

KNOWLEDGE BASE OF THE REGION - ROLE OF THE UNIVERSITIES IN REGIONAL INNOVATION (THE CASE OF SOUTH TRANSDANUBIA)

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Abstract

Knowledge base of the region - role of the universities in regional innovation (the case of south Transdanubia)

The economic attraction and competitiveness of the regions depends on the spatially balanced network-based co-operation of different research bases and firms involved in innovation development. The utilisation of the regional knowledge base, innovation potential and co-operation between businesses and universities & research institutions continues to play an increasing role in regard to business success and the competitive economic performance of the regions. Innovation is considered as an interactive and system-like process depending on traditions with definite spatial forms and it is manifested in the form of "networks" among the companies and universities, and among the different transfer organisations, which can stimulate university-industry linkages. The paper presents the findings of the "ERAWATCH regional benchmarking surveys – in which the South Transdanubian region participated in – on innovation potential and investment into research" surveys concentrating on the role of innovation networks, within them highlighting the special role of regional universities in the collaborative research networks. The introduction is followed by a demonstration highlighting the role of universities in national and regional knowledge transfer emphasizing the fact that the spatial (regional) structure of innovation is very much determined by the transformation of potential universities and their widening innovative functions during the economic transition in Hungary. The next section provides an overview of findings of the ERAWATCH survey (2006) on the role of universities in regional network building and discusses those factors that are necessary for the establishment of a research university model. The last section assesses the efficiency and coherence of the Regional Innovation System with regard to the needs and capacities of the regional economies and the extent of matching or mismatching between the knowledge and economic specialization.

Key words

regional innovation, knowledge base, ERAWATCH Survey, university-firm links, knowledge and economic specialization

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1. Knowledge creation: a new tool for regional competitiveness

Consensus exists on innovation-oriented regional development in the literature in which the utilization of regional knowledge base, innovation potential and co-operation between businesses and research institutions continues to play an increasing role not only in regard to business success but also in the competitive economic performance of a certain region (Cooke 1995).

Although several factors are influencing regional competitiveness its driving forces still can be identified. The European Union's regional reports are considering innovation, research and technology development as the major potentials of gaining competitive advantages. The competitiveness of regions can be increased by successful R&D activities within the region and by the creation and spreading of innovation in a wider sphere. Regional level innovation and especially the practical implementation of R&D results may directly be manifested by the competitive advantages of the region's business enterprises (Lengyel 2000).

The development of science and technology and their accumulated knowledge basis have become one of the key factors of the development of regional economy. Universities and research institutes as knowledge centres extending and disseminating comprehensive scientific information are playing an increasing role in regional development. A wide range of literature has studied the regional effects of the universities' research-development potentials (Ács-Varga 2002, Varga 2004). Not only the direct support of universities has increased significantly but for regional governments' budgets the subsidisation of projects involving universities in various forms with the support of university-industry links are the biggest items of expenditure (Varga 2004).

This paper provides an overview on the "ERAWATCH regional benchmarking surveys – which the South Transdanubian region participated in – on innovation potential and investment into research" surveys concentrating on the role of innovation networks, within them highlighting the special role of regional universities in the collaborative research networks. The introduction is followed by a demonstration highlighting the role of universities in national and regional knowledge transfer emphasizing the fact that the spatial (regional) structure of innovation is very much determined by the transformation of potential universities and their widening innovative functions during the economic transition in Hungary. The next section will introduce the findings of the ERAWATCH survey (2006) on the role of universities in regional network building and university – industry links and will discuss those factors that are necessary for the establishment of a research university model

2. Role of the universities in regional innovation

Higher education has a potential influence on regional development, not only because of its place in the R&D sector, but also because of its dominant position in the training of the experts responsible for producing technologically-developed products and competitive services. From this point of view, the rapid development of tertiary education, especially outside Budapest, plays a balancing role. The number of students has been growing rapidly since 1990, especially in the newly-established provincial tertiary education centres (Tab. 1).

