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The Impact of Public Research Units on Regional Innovation Processes and Regional Economic Development

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***The Impact of Public Research Units
on Regional Innovation Processes
and Regional Economic Development***
*A case study on the role of distance for knowledge transfers**

by

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JEL-Classification: R1; H4; 03

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Abstract

It is well-known today that innovation activities of private firms play a significant role for economic growth in less-developed regions. There are many studies on these interrelations and on explaining how regional innovation processes are working and which factors are important for them. However, some important questions have still not been completely answered by these studies. One of these questions is that of the role of public research units (PRU, which include publicly financed universities and research institutes) in the process of regional innovation. There have already been several studies on the economic impacts of selected PRU on economic growth. But it is not comprehensively answered so far to what extent the impact on economic growth of a PRU is concentrated on the region where the PRU itself is located. In other words: Whether the “knowledge transfers” offered by a PRU will have more effects on firms located nearby (at a small distance from the PRU) than on firms at other locations - or if other factors than spatial distance are more important for the decision of private firms to use knowledge transfers from certain PRU.

The paper presents the results of a research project for answering this question for the case of the Halle region (= the southern part of the German Land Saxony-Anhalt). It is based on an empirical analysis (two postal surveys on PRU and on knowledge-based private firms) with a focus on the most important types of knowledge transfers. For those firms which are cooperating with PRU, it is shown that spatial distance is an important factor, in the sense that firms which are located nearer to the PRU are cooperating more intensively with the PRU than firms which are located in other regions. But also important for the firms is the import of knowledge transfers from PRU which are located outside Saxony-Anhalt. With regard to the determining factors which are important for the spatial direction of knowledge transfers, it is shown that apart from spatial proximity, also various factors on the demand side may inhibit knowledge transfers. Therefore, for being effective, regional policy should also deal with the demand side (and not just with public research units) to create better conditions for knowledge transfers in structural weak regions.

1. Introduction

In recent years, the traditional role of public research units (“PRU”; publicly funded universities, including universities for applied sciences, and specialised research institutes) as teaching and research institutions is increasingly expanding to also include the capacity to provide a substantial stimulus for economic growth in structurally weak regions. In the regions of the East German Länder (federal states) in particular, which have not yet succeeded in achieving sustained economic growth by themselves, the existence of high-quality public research units is viewed as one of the few possible motors to speed up the process of economic recovery¹. To ascertain the extent to which these expectations are realistic, the Halle Institute for Economic Research (henceforth referred to as “IWH”) has been conducting a research project titled “How do public research units contribute to the regional economy?” since 2001. The project is funded by the Ministry for Culture, Education and Research of the Land Saxony-Anhalt and is using the example of public research units in the Halle region² (= Southern Saxony-Anhalt) to determine the impact these have on the regional economy.

The new role of public research units goes along with recent developments in economic theory, trying to integrate the generation and dissemination of knowledge and innovations into growth theory and models.³ For understanding (regional) economic growth, it is necessary to explain how innovation processes are working and which factors are influencing them.

¹ On this expectation, see ROSENFELD, M.T.W./HEIMPOLD, G.: Öffentliche Forschung in Ostdeutschland: ein Hoffnungsträger für den wirtschaftlichen Aufschwung?, in: *Wirtschaft im Wandel*, 7th year, No. 15, 2001, pp. 393-404.

² Following the delimitations generally used in the framework of the regionalised structural policy of Saxony-Anhalt the Halle region is composed of the following districts: Saalkreis, Landkreis [administrative district] Merseburg-Querfurt, Landkreis Weißenfels, Burgenlandkreis, Landkreis Sangerhausen and Landkreis Mansfelder Land as well as Halle, a town independent of district administration (*kreisfreie Stadt*). The Halle region has three institutes of higher education (the Martin-Luther-University Halle-Wittenberg, the Burg Giebichenstein University of Art and Design Halle as well as the Merseburg University for Applied Sciences) and nine independent research institutes (of which the IWH was not considered in the study).

³ Cf. e.g. ROMER, P.: Endogenous Technological Change. in: *Journal of Political Economy*, 1990, vol. 98, no. 5, S71-S102.

It is evident that academics and public research units can never focus exclusively on the region in which they are located; this would severely limit their horizons and also impair their so-called “aerial function”⁴, defined as the role of public research units in bringing new knowledge into a region from outside. However, from the view of regional policy, public research units which have only few (or even no) links with private firms or public authorities within the region in which they are located will not be the favourable “species” of public research, because such public research units will not be able to stimulate innovation processes and economic growth within the region in question.⁵ In addition, it is relevant for an innovation-oriented regional policy to find out how the impact of intraregional public research units on regional economic growth could be increased.

In various studies, evidence had been presented for supporting the hypothesis that a region’s private firms are in general benefiting from the existence of public research units within the region in question and are better off than if they had to “import” the knowledge they need from public research units in other regions. Throughout economic literature, it is suggested that public research units play a prominent role in regional economic growth.⁶ Empirical studies on this subject are mostly working with macroeconomic data and are not differentiating between different categories of knowledge transfers.⁷ In addition, there have only been few investigations so far which were focussing on the questions

⁴ The term is found in FRITSCH, M./SCHWIRTEN, C.: The role of public research institutions in regional innovation systems – Evidence from three German Regions. Freiburg, Working Papers 98/23.

⁵ It is no question that some public research units – e. g. economic research institutes like the IWH – will always have primarily links with a region’s public authorities, not with private firms. Knowledge transferred to public authorities is of great importance, e. g. for restructuring public policy measures. But with regard to regional economic growth, the links between public research units and the private sector are of primary concern. Therefore, in this paper, only the knowledge transfer from public research units to private firms will be discussed.

⁶ Cf. e.g. JAFFE, A.B./TRAJTENBERG, M./HENDERSON, R.: Geographic Localization of Knowledge Spillovers as Evidenced by Patent Citations. in: *The Quarterly Journal of Economics*, 1993 S.577-598, p. 577.

