correct wording for transfer type (08) is: "Inspection orders and/or advisory opinions by and for firms or institutions".

Figure 5: Knowledge transfer of FH Jena and FSU abroad



Source: Gerlach/Sauer/Stoetzer Expert survey FH and FSU Jena 2004/2005, Data weights with the practice intensity:
 Note: The correct wording for transfer type (08) is: "Inspection orders and/or advisory opinions by and for firms or institutions".

Table 3: Partner types of the different universities and subject groups

University	Partner ...		
	Inside the area of public education institutions	Inside the area of other public research institutions	Outside the area of public research and education institutions
University of Applied Sciences Jena	29,5	13,9	53,0
Friedrich Schiller University Jena	51,6	18,3	29,7
<i>In total</i>	<i>45,3</i>	<i>17,0</i>	<i>36,4</i>

Source: Gerlach/Sauer/Stoetzer Expert survey FH and FSU Jena 2004/2005, Data in percent.

Subject groups	Partner of the University of Applied Sciences Jena ...		
	Inside the area of public education institutions	Inside the area of other public research institutions	Outside the area of public research and education institutions
Law-, economic- and social sciences	22,0	7,7	63,6
Mathematics and informatics	41,7	15,5	42,7
Engineering sciences	30,4	19,7	48,5
<i>In total</i>	<i>28,4</i>	<i>14,2</i>	<i>54,0</i>

Source: Gerlach/Sauer/Stoetzer Expert survey FH and FSU Jena 2004/2005, Data in percent.

Subject groups	Partner of the Friedrich Schiller University Jena ...		
	Inside the area of public education institutions	Inside the area of other public research institutions	Outside the area of public research and education institutions
Language- and culture sciences	55,9	15,5	26,8
Law-, economic- and social sciences	45,9	17,6	36,5
Mathematics and informatics	50,9	23,5	25,6
Human medicine	50,8	13,1	36,0
<i>In total</i>	<i>51,6</i>	<i>18,3</i>	<i>29,7</i>

Source: Gerlach/Sauer/Stoetzer Expert survey FH and FSU Jena 2004/2005, Data in percent.

Table 4: Origin of transfer activities

University	Origin of transfer contacts in the most important kinds of transfers		
	On the professor's own initiative with companies/institutions	Direct inquiries by firms/non-university institutions to the interviewee	Indirect inquiries by firms/institutions; to the university or department and forwarded to the interviewee
University of Applied Sciences Jena	42,5	49,4	8,1
Friedrich Schiller University Jena	43,2	47,6	9,1
<i>In total</i>	<i>43,0</i>	<i>48,1</i>	<i>8,8</i>

Source: Gerlach/Sauer/Stoetzer Expert survey FH and FSU Jena 2004/2005, Data in percent.

Table 5: First contacts on the part of the professors

By the professor's initiative with companies/ institutions	University		
	University of Applied Sciences Jena	Friedrich Schiller University Jena	<i>In total</i>
Application to tender	0,6	1,1	<i>1,0</i>
Conferences, conventions, fairs, research groups, workshops, seminars	2,6	2,7	<i>2,7</i>
Publications in Scientific Journals/Media/Internet	1,8	2,3	<i>2,1</i>
Joint years of study/assistance time or job with contact person or other employee of firm/institution	2,7	1,4	<i>1,8</i>
Private contacts	1,4	1,2	<i>1,3</i>
Recommendation by third party	2,3	1,8	<i>1,9</i>

Source: Gerlach/Sauer/Stoetzer Expert survey FH and FSU Jena 2004/2005, Average value representation.

Table 6: First contacts on the part of non-academic firms and institutions

Direct inquiries by firms/non-university institutions to the interviewee	University		
	University of Applied Sciences Jena	Friedrich Schiller University Jena	<i>In total</i>
Conferences, conventions, fairs, research groups, workshops, seminars	2,5	2,8	2,7
Publications in Scientific Journals/Media/Internet	1,7	2,9	2,5
Joint years of study/assistance time or job with contact person or other employee of firm/institution	2,3	1,4	1,7
Private contacts	1,1	1,0	1,0
Recommendation by third party	2,4	2,5	2,5
Transfer catalog/Report of research of the University	0,6	0,6	0,6

Source: Gerlach/Sauer/Stoetzer Expert survey FH and FSU Jena 2004/2005, Average value representation.

Table 7: Structure of the Faculties at the Friedrich Schiller University Jena, WS 04/05

Faculty	Professors
Biologically pharmaceutical faculty	30
Chemically - geoscientific faculty	33
Faculty of mathematics and informatics	31
Faculty of social- and behavior sciences	38
Medical Faculty	70
Philosophical Faculty	71
Physical-astronomical Faculty	21
Jurisprudential Faculty	19
Theological Faculty	10
Economic science Faculty	17

Table 8: Structure of Departments at the University of Applied Sciences Jena, WS 04/05

Department	Professors
Business Administration	18
Electrical engineering/ Information technology	13
Fundamental sciences	15
Mechanical engineering	6
Medical engineering	16
SciTec (Precision - optics - materials - environment)	22
Social sciences	20
Industrial engineering with business studies	14

¹ At the same time effects result from the expenditures of the universities - the so-called demand effects and reputation effects as the recapitulated expression of the effects of a university on the attractiveness of a location.

² Martin/Scott 2000, for Germany: Schmoch/Licht/Reinhard 2000, Wagner 1990.

³ Audretsch/Lehmann/Warning 2003, Branstetter 2000, Varga 2000, Feldman 1999, Zucker/Darby/Brewer 1998, Jaffe 1989). For Germany see Pfähler/Clermont/Hofmann (1998) and Funke/Niebuhr (2005).

⁴ This usual micro-economic approach does not exclude that categories such as confidence and reputation are important especially for the long-term transfer relations.

⁵ That in reverse also the development of universities in Jena was highly pushed by the Carl Zeiss company clarifies one endogenous problem so far unaccounted for in empirical studies because the research activities of universities are used as exogenous explanatory factor in all analyses.

⁶ The pre-determined interviews could not be realized in every case. Apart from coincidental influences (illness, research free term and so on) interviews were also refused. With the denials the reference to relevance lacking of a subject's own transfer activities played a role. This could not be eliminated in all cases by the reference to the interest of realization of a pure inventory without normative background or threatening (university) political sanctions. The selection of the professors exhibits therefore a slight bias towards an over-estimation of the transfer activities. Compared with other existing investigations this distortion is still small.

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