Tab. 1: Share of Higher education in the Hungarian RTD, 2005.

INPUT	OUTPUT
RTD units: 70%	Published books: 77%
RTD expenditure: 25%	Published studies: 70%
RTD personnel: 57%	Patents: 32%
RTD personnel (FTE): 38%	Patents at EPO & USPTO: 16%
Share of doctorates: 72%	
RTD investment: 12%	

Source: CSO publications, 2005.

Universities can have an impact on the economic development of their own region in two ways (Forax 1992): on the one hand through the multiplier effect of the purchasing of students (a so-called expenditure effect) and on the other hand through the (scientific, technical, technological and economic) knowledge transfer from the university into the business sector (knowledge effect) (Varga 2004). A very important side-effect of technology transformation is that industries and companies manufacturing competitive products are selecting their sites on the basis of qualitative criteria.

Higher education is such a very important factor of which attractive force for capital secured not only by creating competitive advantages in local labour market but also by its absorbing innovative capacities. It can be seen all over Europe that while the development of big technology systems concentrated in metropolitan agglomerations was mostly determined by the research-development units of big firms, the technology innovation of SMEs, the organisation of local and regional technology clusters in the majority of cases were initiated by institutes of higher education. The engine force of regional higher education can be touched upon the development of the West-European core regions (Bennett-Krebs 1991). In several Hungarian regions (for example in South Transdanubia) the higher education sector is the largest knowledge potential and value generator which at the same time has fewer links with the industrial sector than it would be necessary. The potential links between the two sectors should be identified and the institutional background of these links should be created. The successful cooperation between business and university sector may secure a favourable environment for innovation.

For enabling the higher education system to exercise its innovative functions and to be capable for performing its *integrative functions* as an element of the innovation system (Horváth 2003) is emphasizing the necessity of at least preconditions:

- Research should be regarded as a primary function of higher education. This should be reflected in its financing and the development of the knowledge potentials of university research base should also have a key role.
- The structure of higher education should be adapted to the requirements of post-fordist economy and should be capable for generating technology and economic innovations.
- National innovation policy and regional policymakers should support the institutionalized cooperation of higher education and business organisations.
- Higher education should territorially be decentralised, institutional developments and university integrations should be in conformity with the aspects of the economy of scale. An optimal efficiency of scale with the institutions of the core region can create equal chances both for accessing

research funds and for joining the international division of labour in research and development.

Higher education, which placed among the R&D performing sectors, is very much in the national interest as it plays a significant role in innovation processes. The economic attractiveness of the regions and spread of knowledge depend largely on a spatially-balanced network of university-based research facilities, with special regard to their relation to companies (Gál 2002). The Act on higher education defined the tasks underpinning a dual transformation of the universities so that research might be returned to them and traditional universities transformed into research ones.

Higher education has developed into Hungary's biggest R&D generating sector an its share of Hungarian higher education from governmental R&D spending is similar to the West European ratios, lagging may be observed regarding two indices. On is the very low ratio of business sector funded research departments and the other is the very weak links between the university research and business sector. While in OECD countries the average rate of corporate funded R&D is 70% in Hungary this figure was 38% only in 2002. The ratio of R&D expenditures to Hungarian GDP is also low (0.3%) especially when comparing it with the 0.87% of Slovene or with the 1.2% EU-15 ratio (Gál 2005).

However, most of the university-based research units are too small to be effective in terms of both share of researchers and overall R&D expenditure. Despite the co-operation between universities and the private sector, and participation in multilateral scientific programmes, the R&D budgets of universities are largely dependent on governmental subsidies.

3. Description of regional knowledge base in South Transdanubia

The knowledge (RTDI) infrastructure, which includes universities, research centres, plays significant role in the knowledge creation capacity of the regions. This infrastructure, which is easily accessible by firms can constitute the foundations of innovative systems (using proximity arguments), but not automatically. There are many cases reported where HEIs or research laboratories operate in relative isolation from the regional productive processes. They do so, in particular when they concentrate on formal educational duties rather than covering the wider range of functions of a modern university when they are active in sectors that lead them to have better connections with firms outside the region or when they focus exclusively on basic research.

