The role of mid-range universities in knowledge transfer: the case of non-metropolitan regions in Central and Eastern Europe (examples from Hungary and the Czech Republic)

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THE ROLE OF MID-RANGE UNIVERSITIES IN KNOWLEDGE TRANSFER: THE CASE OF NON-METROPOLITAN REGIONS IN CENTRAL EASTERN EUROPE

(EXAMPLES FROM HUNGARY AND THE CZECH REPUBLIC)

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ABSTRACT

The paper focuses on the specific role of mid-range universities in knowledge transfer and explores the knowledge flows from these mid-range universities facing a number of extra constraints in transitional Central Eastern European (CEE) regions. Mid-range universities, very often located outside of the metropolitan regions, represent the keystones of regional innovation systems for the less developed regions where the "density of contacts" is much lower and possible spillovers emerge more sparsely. The first part of the paper focuses on the types of possible linkages between mid-range universities and industry, and limitations of these relations bringing examples from Western Europe where the position of universities in the collaboration with business sector and their role in the innovation system is quite different form their CEE counterparts. It is mainly due to the different development path of innovation systems and development trajectories in post-communist countries described in the paper. Based on case studies bringing examples mainly from the non-metropolitan regions of Hungary and the Czech Republic, where the number of constraints, such as the lack of critical mass in their techno-economic systems, the traditionally weaker role of university based experimental researches, the mismatch between the economic and knowledge sectors, the weak regional innovation systems and less intense university–industry links are the major impediments of knowledge transfer. The paper argues that ambitious university-based developmental models have to be revised in CEE regions and the future role of universities has to be reconsidered as potential engines of local economic development from a more realistic perspective. The paper also argues, that the regional techno-economic system needs to achieve a certain degree of maturity in order to be able to determine the foci of a research and innovation-oriented regional development within the reindustrializing CEE regions and makes policy recommendation for the mid-range universities to take on new role, which means a stronger regional engagement in also medium-tech innovations and in social and organizational innovation.

1 Introduction

This paper focuses on mid-range universities and their role in knowledge transfer and knowledge flows in the Central Eastern European (CEE) post-communist countries, namely in

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Hungary and in the Czech Republic. The term of mid-ranged universities was borrowed from the study by Wright at al (2009), which is focused on mid-ranged universities and their links with industry in British, Belgian, German and Swedish regions.[3] Mid-range universities in the UK are defined as all universities except top universities and new (post 1992) universities. In the case of UK there are lots of high class universities located in non-metropolitan regions. This is not the case in CEE. Because of historical path-dependence, specified later in chapter 4, there is a substantial spatial concentration of top universities in CEE countries almost exclusively in metropolitan areas. Mid-range universities are most often located in non-metropolitan regions or put it another way, most of the universities outside the capital cities can be classified as midrange, where the RTD potential and "density of contacts" are much lower and possible spillover effects emerge more sparsely. On the other hand mid-range universities represent the keystones of regional innovation systems and are often crucial parts of regional innovation strategies. Expectations with their possible role in re-shaping of regional growth trajectories are also very often overly optimistic. This paper views the non-metropolitan CEE regions from this perspective and to answer the question whether the general economic effects of universities and related R&D investments are visible in transition economies.

The study is the first that applies the mid-range university concept to CEE. The paper discusses the specific role of mid-range universities in knowledge transfer and explores the knowledge flows from these mid-range universities facing a number of extra constraints in transitional CEE regions. These constraints in the long run impede these less developed regions and their universities to exploit the advantages of global knowledge flows transmitted through global knowledge networks and KIBS based clusters of the relatively most advanced CEE regions. The paper also focuses on the peculiarities of university-industry linkages development and on the elaboration of the broader theoretical framework .

The main findings of the paper is based on our empirical research commissioned by ERAWATCH S.A. (Gál and Csonka, 2007). This research analyzed the state of the regional techno-economic systems, the related RTD investments and policies in various European regions (including the Hungarian and Czech regions) with a special focus on the university based knowledge transfers. The main objective of this project is to provide the key factors conductive to increase R&D investment and to identify the main barriers of knowledge transfers from academia to economy. The qualitative regional case study reports are based on

[3] Mid-range universities in the UK are defined as all universities except top universities and new (post 1992) universities and there are lots of high class universities which are located in non-metropolitan regions.

primary statistical analysis and stakeholder interviews conducted with policy makers, entrepreneurs and R&D professionals.