⁷ Cf. e.g. JAFFE, A.B./TRAJTENBERG, M./HENDERSON, R.: ACS, Z.J./AUDRETSCH, D.B./FELDMAN, M.P.: R&D Spillovers and Innovative Activity. Discussion Paper FS IV 92-10, Wissenschaftszentrum Berlin 1992.

- to what extent the knowledge which is generated by regional public research units actually remains within the respective region⁸ (or is “exported” to other regions),
- whether the firms within a region are depending on the intraregional supply by public research units (or are able to “import” some of the knowledge they need from other regions) and
- which are the relevant factors for determining the “export” behaviour of a region’s public research units and the “import” behaviour of intraregional private firms?

In this paper’s *section 3*, it is discussed how a region’s “export” (from the intraregional public research units) and “import” of knowledge (by the intraregional private firms) could be operationalized for the purpose of empirical investigations. Afterwards, empirical evidence is presented for answering these questions for the example of Southern Saxony-Anhalt (see *section 3*). Finally, in *section 4*, it will be asked for the conclusions from the empirical results for regional economic growth, regional policy and for future research into intraregional innovation and growth processes.

2. Operationalizing the “Export” and “Import” of Knowledge between Public Research Units and Private Firms in Different Regions

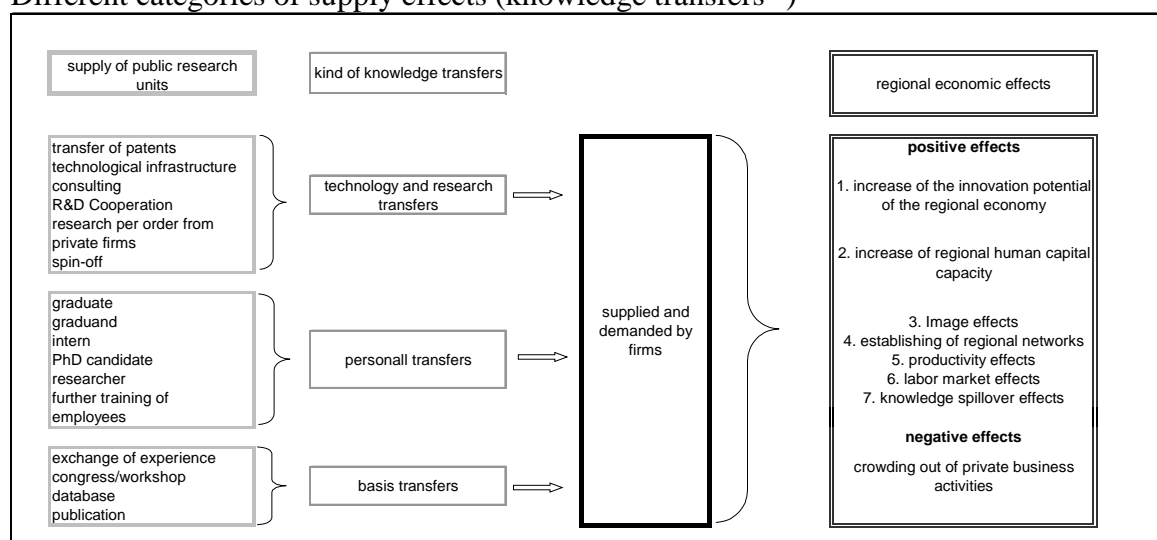
When considering the economic impact of public research units the rough distinction can be drawn between *demand effects* and *supply effects*.⁹ The demand effects arise through the purchases made by public research units (purchases of all kinds of input factors), whilst supply effects result from the services provided to the private economy by public research units (e.g. through educating students who subsequently find

⁸ Fritsch/Schwirten 1998 e. g. found out for three German regions that public research units had a preference for cooperation with businesses which were located in their own region, but they did not differentiate between different forms of knowledge transfers and did probably only ask for the dominant kind of cooperation. In practice, there is usually more than one kind of cooperation between a public research unit and private firms.

⁹ There is no uniform description of these effects in academic literature. Some authors also use the terms human effects and capacity effects (see ROSNER, U./WEIMANN, J.: Die ökonomischen Effekte der Hochschulausgaben des Landes Sachsen-Anhalt. Fiskalische, Humankapital- und Kapazitätseffekte der Otto-von-Guericke-Universität Magdeburg und der Hochschule Magdeburg-Stendal (FH). Working Paper 19/2003, p.16ff).

employment in the business sector or through developing innovations which can be used to boost turnover in the business sector).¹⁰ As in all other parts of public activities, the supply effects of public research units are much more important for (regional) economic growth than the demand effects. Therefore, this paper will only refer to the supply effects of public research units. These effects may be differentiated into different categories, as shown in Figure 1.

Figure 1:
Different categories of supply effects (knowledge transfers¹¹)



Source: IWH research.

To respond to the question to what extent the economy of a region R_1 benefits from this region's public research units, we suggest to compare

- (1) the share of knowledge transfers from the public research units in R_1 to private firms in R_1 with the share of knowledge transfers from the public research units in R_1 to n private firms in another region (region R_2) which is located rather near to R_1 and to

¹⁰ FRANZ, P./ROSENFELD, M.T.W/ROTH, D.: Was bringt die Wissenschaft für die Wirtschaft in einer Region? Empirische Ergebnisse zu den Nachfrageeffekten und Hypothesen über mögliche Angebotseffekte der Wissenschaftseinrichtungen in der Region Halle. IWH Discussion Paper, No. 163, 2002.

¹¹ For definition see: BLUME, L./FROMM, O.: Regionalökonomische Bedeutung von Hochschulen. Eine empirische Untersuchung am Beispiel der Universität Gesamthochschule Kassel. Wiesbaden, 2000, p. 56.