The knowledge transmission mechanisms and knowledge enhancing linkages including university-industry and intra-industry links, such as technology intermediaries, spin-offs, inter-firm research collaborations, as well as developments of science parks, technopoles are important factors in strengthening the knowledge diffusion capacity of the regions. The knowledge enhancing linkages, which are ideally based on a dense interaction of interdependencies between research establishments and firms and/or among firms themselves, evolve into trust relationships that characterise, for example, economies of scope.

South Transdanubia is not among the wealthiest regions in Hungary. Until the mid-1990s South Transdanubia had the poorest R&D capacities in Hungary (in 1995 only

3.5% of all R&D employees worked in the region and not more than 1.5% of the total expenditure was realized here). This setback in R&D activities was an outcome of the disintegration of those large enterprises and research institutes engaged in R&D. The South Transdanubian region has the largest provincial university centre (Pécs) in Hungary in terms of the number of students (34,000), and the two universities have significant research capacities in certain fields. The HEI sector plays dominant role in R&D performance as it accounts for 78% of total RTD expenditures. Despite these endowments RTD creation of the business sector in South Transdanubia is limited (3.4 M € BERD in 2003). Outputs of R&D and the uneven disciplinary structure of higher education are not very advantageous from all point of view of innovation. South Transdanubia's regional GERD was 22 M Euro in 2004, which is only 3.2% of Hungary's total.

Based upon the key indicators (measured as a percentage of the national average) the following picture of the regional knowledge base of South Transdanubia can be drawn. The region has large public RTD infrastructure mainly based on the two universities absorbing more than two thirds of regional GERD. Among them, the University of Pécs has a dominant position. It hosts 87% of the enrolled students and 84% of the research staff of the HEIs. Unlike the public RTD sector, the visibility and the performance of the business sector is very low, even by comparison with the national average. Universities are the major employers of RTD personnel. They account for three quarters of the total RTD personnel of the region. The remainder is divided almost equally between corporate and public RTDI sector. As a percentage of total employment with the national average (=100%) South Transdanubia's share of RTD personnel is 73%. However, there are huge differences in expenditures between the different sectors. HEIs exceeded the national average (107%), while RTD personnel make up very small shares of the total in business and the government sector, accounting respectively for only 28% and 25% of the national average, (Fig. 1).

The orientation of the knowledge creation activity of the region is based largely on the scientific profile of its universities. Of all the knowledge creation sectors, HEIs (University of Pécs and University of Kaposvár) have the strongest potential in life science (biotech and animal cytology) research and they have a good reputation with measurable RTD outputs in laser physics, environmental and agrarian research. At the same time, engineering and some fields of science (informatics, electronics and chemistry) are proving to be the weakest elements of the regional RTD base.

The strength of the life science (biotech) research base is demonstrated by its large share of total input-output indicators and by the increase of RTD spending in this field (€4.8m in 2004). In addition, the 11 university spin-offs in the biotech sector are strongly connected to the Medical School (MS), which has 48 employees (40 of them with an HEI degree) and produces a turnover of €3 million (2004).

In contrast to this positive trend, the share of engineering in total RTD personnel especially in the fields necessary for technology change (micro-electronics, informatics, automation), dropped from 8.9% to 6.9% during the short period from 2002–2004. Due to the uneven disciplinary structure of HEIs, the outputs of the RTD sector in the region are not very advantageous and from the point of view of innovation are clearly characterised by lower patenting activity in the region. There was a similar decline in the proportion of researchers in natural sciences and in agrarian science (which declined from 6.6% to 5.4% and from 8% to 7.3%

respectively). The traditional overrepresentation of researchers in social sciences and humanities is changing only slowly, and even though their share has declined from 42% to 29.5%, it is still high. (Fig. 1).