This paper is structured as follows. The first part focuses on the types of possible university-industry linkages in the case of mid-range universities, and limitations of these relations as well as on the theoretical framework of knowledge transfers. Next part examines the development path of innovation systems and peculiar trajectories in post-communist countries. In the third part, case studies based on Erawatch research bring examples from the non-metropolitan regions of Hungary and the Czech Republic on the universal but also the specific barriers for knowledge transfer and explain the reasons behind the traditionally weaker role of mid-range universities. The conclusion summarizes the main findings of the empirical research and makes policy recommendation for the mid-range universities in CEE.

2 Universities, innovation and knowledge transfer

According to Acworth, (2008) universities are ranked behind competitors, customers, exhibitions, own research, suppliers, trade associations and other sources. This is surprising, but there are grounds for believing that the role of universities in the knowledge economy will acquire greater importance and there are several reasons for anticipating such a trend (Yusuf, 2009):

- Firms are assigning to product and process innovation to sustain competitiveness, enhance returns and to diversify into promising market niches. This trend, which has surfaced only in the past decade, is likely to strengthen the tendency of firms to adopt 'open' innovation strategies. In this stage of development perhaps only the more prominent, large, strategically located ones with an established track record of research in specific fields are attractive for firms.
- University researchers are the principal channels through which new knowledge enters the commercial domain and dynamic firms are turning to the new opportunities arising from scientific advances.
- Universities need to diversify sources of funding (intensifying competition for students, faculty, research contracts, and IP) to maintain their academic standing and in some cases, to even survive. In fact, attracting more and better students is a function of the calibre of the faculty and the university's reputation in its selected areas of research, because even the largest and best-endowed universities have to specialize to some degree.

- The encouragement and incentives that governments are giving to the university sector in an effort to expand the research function. The rising relative costs of education, much like health costs, in conjunction with fiscal and demographic pressures (which vary in severity from country to country), are using public policies in a broad spectrum of countries, to push for closer and multi-stranded university industry linkages.

New industries are drawing on technologies that are not yet codified, so they are far more reliant on the tacit knowledge of researchers. For this reason, proximity to universities, contacts and papers jointly authored with researchers and access to as well as assimilation of this tacit knowledge through several channels, is advantageous to pioneering firms (Zucker et al. ., 2002).

Direct and indirect forms of knowledge transfer tend to be associated with the dichotomy between tacit and explicit knowledge (Polanyi, 1967). Tacit knowledge cannot be codified, and is hard to formalize and communicate (Nonaka, 1991). The transfer of tacit knowledge requires close social interaction between people and is difficult to manage. The knowledge that underlies skilful performance at universities is in large part tacit knowledge, in the sense that scientists are not fully aware of the details of their skills and find it difficult or impossible to articulate a full account of those details (Nelson and Winter, 1982). The concept of tacit knowledge is important for those trying to understand the roots of uniqueness at universities because it is the unexpressed knowledge and experiences of organizations which provide the unique competencies that cannot easily be replicated by competitors (Barney, 1991). In contrast, explicit knowledge can be more easily articulated and universities increasingly have developed various sorts of IP policies to protect this form of knowledge and capture its value. The underlying premise of this policy is that most of the knowledge at a university is explicit and could benefit from being marketed by technology transfer offices (TTOs).

3 Types of university–industry linkages

There is a vast literature focusing on the mechanisms of knowledge transfer. To examine the nature of university–industry linkages involving knowledge and technology transfer, we adapt a framework developed by Polt et al. (2001) and partly reflected in the case study focused on mid-range universities in mid-range environments in the UK, Belgium, Germany and Sweden by Wright et al. (2009). In their findings they "suggest that midrange universities primarily need to focus on generating world-class research and critical mass in areas of expertise, as well as developing different types of intermediaries. Midrange universities may need to develop a portfolio of university–industry linkages in terms of the scope of activities and the

types of firms with which they interact". They also showed that "different intermediaries have important roles to play in developing university–industry linkages for mid-range universities". We tried to find relevance specific also on CEE countries, but in our opinion the framework is general enough and also fits very well to the specificities of CEE countries.