- n private firms within a region (region R_3) which is further away from R_1 than R_2 ,
- (2) the share of knowledge transfers to private firms within R_1 which have their origin from public research units within R_1 with the share of knowledge transfers to private firms within R_1 from
 - n public research units which are located outside of R_1 in region R_2 , which is located rather near to R_1 , and from
 - n public research units which are located within region R_3 , which is further away from R_1 than R_2 .

It is not easy to ask firms about the spatial reach of their knowledge transfers. Therefore, for our investigation on the public research units in Southern Saxony-Anhalt (= the Halle region), we have operationalized

- R_1 with the Halle region (Southern Saxony-Anhalt),
- R_2 with all other parts of Saxony-Anhalt,
- R_3 with all other regions in the world (outside Saxony-Anhalt).

In addition, we also refer in some cases to Saxony-Anhalt as a whole (= regions R_1 plus R_2). Table 1 is showing the possible cases of knowledge transfers from public research units (“supply side”) in one of the regions mentioned above to businesses (“demand side”) located in one of these regions.

The question to what extent the economy of a region R_1 benefits from this region’s public research units may now be specified by asking *whether businesses in the Halle region benefit more from the existence of public research units in the Halle region than is the case for businesses in the rest of Saxony-Anhalt and elsewhere in the world*. For this purpose the advantages obtained by businesses in the Halle region (on account of the public research units located there) are compared with the advantages experienced by businesses in other regions. In addition, the advantages of public research units in Halle for businesses in the Halle region are compared with the advantages presented by public research units from other regions. As the main focus is laid on the Halle region,

firms and public research units from other regions are used as control groups and listed as “comparative cases” in Table 1.

Table 1:
Overview of the possible spatially-differentiated cases of knowledge transfer (from public research units [PRU] to businesses [B]) and their relevance for the IWH study [ST = Saxony-Anhalt]

Demand side:	Supply side:		
	PRU in Halle	PRU elsewhere in ST	PRU outside ST
B in Halle	Central cases to ascertain the spatial reach of knowledge transfers	Comparative cases	Comparative cases
B elsewhere in ST	Comparative cases	Comparative cases	Comparative cases
B throughout ST	Comparative cases	Comparative cases	Comparative cases
B outside ST	Comparative cases	not part of the study!	

Source: IWH research.

Empirical investigations on the regional scope of knowledge transfers may only take into account those businesses (or researchers) which were having some form of actual contact with public research units (or businesses) during the period under consideration. In the following, these firms (or researchers) are referred to as “transfer-oriented” businesses (or researchers).

Looking solely at the business side in Table 1, it is possible to define various categories of transfer-oriented businesses in terms of the spatial reach of their knowledge transfers. This is necessary because most businesses cannot be definitively classed into just one of the matrix fields in Table 1 as they had contact with public research units from various regions (see Table 2). The study focuses on the knowledge transfers that transfer-oriented businesses in the Halle region had with public research units from the Halle region. The category “Locals” is used for this purpose. This refers to businesses from Halle which *only* carried out knowledge transfers with public research units from the Halle region. Those businesses which conducted knowledge transfers exclusively with public research units in the rest of Saxony-Anhalt (“Regionals II”) or exclusively with

public research units from outside Saxony-Anhalt (“Externals”) are the most suitable comparative cases.

Table 2:

Categorisation of transfer-oriented businesses according to the spatial reach of their knowledge transfers

Categorisation	Transfer-oriented businesses carried out knowledge transfers with public research units...							
	within the Halle region, and located				outside the Halle region, and located			
	only within the Halle region	both in the Halle region and elsewhere in Saxony-Anhalt	both in the Halle region and outside Saxony-Anhalt	All (some kind of contact with Halle)	only in the rest of Saxony-Anhalt	only outside Saxony-Anhalt	both within and outside Saxony-Anhalt	All
Short term	“Locals”	“Regionals I”	“Anywheres”	“All with Halle”	“Regionals II”	“Externals”	“Cosmopolitans”	“All without Halle”

Source: IWH research.

Table 3:

Categorisation of transfer-oriented researchers from the Halle region according to the spatial reach of their knowledge transfers

Categorisation	Knowledge transfers from transfer-oriented researchers to businesses...				
	in the Halle region and		in Saxony-Anhalt and		Exclusively with businesses outside Saxony-Anhalt ^a
	Exclusively in the Halle region	both with businesses in the Halle region and businesses in other regions	exclusively with businesses in the rest of Saxony-Anhalt	both with businesses in Saxony-Anhalt (including the Halle region) and businesses in other regions	
Short term	“Locals”	“All with Halle”	“Regionals”	“All with Saxony-Anhalt”	“Externals”

^a Researchers only focused on businesses outside Saxony-Anhalt.

Source: IWH research.

With regard to transfer-oriented researchers from the Halle region, the analysis is focussing on those who *only* conducted knowledge transfers with businesses in the Halle region (“Locals”, see Table 3). The comparative cases here are transfer-oriented researchers having knowledge transfers *exclusively* with businesses in the rest of

Saxony-Anhalt (“Regionals”) or *exclusively* with businesses outside Saxony-Anhalt (“Externals”).