The lagging position of the region is best expressed by the RTD expenditure indicators measured as a percentage of GDP. Comparing the performance of the region in relation to the country as a whole, the GERD only improved slightly during the last decade, reaching only 43% of Hungary’s average. The largest increase in R&D expenditure in the case of South Transdanubia can be observed in the HEI sector, illustrated by its high HERD figure of 108% (above the national average). Unlike the HEI sector, the limited RTD activity of the business sector is the main characteristic of regional RTD performance, accounting for only 17% of Hungary’s average as a percentage of GDP. This figure is lower than the RTD expenditure of the government RTDI sector (23%).

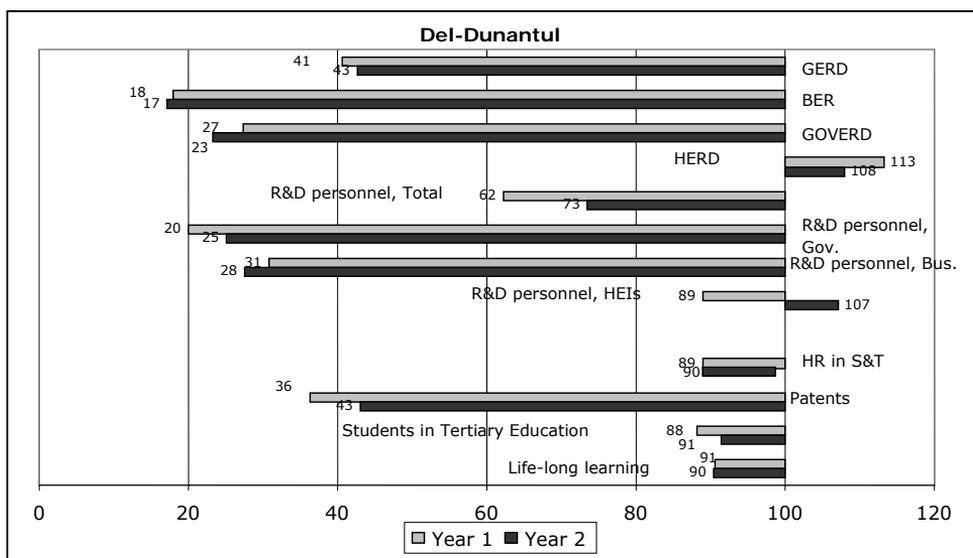


Fig.1: Key indicators on South Transdanubia’s knowledge base development in comparison to the national average.

Source: author calculation based on the EUROSTAT, Gál-Csonka (2006).

Note: The following years were used for BERD, GERD, HERD GOVERD 1999, 2003; R&D personnel 1999, 2004; HR 1997, 2005; Patents 1995,2003 and Lifelong learning 1999,2004.

4. University industry links: cultural barriers?

Universities and research institutes through their integration to national and international knowledge bases and networks are functioning as potential knowledge bases for companies in their environment even if universities are generally less embedded into their regional context and preferring rather national and international co-operation (Koschatzky-Sternberg 2000). The importance of universities compared with customers and suppliers is by far less for business sector than information and knowledge bases. It is obvious that small companies are co-operating with universities to a less extent and especially local SMEs rarely communicate with universities for technology information, but in case of co-operation geographical proximity has a key role in connection building. It seems

obvious that the co-operative affinity of SMEs is the smallest but it is they are who need cooperation most of all. In case of co-operation SMEs naturally prefer establishing relations with local knowledge bases (Koschätzky-Sternberg 2000).

In regional innovation surveys, special attention is paid for universities as major sources of regional innovation. Our survey surveys among others is assessing the importance of universities in comparison to other actors of innovation system with the channels of knowledge transfer and also the geographical features of knowledge flow between universities and industrial companies. In some less developed regions, the university sector has no links with the economic sector.