3.1 Spin-offs

Central and Eastern European case studies – though they are still rare in the literature – show that university environment in most of the CEECs for spin-offs is rooted in the continental (mainly German) tradition, but it also inherits some characteristics from the even more centralized socialist (soviet) tradition (Erdős-Varga, 2009). In general**,** Europe performs less successfully than the US in transferring knowledge from university labs to the regional economy via spin-off companies. The main reasons behind this can be derived from the different nature of the status of researchers between the US and universities in continental Europe (Franzoni and Lissoni 2009).

3.2 Licensing

Licensing has traditionally been the most popular mode of university technology transfer (Siegel et al. ., 2003a,b) and arguably involves little transfer of tacit knowledge. Universities in regions with higher levels of R&D and GDP appear to be efficient in technology transfer, implying that there may be regional spillovers in university technology transfer. DiGregorio and Shane (2003) suggest that top universities will always look to 'spin-off', but 'second rank' universities are more likely to use licensing as the average licensing income is "short-term and not very high" (Wright at al. 2009).

3.3 Contract research, consulting and reach-out

Typically, contract research between a university researcher and a corporation involves applied research, often in the form of specified formal knowledge. From a commercial standpoint, these ideas are still at a very early stage and only a fraction of the knowledge is actually codified (Poyago-Theotoky et al. ., 2002). Measuring of these activities is often very difficult. Nevertheless, university systems make an important contribution to them.

What seems to be crucial for the mid-range universities is the complementarity in fundamental research to the local needs of the local industry. Research centres of excellence

typically do not only have local contracts; they play at the international level as well. That means that a research group has to build up a minimum critical size in a particular domain to ensure long-term competitive advantage (Wright at al. 2009).

3.4 Graduate and researcher mobility

Graduate mobility is quite closely related to contract research as graduates from universities might embody the absorptive capacity an industry needs to identify opportunities at universities. In other words, it may be an important source of local knowledge transfer as evidence suggests that graduates will often reside in their local area (Jaffe et al. ., 1993).

But especially in continental European universities, industry research experience is not seen as adding value to a job application (Wright at al. 2009).

3.5 Intermediaries

Intermediaries that play boundary-spanning roles between universities and SMEs are not new. Different types of intermediary may be equipped to facilitate the transfer of tacit or explicit knowledge. These intermediaries can involve a range of actors from those internal to the university (e.g. TTOs, specialist fellows), through intermediate organizations such as incubators and science parks, to those that are external (e.g. surrogate entrepreneurs, venture capital firms and development agencies).

3.6 The stronger regional engagement of mid-range universities

In less developed regions, particularly in CEE, for mid-range universities, not necessarily producing world-class research a stronger engagement in low and medium tech innovations and community service would be important functions to develop (Srinivas and Viljamaa 2008). Universities once largely focused on *teaching (first* mission*)* and *research* (second mission) while recently universities adapt *developmental role*, the so called third mission, in *regional economic and innovation development*, which can also be described as "community service" and "regional engagement". There is a pressure from government on businesses and communities for universities to align their core functions with regional needs (Boucher G., Conway C. and Van der Meer E. 2003). From a regional perspective, universities appear to be increasingly viewed as an economic asset especially because, unlike firms, they are relatively

permanent institutions and therefore "safer" for development policy measures. The third role calls for universities to transform themselves into economic institutions by taking on specific tasks such as greater technology transfer, more patenting, visible employment, and commercial outputs (Gunasekara 2004, 2005).

In regard to the role that universities perform in regional innovation systems, there are two dominant approaches to conceptualisation. These two approaches — the triple helix model of university, industry, government relations (Etzkowitz and Leydesdorff, 1999; Etzkowitz, 2003) and the literature on the engaged university — overlap, but also manifest some important differences in emphasis and the literature on university engagement (Holland, 1999, 2001; Chatterton and Goddard, 2000).