3. Empirical Results on the Regional Scope of Knowledge Transfers

3.1 Is there a “Distance Paradox”?

The data presented is based on written surveys of knowledge-based businesses¹² in all parts of Saxony-Anhalt (‘IWH Knowledge Transfer Survey 2003’) as well as of public research units in the Halle region (‘IWH Survey of Researchers 2003’) In cooperation with the Saxony-Anhalt Office for Statistics a total of 4,900 knowledge-based businesses were contacted in winter 2002/2003. 534 usable questionnaires were returned (10.9%).¹³ From February to July 2003 a total of 311 selected researchers at public research units in the Halle region were sent a survey. There were 151 replies (48.6%).¹⁴

Both the written survey of businesses and the survey of public research units point to an (apparent) “distance paradox” in the sense that with increased spatial distance between public research units and businesses the intensity of the links between both sides initially decreases but then increases again. In other words, the public research units in the Halle region were of greater significance for the businesses within this region than for businesses elsewhere in Saxony-Anhalt, but they were also very important for businesses based in other German Länder. Conversely, although the businesses in the Halle region focused more on public research units within this region than on public

¹² This selection was based on the hypothesis that demand for academic services comes above all from businesses employing graduates. There are an above-average number of such businesses in knowledge-based sectors. For a list of knowledge-based sectors, see : GRUPP/LEGLER: *Hochtechnologie 2000: Neudefinition der Hochtechnologie für die Berichterstattung zur technologischen Leistungsfähigkeit Deutschlands*, Karlsruhe/Hannover 2000, p. 29ff; BMBF: *Zur technologischen Leistungsfähigkeit Deutschlands 2001*, Bonn 2002, p. IV. Some modifications were made to this list bearing in mind that the economic structure of Saxony-Anhalt was the focus of the study.

¹³ The hypothesis of a link between the distribution of the total survey (the questionnaires sent out) and the sample survey (returns) is negated with a significance level of 95% (Chi-square test).

¹⁴ The questions contained in the business survey related to 2001 and those in the survey of researchers to the past twelve months.

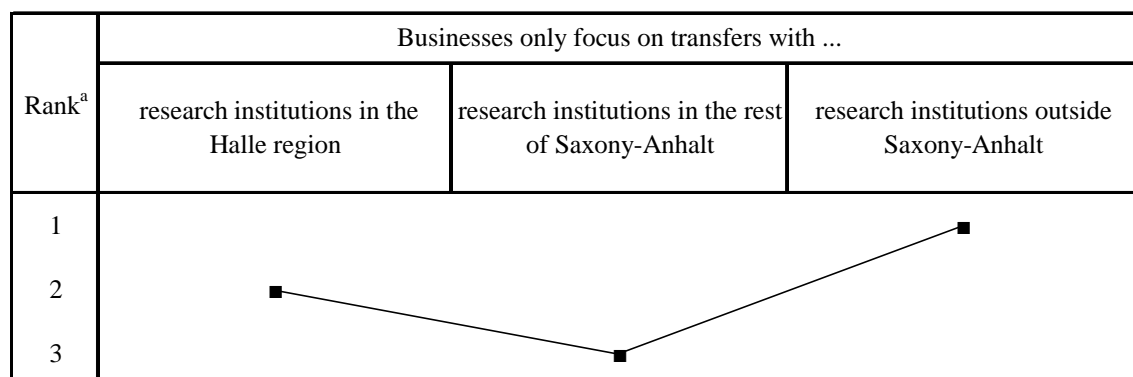
research units elsewhere in Saxony-Anhalt, the import of knowledge also played an important role for these businesses (use of public research units not based in Saxony-Anhalt). In the following two subsections, these results are pointed out in detail.

3.1.1 Findings from the Survey of Businesses

The distance profile of transfer-oriented businesses¹⁵ in the Halle region shows that, in line with expectations, they had more knowledge transfers with public research units located in the Halle region¹⁶ than with public research units elsewhere in Saxony-Anhalt (see Figure 2).¹⁷

Figure 2:

Profile of the transfer-oriented businesses in the Halle region according to the location of their transfer partners



^a The first rank indicates the category of public research unit with which most businesses had knowledge transfers.

Source: IWH knowledge transfer survey 2003; Figure by authors.

At the same time, however, the transfer-oriented businesses in the Halle region also had strong links with public research units outside Saxony-Anhalt (although this does not necessarily mean that these public research units were far away from the businesses in Saxony-Anhalt as Leipzig and other university towns are practically “on the doorstep”).

¹⁵ This relates to businesses involved in knowledge transfers with public research units (including the employment of higher education graduates) (N=291).

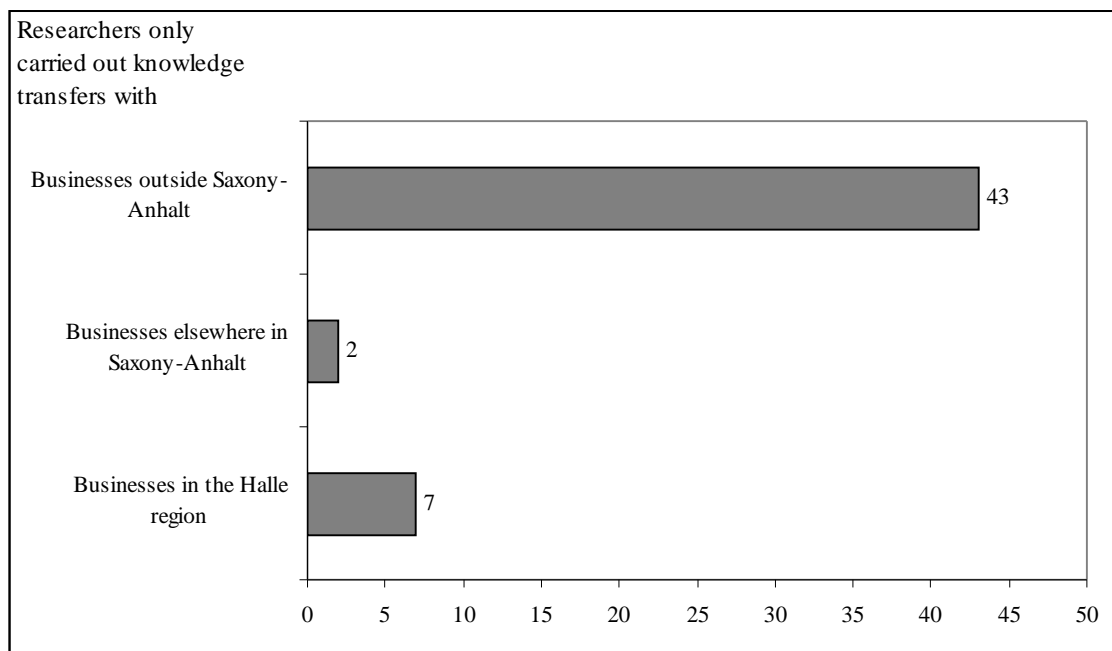
¹⁶ This includes the public research units in the Halle region as well as the Institute for Plant Genetics and Crop Plant Research (IPK) in Gatersleben, which in the district of Aschersleben-Staßfurt in the Harz region. As the IPK has close staff and research links with faculties at the Martin-Luther-University it was decided to class it with the Halle region.