It is clear, that most Hungarian businesses do not want to collaborate with any non-business organizations. The most popular non-business organizations for past and future co-operation in the South Transdanubian region are the chambers (47%), the University of Pécs (40%), and the regional innovation centre (DDRFÜ) (37%).

The spatial extent of knowledge flows emanating from university research laboratories has attracted considerable attention in the international literature. There are theoretical arguments for localized knowledge transfers (the importance of tacit knowledge, the role spatial proximity plays in easing maintaining interactions etc) which are supported by empirical evidence largely, however substantial variation can be observed according to firm size, industrial sector or the stage of innovation (Varga 2002).

It is clear that university research units more frequently collaborate with local (within region) firms and the intensity of cooperation vanishes with distance. There are also notable differences across research fields. Whereas for some scientific fields we can observe that active local collaboration is followed by active domestic and international interactivity with firms (Physics and Surgery) for some other fields (such as Informatics and Construction) localized connections are more important than collaborations with distantly located companies.

Several hindering factors may be owed to universities in building regional level relations. Universities are operating by their own rules and principles, which are hard to make compatible with the objectives of business sector. Both universities and companies are organised by their own differing logical, cultural and organisational limits, which raises difficulties in co-operation between the two parties. The majority of the universities' research departments are carrying out basic or applied researches but very few university research organisations are joining experimental development projects. The interest of universities in co-operating with business sector is much more oriented towards short-term fund raisings than towards a strategic development of the innovation chain. Universities with industrial links are rather more interested in projects involving large-scale funding than in the support of SMEs. In several cases, the purchase of technology license from outside the region is much more profitable for companies than intraregional innovation co-operation.

Thus, the potential areas of co-operation should be identified between the two sectors and the institutional background should be created for these links (Tab. 2). A successfully co-operating business and university sector may secure an innovation friendly environment. The majority of researchers are doing basic research and against the difficulties in the financing of higher education are

uninterested in direct co-operation with the business sector yet. Research tasks are fragmented, the concentration and their corporate relation system are weak and market-oriented research-development is still a rare phenomenon. Even recently for example in the case of the University of Pécs, being one of the largest provincial universities in terms of student numbers, 5 years contribution of the business sector project to university's total income was about the third of the one year total budget. Spin-off ventures originating from universities have important functions, although they are rare case in the LDRs (Gál 2003b).

The co-operation of universities and research institutions with businesses and especially pre-competitive researches generally have positive impacts on the business success of companies and the region's economic performance. Yet large and medium-size companies have more extensive relations with universities, though these links are crossing the border of their region, and this seems to support the theory of the low impact of universities on their region. For all that, building information and technology transfer links between SMEs and university R&D bases, the co-ordination of university re-training and information courses are very important for both sectors.

Tab. 2: Motivations behind the university-industry co-operation.

UNIVERSITY	INDUSTRY
Decreasing state support: Gain additional financial resources	Knowledge became the main factor of business competitiveness
Increasing cost of R&D: force to co-operate	Access to knowledge base/R&D
Developing the service & knowledge transfer function of the university	Outsourcing: involving academic expertise
Increasing researchers' practice in outer contracts	Strengthening external relations of companies
New challenges of experimental research & development	Increasing precompetitive R&D
Direct link to the labour market; an increasing labour mobility	Get acquainted with students as a potential future employees
Practice-oriented training	Influence on improving the training structure and curriculum
Strengthening Spin-off enterprises	Favourable start-up conditions
Stimulate Regional development	Stimulate economic development

Source: by the author.

5. Assessment of the regional innovation system in South Transdanubia

When trying to assess the efficiency and coherence of the RIS with regard to the needs and capacities of the regional economies and the extent of matching or mismatching between knowledge and economic specialization (Tab. 3). South Transdanubia is considered a backward region in terms of RTD and the knowledge absorption capacity of its economy, and the basic conditions for change in the technology sphere were rather unfavourable in the region during the transition period¹.