This model can be adopted by those mid-range universities in the less developed regions of Central and Eastern Europe, which do not have the critical mass to engage in world class scientific research, but instead they can focus on other than high-technology innovation. Commitments to social and organizational innovation gaining more-and more importance as main barriers emerge from the social sides even if universities and regions try to introduce adopted technologies.[4]

The literature on the engaged university models puts emphasis on adaptive responses by universities, which embed a stronger regional focus in their teaching and research missions (Goddard, J., 1999, Hagen, 2002, Goddard, J., and P. Chatterton, 1999). While accepting that universities may well undertake generative activities, it proposes that they adopt a broader, *developmental* focus on adapting their core functions of teaching and research, as well as community service, to address regional needs.

For the less developed, reindustrializing CEE regions (industrial catchers) with substantial human capital resources, benefiting from the relocation of European industry but not yet fully developed knowledge creation capacities, this special situation forces mid-range universities to take on new roles in contrast with other countries/regions where university-state-industry-citizen relations have perhaps had longer time frames to evolve. This new role means a stronger regional engagement in medium-tech innovations and in social & organizational innovation. The impact of local universities is not restricted to technical sphere but may spread into wider social and economic effects on their region. Social and organizational innovation means in wider context the generation and implementation of new ideas in order to

[4] A good example derived even from the Silicon Valley proves this new trend as since 2008 the Standford University spent more on social and organizational innovation than on technology oriented R&D!

overcome the social barriers of innovation and it requires ongoing social interactions. This facilitates the formation of new institutions, networks and building up social capital through collective learning processes (Fumi, 2004). Nevertheless, in the CEE countries with centrally coordinated innovation policies, non-capital city-regions have substantially different innovation and third role histories and policy options than in capital city regions.

4 Path-dependent development of innovation systems in post-communist countries

4.1 Restructuring the R&D funding system during transition period

The expenditures on R&D as a percentage of GDP (GERD)[5] under Communist regimes were not too much below the expenditures in Western countries (Lepori at al, 2009). For example in Russia in 1990 the expenditures on R&D as a percentage of GDP (GERD) reached 2.98% which was actually the original target of the Lisbon strategy from 2000. A large share of research and development in socialist economies was of the ”reinventing the wheel” type, that is, of the excessive import substitution type (Yegorov, 2009, Radosevic and Lepori, 2009). On the other hand, thanks to the focus on military and space research, communist countries were able to keep pace with Western countries. Also in non-military research some industry branches and their research institutes (like heavy engineering, garment or food chemistry research institutes) were fully comparable with the world top research base. On the other hand, there were certain neglected R&D branches like IT, biotechnologies, and so on.

Funding of research in CEE has undergone significant changes in terms of funding sources, performers and instruments. The overall transformation was shaped by the economic restructuring and by two key systemic changes: opening of previously closed research systems and gradual introduction of the principle of quality in funding criteria (Radosevic, Lepori, 2009). In the first phase, a decline in economic development came largely as a result of institutional uncertainty, not only in terms of institutional system but also in terms of disrupted production, technology and trade linkages (Havrylyshyn, 2006; Mickiewicz, 2005).

The common trend was a very sharp decline in relative funding for R&D in relation to GDP, where the average gross expenditure on R&D (GERD)/GDP ratio in CEE-10 fell from well above 1% to 0.8% in 1994. In case of Hungary and the Czech Republic, the minimum was reached in 1996-1999 by the value of 0.7% of GDP (Gál, 2005). As economic growth

[5] Gross expenditure on Research and Development

kicked off in all CEE-10 countries in 2000, this led to stabilisation of relative R&D expenditures. With the continuation of growth but, even more importantly, with the accession to the EU came an increase in GERD/GDP ratios, which could be largely attributed to the EU funding. On the average of CEE-10, GERD/GDP increased from 0.75% in 2000 to 0.90% in 2007, however, with very large differences between countries. GERD/GDP exceeds 1.5% in the Czech Republic and Estonia, thus approaching the level of some western-European countries, but it is still below 0.5% of GDP in Slovakia and Bulgaria (Eurostat, 2009).