¹⁷ The rest of Saxony-Anhalt comprises the Altmark region, the “Magdeburg Permanent Regional Committee”, the Harz region and the Anhalt-Bitterfeld-Wittenberg Regional Committee.

By contrast, the public research units in other regions of Saxony-Anhalt were of relatively low importance for the transfer-oriented businesses in the Halle region. This result may be interpreted in the sense that business from the Halle region are able to “import” knowledge from outside the region, but that the public research units from their own region are more important for them than public research units from the other regions within Saxony-Anhalt.

3.1.2 Findings from the Survey of Researchers (Survey of Researchers at Public Research Units Based in the Halle Region)

Figure 3:
Profile of the transfer-oriented researchers from the Halle region in terms of their transfer partners^a
- absolute values -



^a When analysing the results it should be taken into account that the case numbers are sometimes very low and only those categories of researchers are included whose contacts were restricted to businesses in one of the three region groups. In addition, transfers of graduates are not included in the information.

Source: IWH survey of researchers 2003; Figure by authors.

The distance profile of the surveyed researchers from the Halle region shown in Figure 3 allows the following observations, although there are reservations on account of the

low number of cases. The transfer-oriented researchers¹⁸ from the Halle region focused more on businesses in this region than on businesses elsewhere in Saxony-Anhalt.¹⁹ At the same time, their efforts were also very much concentrated on knowledge transfers to businesses located outside Saxony-Anhalt. The survey of researchers is therefore identical to the survey of businesses to the extent that nearby businesses in the rest of Saxony-Anhalt were of little significance for the transfer-oriented researchers.

This result may be interpreted in the sense that public research units of the Halle region are “exporting” a great amount of their knowledge to other regions. But the private firms in the Halle region are more important as partners of knowledge transfers for the private research units in Halle than the private businesses in the other parts of Saxony-Anhalt.

3.2 Explanations for the Distance Orientation of Halle-based Businesses and Research Units

The purpose of this section of the paper is to answer the following questions:

- (1.) What are the reasons that firms from the Halle region have more interactions with public research units from the rest of the world than with public research units from the Halle region - and more interactions with public research units from the Halle region than with public research units from the other regions of Saxony-Anhalt?
- (2.) What are the reasons that public research units from the Halle region have more interactions with private firms from the rest of the world than with businesses from the Halle region – and more interactions with private firms from the Halle region than with businesses from the other regions of Saxony-Anhalt?

Two possible explanations for the distance orientation of businesses and public research units in the Halle region are examined in more detail below. One assumption is that there is a *mismatch* between the supply from the public research units and the demand

¹⁸ Researchers involved in knowledge transfers to businesses.

¹⁹ However, there can only be a limited interpretation of the results as there were only a very small number of cases.

of businesses in the Halle region. One possible consequence of such a *mismatch* could be that the transfer-oriented businesses are forced to “import” the necessary knowledge, whilst the public research units tend instead to “export” their knowledge output. This could in turn explain the major importance of the “rest of the world” both for businesses and public research units from the Halle region.

Another conceivable explanation is a lack of absorption capacity on the part of businesses from the Halle region, measured in this study in terms of business size. It is assumed that larger businesses have more resources to investigate knowledge transfers than small businesses and therefore a higher absorption capacity. If private firms in the Halle region are significant smaller than those in the rest of the world, this could explain the tendency of public research units from the Halle region to “export” their knowledge transfers. And if businesses from the Halle region are significant larger than private firms from the other parts of Saxony-Anhalt, this could explain why public research units from the Halle region have more links with firms from the Halle region than with firms from the other regions of Saxony-Anhalt.

The *mismatch hypothesis* is examined more closely below, followed by an analysis of the *absorption capacity of businesses* as another determining factor. In addition we will look at Spin-offs as determinants of intraregional knowledge transfer activities.

3.2.1 Mismatch Hypothesis

There are two possibilities to explain a mismatch between public research units and private firms, by

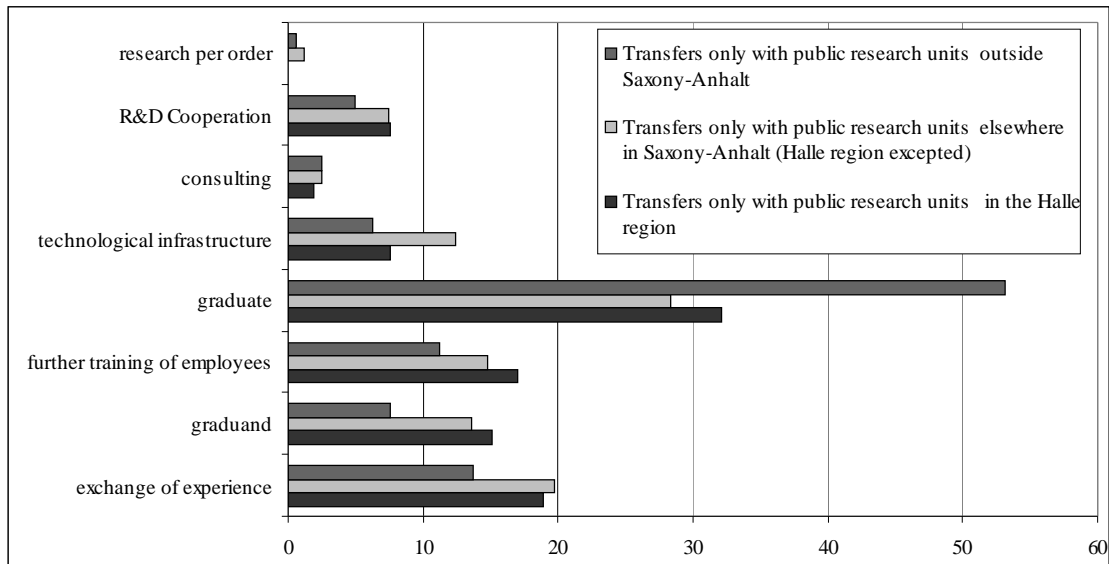
- a lack of professional competence of the public research units in the Halle region
or
- differences between the transfer partners in terms of their preferences for various types of transfers.