¹ Some restructuring can be seen within the industrial sector, moving towards mechanical engineering and the emergence of high-tech electronics through foreign direct investment; however, the share of labour-intensive, lower-tech sectors, such as the food, textile and leatherwear industries, is still above the national average.

Public sector RTD infrastructure investment, which is dominated by the local universities, is much larger than the investments and RTD capacity of the business sector in South Transdanubia. The orientation of the knowledge creation activity of the region is largely based on the research profile of the two universities. As regards the relationship between RTD and economic specialization, we found a stronger correlation in certain traditional fields with a considerable research background (agrarian research). Universities have also built strengths in biotechnology, laser physics and in environmental science, demonstrating the most promising and deeply rooted avenues of research for the future development of the region. The new clusters of Biotech, Health and the Environmental industries have been built on the expanding knowledge creation capacities of the affiliated faculties and the enterprise networks. Nevertheless, the industrial background of the region in these fields is still weak. Therefore, the research outputs from biotech (produced by the university spin-offs) are still mainly utilized outside the region.

When comparing the matching of the economic structure in the region to its knowledge specialization, some discrepancies can be observed. In contrast to the positive trends in RTD, some fields of natural science are rather under-represented in terms of the research capacity in engineering, while social sciences and humanities with less direct economic benefits are over-represented. The absence of a strong research capacity in S&E during the 1990s became one of the serious obstacles to the modernization of industry, as it was unable to meet the demand coming from the high-tech companies located in the region. The shortage of highly skilled engineering graduates at UP and the lower standard of RTD at the Faculty of Engineering in the fields of informatics, IT and electronics contributed in large measure to the relocation of the NOKIA plant from Pécs in 1999. In the case of engineering, both the weaker research capacities and the low demand from the underdeveloped branches of local industry compound their respective handicaps.

The private sector in the region is dominated by SMEs operating in low/medium-tech sectors (LMT) characterised by a lower level of innovativeness. The smaller number of indigenous large companies mainly specializes in traditional LMT industries (food, textile, leather). A few large enterprises in high tech electronics (mainly multinationals or locally based joint-stock companies) have been engaged in high-tech activities, but their influence on the local RTD sector is considered marginal, as they usually rely on the in-house RTD activities of their parent companies importing the technology from outside the region. Nevertheless, a few dozen innovative SMEs with significant RTD performances are to be found in the biotech, IT, plastic and the mechanical engineering sectors. In general, it can be said that the RTD capacity and visibility of the business sector is still low and the region is heavily dependent on public funding.

However, the main reasons for the poorer performance in RTD activities are the following: on the one hand, the mismatch between the economic and research specializations, combined with the low share of the business sector in RTD investment, the high share of the traditional lower tech sectors, the small size of local SMEs and the consequent lack of resources to invest into RTD and absorb its results and, on the other hand, the lack of demand for research results from larger (mainly foreign) companies and, to some extent, the lack of the necessary knowledge supply in the region in certain fields. These factors, together with other mismatches in economic and RTD specialization, explain why demand for research results in the region remains low.

From a study of the relationships between the regional economic structure and knowledge, creation it can be concluded that establishment of the local knowledge base in some cases (e.g. laser research) did not take the existing sectoral specialization of industry into consideration. In other cases, the extensive agrarian research base, strongly linked to the agro-food sector, is slightly loosening their sectoral background due to the structural decline of agriculture during the transition. The biotech sector, based on the Medical School research teams and university spin-offs, relies to a much lesser extent on local RTD co-operation. As a result, the players have integrated into the interregional RTD networks, establishing co-operation with companies outside the region.

Other research bases in S & E were established in order to extend the disciplinary profile of the HEIs during the 1980-90s, and their development was based on their internal dynamics rather than on local economic development. RTD processes have been speeded up recently mainly through-accelerated public investment. In the future, RTD investment ought to rely much more on the business sector contribution in order to ensure the direct economic benefit of RTD activities, which can foster industrial modernization, and economic restructuring of the regional economy.