The main source of funding of R&D in CEE-10 is government (49% in 2007) closely followed by industry (40%). This is typical for countries of this level of development, with the two richest countries (Slovenia and the Czech Republic) having shares of industry above 50% (Radosevic and Lepori, 2009).

Changes in funding bodies and sources since the mid-2000s strongly reflect Europeanisation of R&D systems of the CEE-10 (Radosevic and Lepori, 2009). This led to a variety of adjustment strategies of R&D institutes, many of which opted to move upstream towards basic research where they knew that the state would still preserve its funding responsibility. In some countries, they have been losing their function of funding agency, as in Poland, where their institutes are entirely funded by research ministry (Jabłecka and Lepori, 2009), while in yet other cases their size has been reduced, but they kept essentially their organisations and functions (as in the Czech Republic; Lepori *et al.* , 2009) or even they are still the dominant player in the public research sector, as in Bulgaria (Simeonova, 2006) and Hungary (Havas, 2007; Mosoni-Fried, 2004). In all countries, higher education institutions have emerged as a major player in public research, but there are still large differences between countries in this respect.

4. 2 Specific role of universities in university-industry linkages in post-communist countries

The role of universities in R&D sector in post-communist countries is different and relatively weaker than in Western countries. It is connected with the different organisational forms of basic and applied research in these countries before 1989 and also to a big extent two decades after. Both, basic and applied research was mostly concentrated outside of universities, in academies of sciences or in applied research institutes in industry. Universities traditionally did not play the central role in the basic and applied research. This is important to take into account when we think about the specific role of universities in post-communist countries. In old-EU member states the university systems can be divided into two basic

groups (Bonaccorsi and Daraio, 2009): the group of universities with specialized profile, where universities can be research-oriented or teaching oriented (like in UK, Netherlands) and undifferentiated system (Italy, Spain, Portugal) which is also more resembled to post-communist countries. They were much more focused on teaching and the collaboration with industry was facing many organisational and administrative constrains.

In this sense, in communist countries applied research was concentrated in companies and branch R&D institutes. They had only limited connection with (mostly technical) universities. Basic research was carried out in the institutes of Academy of Sciences and their role was not primarily focused on collaboration with industry. Their spatial concentration in capital cities or in big cities like Budapest, Prague or Brno did not help much to spillover of knowledge between them and mid-range universities located mostly outside of these agglomerations. Therefore it can be argued that, despite its revitalisation, the highly concentrated institutional network of academies play a less important role in regional innovation.

After 1989, especially in 1990s the situation did not change so much. Universities were mostly facing the pressure of the state to increase their educational role. The system of universities financing in this decade did not motivate them to search for new contacts and collaboration with industry and it was much easier to survive and to develop further thanks to rising number of students.

This rigid situation remained at the Academy of Sciences as well. For both universities and for Academies of Sciences we can describe the lack of managerial skills, the lack of finances, brain drain from here to private sector or abroad, organisational and institutional limitation of research commercialisation as their common characteristics. They often selected defensive strategy and instead of reducing the number of employees, they reduced their material costs to save their human capital (Yegorov, 2009). In better cases more efficient scientists stayed there and were running private businesses using “state” equipment. This enabled them to stay in contact with industry and it has led to the paradox: nowadays these researchers are one of the key persons enabling knowledge spillover from universities into industry.

The situation after 2000 started to change slowly at the universities because of slow “marketisation” of the sector as a result of several factors. Generally speaking it was the recognition of knowledge as a source of economic growth. The marketisation started to use standard tools borrowed from Western Europe, but the result cannot be the same because of different history and position of universities in the regional or national innovation systems.

This has led to the changes in the legislation. Post-communist states started to elaborate national and regional innovation strategies and to implement innovation acts (Hungary in

2004). It was a kind of response to the pressure of the EU during accession negotiations. EU accession and possibility to use cohesion funds for building of knowledge infrastructure induced an active approach from the side of universities. Establishing of supporting innovation infrastructure (scientific parks, scientific incubators) was further developed at the universities thanks to the role of intermediaries (mostly TTOs or R&D services) which focused on the one hand on building of ties with industry and on the other hand on gaining of the EU funds for infrastructure building.