In the following subsections, these possible explanations are checked out in detail.

Figure 4:

Distribution of the knowledge transfers carried out by transfer-oriented businesses according to type and spatial reach

- Percentage of different transfer types in all transfer types within a specific spatial category, multiple entries possible-



^a See categories.

Source: IWH knowledge transfer survey 2003; Figure by authors.

Figure 4 is presenting results for Saxony-Anhalt altogether. As indicated by the Figure, the high focus on knowledge imports among transfer-oriented businesses in Saxony-Anhalt is above all attributable to the fact that these businesses imported many higher education graduates to Saxony-Anhalt.²⁰ This result does not fully explain the import orientation as a whole but points to the *tendency* that transfer-oriented businesses in Saxony-Anhalt cannot fulfil their requirements for higher education graduates using the higher education services provided by public research units in Saxony-Anhalt alone. The significance of the import of higher education graduates to Saxony-Anhalt for all

²⁰ The survey used as the basis for these findings only asked where the graduate employees had obtained their qualifications, not how many graduates were employed. Figure 5 only considers the number of companies which stated that they had employed higher education graduates from a specific region. It is not possible to state how many of the graduate employees in Saxony-Anhalt had gained their qualifications within or outside Saxony-Anhalt. Consequently, the Figures relate to the number of surveyed businesses which *only* employed graduates from the Halle region, the rest of Saxony-Anhalt or from outside Saxony-Anhalt.

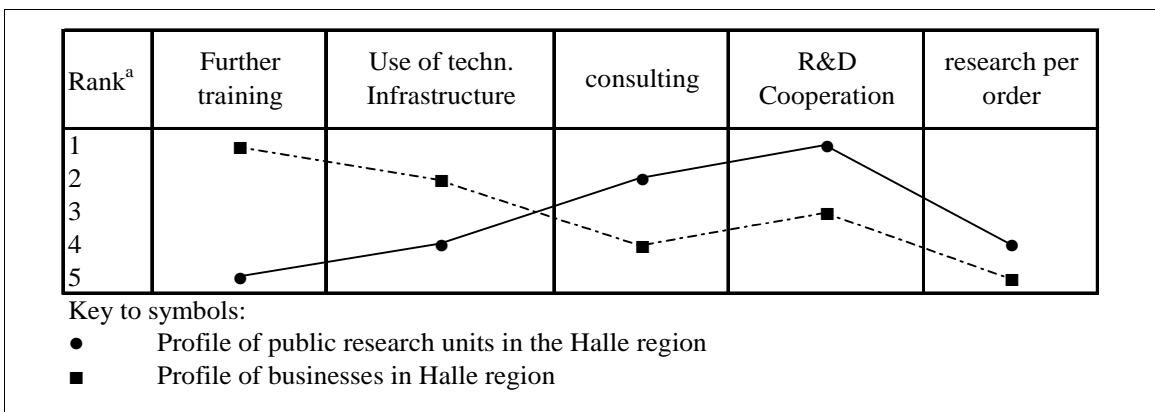
transfer-oriented businesses in this Land, shown in Figure 4, can also be applied to the transfer-oriented businesses in the Halle region. The - as yet unresolved - question arises to whether the import of higher education graduates results from an insufficient supply from the public research units in the Halle region or simply reflects the high inter-regional mobility of graduates, a constant and desirable factor. In any case, it is evident that businesses are able to import graduates from outside the region.

The results of the knowledge transfer survey and the survey of researchers regarding the import or export of knowledge could also point to a professional *mismatch* between the supply available from public research units in the Halle region and the demand of businesses in the Halle region and in Saxony-Anhalt respectively. The data collected so far does not allow for a comprehensive assessment of this hypothesis, but there is some evidence for it.

Figure5:

Profiles of the supply and demand of knowledge transfers

- Various types of transfer ranked by the transfer-oriented researchers or business representatives -



^a The first rank indicates the transfer type used by most transfer-oriented researchers or business representatives.

Source: IWH survey of researchers 2003, IWH knowledge transfer survey 2003; Figure by authors.