The conclusion can be drawn from the findings of the survey that RDTI intensity is not necessarily a decisive element of regional growth. It should be emphasized that the region needs to build on existing capacities rather than attempting to build their strategies by reference to yet undeveloped or non-existent technologies, industries or fields of research. Nevertheless, an international reputation in university-based RTD activities (e.g. biotech), even without an extensive local industrial background, would make the regional knowledge centres more attractive for business sector investment, which may lead to the location of new plants in the region. In addition, when making RTD investment decisions, the importance of the regional context and the established policies have to take into account.

Tab. 3: Strengths and weaknesses of the Regional innovation system.

	Strengths	Weaknesses
Knowledge creation capacity	<ul style="list-style-type: none"> -Strong university base with wide disciplinary profile -The largest provincial university centre in Hungary in terms of the number of students (UP) -Strong RTD base at HEIs in agro and life sciences 	<ul style="list-style-type: none"> -Weak and biased RTI base, -Uneven disciplinary structure in HEIs' RTD (over-representation of social sciences, weaker S&E base) -Limited RTD activity of Business sector -Lower share of national GERD indicates the lower fund absorption capacity in the region -LMT sectoral dominance in the case of SMEs -Low level of patenting activity
Knowledge diffusion capacity	<ul style="list-style-type: none"> -The region has developed technology and business park infrastructure -High-tech oriented university spin-offs with good performance in Biotech 	<ul style="list-style-type: none"> -Technology transfer/liaison infrastructure still in its initial phase and lacks of resources to supply all needs of SMEs

Tab. 3: Strengths and weaknesses of the Regional innovation system (cont.).

Knowledge absorption capacity	-General HR endowment of the region is close to the national average	-Participation rate in Life-long Learning is half of the EU-15 average -Share of HR in S&T is below the national average -Students in tertiary education is lower than the national average
Interactions of main actors	-Huge variety of collaborative programmes - from informal networks, clusters to the Regional University Knowledge Centres – introduced -Active participation by a few innovative firms in a variety of collaborative ventures	-Difficult to orientate and choose among the forms that best fit the participants' needs -Overall low intensity of participation and low level of utilization of results -Weak communication among the different sectors / potential partners
RTDI governance capacity	-Reorganized RTDI governance structure following the EU recommendations, growing regional awareness	-Centralized policy-making but rather weak coordination among the different national bodies -Lack of legislative and decision-making right and financial resources of the regions

Source: edited by the author.

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Summary

The role of universities and research institutes as knowledge centres improving and disseminating comprehensive knowledge have an increasing importance in regional development. Today the facilitation of the spatial diffusion of knowledge, the spatial mechanisms of knowledge transfer and the access of business sector to knowledge bases are priorities in support and development policies (Landabaso 1997). Consensus exists on innovation-oriented regional development in which innovation oriented regional development through the co-operation between businesses and universities continues to play an increasing role not only concerning business success but also in the economic catching up of a certain region.

Spatial differences in economic development have serious impacts on the network relationship of universities and business organisations. The differences between the advanced core regions of metropolitan agglomerations and the most backward regions are manifested in the relationship between universities and their environment. In his researches, Attila Varga is pointing out that agglomerations are not negligible factors of the efficiency of regional development policy. With the same amount of university expenditures the impact of university knowledge transfer is significantly higher in areas of high industrial density than in smaller towns (Varga 2000). This statement has high importance from the aspects of economic policy suggesting that the support of university researches for stimulating local economic development may be an outstanding instrument in case of advanced regions but not necessarily for the backward areas.

Most of the sample businesses still consider the university as a traditional educational centre. The most significant impediment of a stronger co-operation between university units and businesses is the limited information about each other. Most firms have no information about what the university is doing besides education while university researchers and staff have only rather dim ideas about business needs and the potential business application of their research. It is good that recently most university researchers now at least recognize the requirements of practical applicability of their research, but acceptance and appreciation of business requests are still under way.