Another very important factor is the response to the changed structure of FDI coming into the region. After 2000 we can observe a quite clear trend of incoming FDI – from the low-paid routine labour towards investment requiring skilled and university educated labour force. In this sense we can speak about the pioneering role of MNCs in the knowledge spillover from universities to industry (Ptáček, 2009).

The regional impact of these processes is leading to the ongoing polarisation of the R&D potential between metropolitan and non-metropolitan areas (Ptáček, 2009, Gál 2005). This resulted in that mid-range universities not only remain the keystones of regional innovation infrastructure outside of the metropolitan regions but even increase their role. Sectoral research institutes and design bureaus (as probably the most perspective units connecting R&D with praxis) were mostly closed down and so their role was taken over by local universities.

Generally speaking, the role of mid-range universities in post-communist countries is weaker than in more developed countries of the EU and the process of adaptation on new social and economic conditions started substantially later than in Western Europe. At the same time mid-range universities located mostly outside of the metropolitan areas have to face similar problems and disadvantages as in their western counterparts.

5 Knowledge transfers in Central and Eastern European universities – the cases from Hungarian and Czech regions

5.1 'Below the critical mass' – the limited economic impact of universities in non-metropolitan regions

It is often argued that universities are able to generate economic effects based on knowledge spillovers and innovation transfers to businesses (Etzkowitz et al. 2000). The

differences between the advanced regions of metropolitan agglomerations and the most backward regions are emphasised in the relationship between universities and their regions (Ács et al. 2000). Varga (2000) argues that the presence of a "critical mass" of agglomeration is required in order to expect substantial local economic effects of academic research. His paper on the geography of university-based knowledge spillovers finds that agglomerations are not negligible factors of regional development policy. With the same amount of university expenditures the impact of university knowledge transfer is significantly higher in metropolitan areas with high industrial density than in less developed regions. Only those metropolitan areas possess the "critical mass" of local economic activities and absorb university generated spillovers in the most efficient manner, which are located in the largest knowledge-based agglomerations.[6] The regional differences between the advanced metropolitan and the less developed regions are manifested in the relationship between universities and their environment.

In many regional situations increasing R&D investment does not have a significant and immediate impact on growth and university researches for local economic development may be an outstanding instrument in case of advanced regions but not necessarily for the less developed regions where the lack of appropriate industrial base is one of the main constraints. The level of impact is highly depending on regions' absorption capacity, and this has to do with their institutional set up, techno-economic characteristics and economic specialization and this explains why the same amount of R&D investment can generate quite different performance in different environment (Goldstein and Renault, 2004, Varga 2003).

This means most of the non-metropolitan CEE regions, where the regional innovation systems are still weak, so are the university and industry linkages that the role of universities in local development has to be revised and, consequently, the economic impact of universities cannot be unambiguously extended to transition economies. Bajmóczy and Lukovics (2009) measure the contribution of Hungarian universities to regional economic and innovation performance between 1998 and 2004. The results showed that the presence of universities does not affect the growth rate of per capita GVA (economic performance) and gross tax base per tax payer (incomes). Research concluded that the knowledge-producing ability did not increase knowledge-exploitation ability of the local business sector. Paradoxically, regions without stronger university base proved to be better in terms of their economic performance