As Figure 5 indicates, there are some major differences between the transfer partners in terms of their preference for various types of transfer. This is clearest in the case of the transfer type of further training of employees. Demand from businesses in the Halle region is highest for this type of transfer, but this is rarely offered by public research

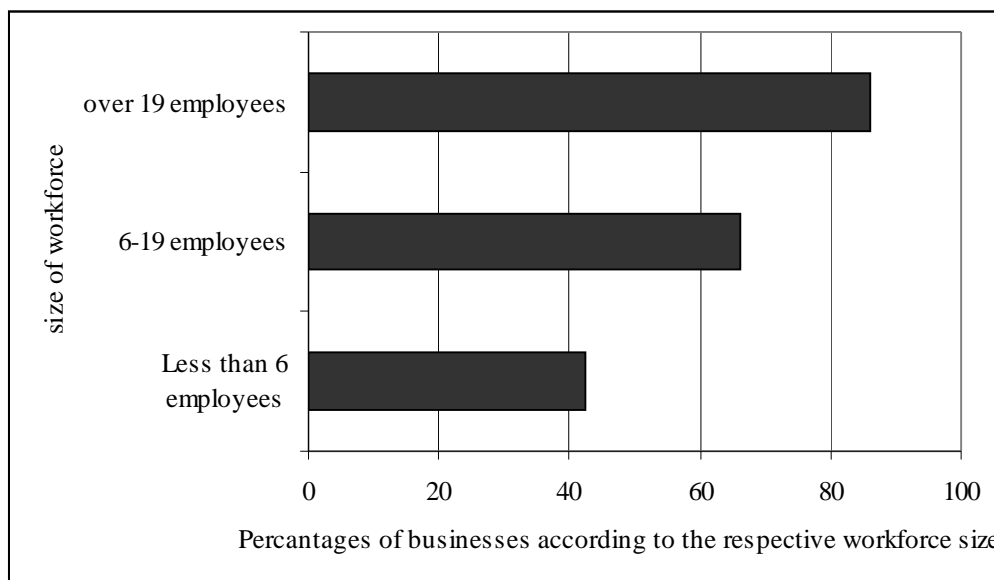
units in the region. There are no differences between firms in the Halle region and firms from other parts of Saxony-Anhalt. So the higher focus of public research units from the Halle region on businesses in the Halle region can not be explained by different schemes of preferences.

3.2.2 Absorption Capacity

Another possible explanation for the spatial orientation of public research units in Halle could be noted in the case that businesses in Halle and those in the rest of the region have different structural features.²¹

Figure 6:

Share of businesses involved in knowledge transfers among all surveyed businesses, according to workforce size (N=286)
- in % -



Source: IWH knowledge transfer survey 2003; Figure by authors.

A different business size could be such a feature and a relevant determinant of knowledge transfers: The expectation is that the larger a business the more it will tend

²¹ See Figure 6.

to make use of knowledge transfers. Empirical evidence from our survey shows (see figure 6) that larger businesses indeed have a greater tendency to make use of knowledge transfers than smaller businesses. And an assessment of the quality²² of knowledge transfers yielded analogous results. Larger transfer-oriented businesses in Saxony-Anhalt tended to be more frequently involved in the relatively expensive transfers such as cooperative research than smaller businesses. This illustrates that determinants on the demand side of knowledge transfers such as business size influence the quantity but also the quality of knowledge transfers.

However, from Table 4 below it emerges that the businesses surveyed in the Halle region and elsewhere in Saxony-Anhalt barely differ in terms of distribution within the individual workforce sizes. This factor can therefore not be used to explain the orientation of public research units in the Halle region to cooperate with domestic private firms, compared to their cooperation with private firms in the rest of Saxony-Anhalt. We have no data for *transfer-oriented* firms from other regions in the world. It can however be presumed that the absence of a stock of very large firms (with more than 1,000 employees) in Saxony-Anhalt as compared to regions in West Germany could be one reason for the greater tendency for the public research units in Halle to export knowledge (knowledge transfers to regions outside the Land).

Table 4:

Share of businesses from the Halle region and elsewhere in Saxony-Anhalt among all surveyed businesses according to individual workforce size
- in % -

Size group	Size of workforce	Total businesses (N =517)	
		Halle region (N=175)	Rest of Saxony-Anhalt(N=342)
I	Fewer than 6 (N=303)	56.6	59.6
II	6-19 (N=144)	30.9	26.3
III	More than 19 (N=70)	12.6	14.0

Source: IWH knowledge transfer survey 2003; authors' own calculations.

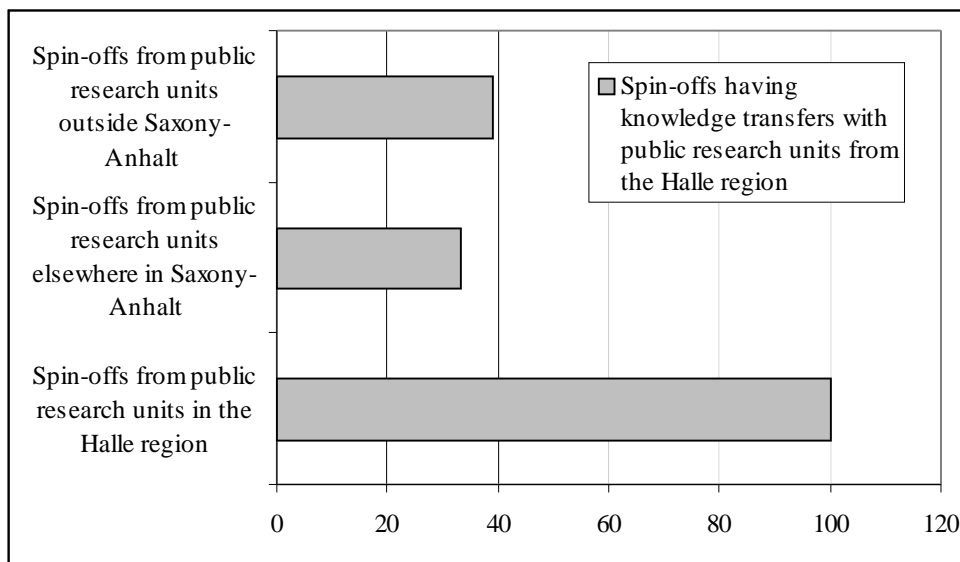
The findings presented lead to the assumption that the rare extraregional knowledge transfer by Halle researchers to businesses in the rest of Saxony-Anhalt can above all be

²² The quality of knowledge transfer relates to the forms of transfer shown in diagram 4 .

attributed to stronger links between these transfer-oriented businesses and the public research units located in their respective regions - in the rest of Saxony-Anhalt. This evidence is backing up the hypothesis that “distance matters” for knowledge transfers between public research units and private firms: Whereas the strong linkages between public research units and private firms from the Halle region and the “rest of the world” – as well as the linkages between private firms from the Halle region and the “rest of the world” – could be explained by structural features of the firms and the public research units, respectively, there are only few differences between firms from the Halle region and firms from other parts of Saxony-Anhalt. Therefore, the stronger relations between firms and public research inside the Halle region, as compared with other regions in Saxony-Anhalt, may be explained by the role of distance.