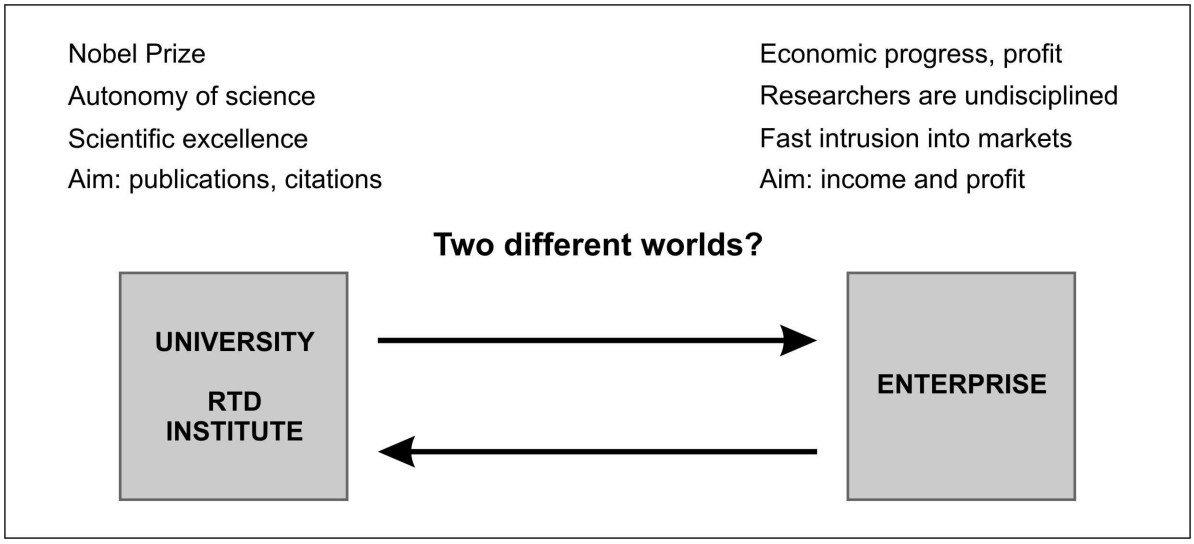
[6] These agglomerations with at least 3 million inhabitants are specialized in high-tech industries with about 40 thousands employees and in developed RTD sector with at least 4 thousands professional research staff.

strongly related to factor inputs. West Transdanubian region, while in the vanguard of economic development through the attraction of FDI, has weaker than expected R&D performance and institutional framework for research (lack of traditional universities). Although, the strong FDI presence has not been accompanied by statistically-significant R&D activities in North-west Hungary, the industrial and innovative traditions, the concentration of multinationals into the high-technology sectors and the formation of Pannon Automotive Cluster have increased the innovation potential in the region (Gál, 2005).

5.2 Barriers in university–industry links: the limits of university based knowledge transfers in South Transdanubia (Hungary) and in non-metropolitan regions in the Czech Republic

In the case of less developed regions, universities may be responsible for several hindering factors of intraregional knowledge transfer. Among the others the professional, organizational and cultural differences can be described. Universities are operating by their own rules and principles, which are hard to make compatible with the objectives of the business sector. Both universities and companies are organised by their own differing logical, cultural and organisational limits, which often raises difficulties in co-operation between the two parties (Figure 1). The majority of university research departments carry out basic or applied research, but very few university research organisations are joining experimental development projects. The interest of universities in co-operating with the business sector is much more oriented towards short-term fund-raising 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 licenses from outside the region is much more profitable for companies than intraregional co-operation. Moreover, universities as the potential knowledge sources for firms located in their vicinity, are less integrated in their respective region, since they prefer international co-operation therefore RTD activities (e.g. biotech), without an extensive local industrial background, would transfer most of their knowledge internationally (Koschatzky, 2002).

Figure 1 Cultural barriers between university and businesses



Source: edited by the authors based on Gál, 2008

Thus, the potential areas of co-operation should be identified between the two sectors and an institutional background should be created for these links. A successfully co-operating business and university sector may secure an innovation-friendly environment (Table 1). The majority of researchers is doing basic research and despite the difficulties in the financing of higher education is uninterested in direct co-operation with the business sector as yet. Research tasks are fragmented, the concentration and their corporate relation system are weak, and market-oriented research is still a rare phenomenon. To provide an example from the University of Pécs a half-decade contribution by the business sector contracts to the university's total income in 2005 was about the third of the average annual budget (Gál, 2008).