Figure 7:

Share of entrepreneurs involved in knowledge transfers with public research units in the Halle region among all business start-ups from public research units according to the regionally-differentiated categories^a
 - in % -



^a The low number of cases should however be taken into account. The business representatives considered here were employed at a public research unit before commencing this activity. In our sample there have been (N=) 7 spin-offs from public research units from the Halle region, (N=) 9 spin-offs from public research units elsewhere in Saxony-Anhalt and (N=) 23 spin-offs from public research units outside Saxony-Anhalt. The percentages refer to the N.

Source: IWH knowledge transfer survey 2003; Figure by authors.

Another relevant structural feature on the demand side of knowledge transfers could be the regional share of spin-offs from public research units between all businesses. IWH findings indicate that spin-offs interact particularly strongly with their formative sources (incubator units), as Figure 7 is illustrating for the public research units Halle region. As there are in this region more spin-offs from public research units from the Halle region than in other parts of Saxony-Anhalt, the strong links between spin-offs and their incubator units could be one determinant for the fact that researchers and firms have a tendency to favour knowledge transfers with partners of their own region and not with partners from the rest of Saxony-Anhalt.

4. Conclusions

One of the central findings of our investigation is that – in accordance with other studies – spatial proximity is generally important for the establishment of knowledge transfers. Hence, it is a fundamental advantage for a region going through a process of economic recovery, such as the state of Saxony-Anhalt, to have its own public research units (what means that intraregional businesses are not exclusively reliant on the import of knowledge). However, from the present state of our research it is not possible to comment on the definitive extent of the regional advantages from their own public research units. It certainly can be said that if there were no public research units in Saxony-Anhalt businesses there would be in a worse situation than they are at present with public research units.

But apart from the intraregional benefits of public research units, we also found out a strong orientation of public research units and private firms in direction to other regions. A high rate of knowledge which is generated by regional public research units in the Halle region is “exported” to regions outside of Saxony-Anhalt. And the firms within the Halle region are not totally depending on the intraregional supply by public research units, they are able to “import” some of the knowledge they need from other regions (outside of Saxony-Anhalt). From the view of regional policy, this extraregional orientation of both the public research units and businesses in Halle could pose a problem. However, it has to be noted that the Halle region is situated near the border

between the German federal states Saxony-Anhalt, Thuringia and Saxony, in the heart of a larger region called “Central Germany”²³. The strong extraregional orientation can therefore also be interpreted as an indication of networks between the Halle region and nearby locations in Saxony and Thuringia.

With regard to the determining factors which are important for the spatial direction of knowledge transfers, it was shown that apart from spatial proximity, also various factors on the demand side may inhibit knowledge transfers. Therefore, for being effective, regional policy should also deal with the demand side (and not just with public research units) so as to create better conditions for knowledge transfers in structural weak regions. An *exclusive* focus of development policy on expanding public research units would do little to solve the economic problems in regions like Saxony-Anhalt.

²³ Central Germany is often operationalized with the three federal states of Saxony-Anhalt, Saxony and Thuringia (= Southern East Germany).

Bibliography

- ACS, Z.J./AUDRETSCH, D.B./FELDMAN, M.P.: R&D Spillovers and Innovative Activity. Discussion Paper FS IV 92-10, Wissenschaftszentrum Berlin 1992.
- BLUME, L./FROMM, O.: Regionalökonomische Bedeutung von Hochschulen. Eine empirische Untersuchung am Beispiel der Universität Gesamthochschule Kassel. Wiesbaden, 2000.
- BMBF: Zur technologischen Leistungsfähigkeit Deutschlands 2001, Bonn 2002.
- FRANZ, P./ROSENFELD, M.T.W./ROTH, D.: Was bringt die Wissenschaft für die Wirtschaft in einer Region? Empirische Ergebnisse zu den Nachfrageeffekten und Hypothesen über mögliche Angebotseffekte der Wissenschaftseinrichtungen in der Region Halle. Halle/S. 2002 (IWH-Discussion Paper No. 163).
- FRITSCH, M./SCHWIRTEN, C.: The role of public research institutions in regional innovation systems – Evidence from three German regions. Freiburg Working Papers 98/23.
- GRUPP/LEGLER: Hochtechnologie 2000: Neudefinition der Hochtechnologie für die Berichterstattung zur technologischen Leistungsfähigkeit Deutschlands, Karlsruhe/Hannover 2000.
- JAFFE, A.B./TRAJTENBERG, M./HENDERSON, R.: Geographic Localization of Knowledge Spillovers as Evidenced by Patent Citations. in: The Quarterly Journal of Economics, 1993 S.577-598.
- ROMER, P.: Endogenous Technological Change. In: Journal of Political Economy, 1990, vol. 98, no. 5, S71-S102.
- ROSENFELD, M.T.W./HEIMPOLD, G.: Öffentliche Forschung in Ostdeutschland: ein Hoffnungsträger für den wirtschaftlichen Aufschwung?, in: Wirtschaft im Wandel, 7th year, No. 15, 2001, pp. 393-404.
- ROSNER, U./WEIMANN, J.: Die ökonomischen Effekte der Hochschulausgaben des Landes Sachsen-Anhalt. Fiskalische, Humankapital- und Kapazitätseffekte der Otto-von-Guericke-Universität Magdeburg und der Hochschule Magdeburg-Stendal (FH). Working Paper 19/2003.