Table 1. Motivations behind university-industry co-operation

UNIVERSITY	INDUSTRY
Decreasing state support: gain additional financial resources	Knowledge has become the main factor of business competitiveness
Increasing cost of R&D: force to co-operate	Access to knowledge base/R&D infrastructures

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 R&D	Increasing pre-competitive R&D
Direct link to the labour market; an increasing labour mobility	Students recruitments
Practice-oriented training	Influence on improving the training structure and curriculum
Strengthening spin-off enterprises	Favourable start-up conditions
Stimulating regional development	Stimulating economic development

Source: Gál, 2008

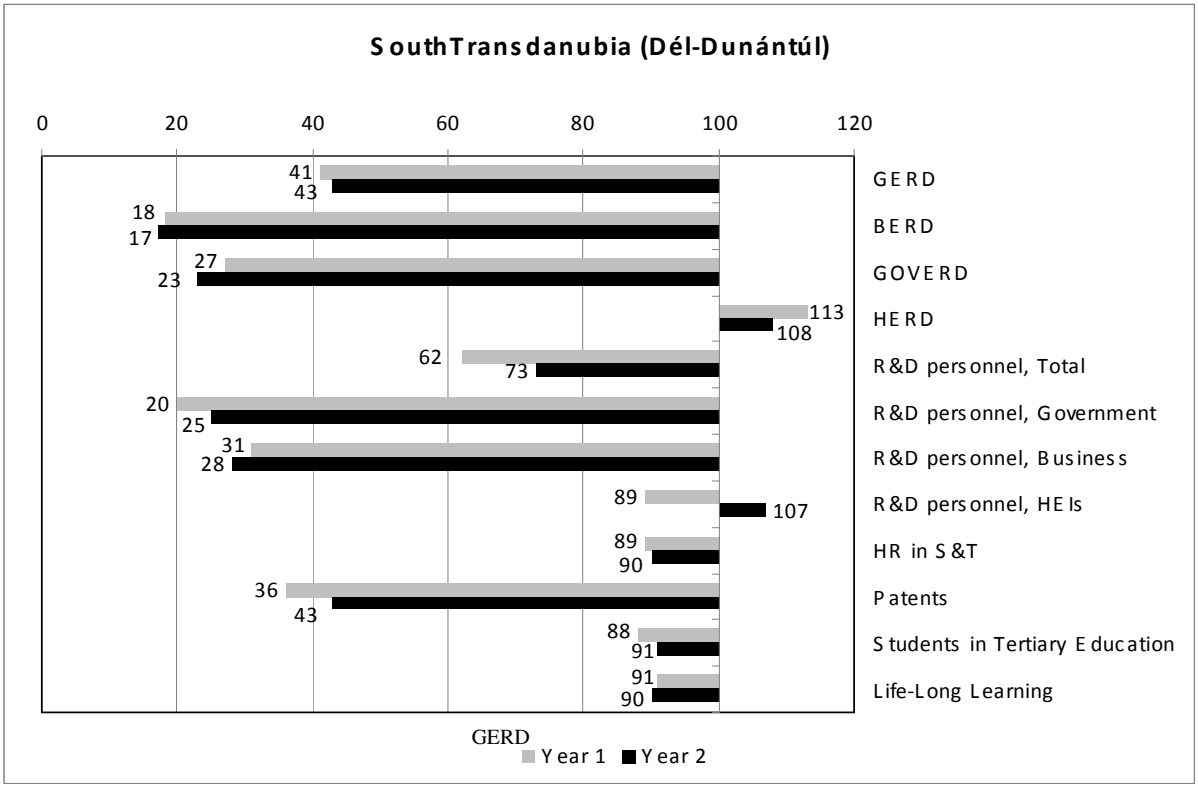
The following part of this section provides the main findings of our qualitative regional case study of the South Transdanubia conducted within the framework of regional benchmarking project by ERAWATCH S.A. (2007). This focuses on the constraints of knowledge transfers in the case of mid-range universities located in the less developed regions and their impacts on the local techno-economic systems (Gál and Csonka, 2007).

South Transdanubia is a less developed reindustrializing region with lower knowledge absorption capacity and with an underdeveloped RTD sector relative to the national average (Figure 2). Basic conditions for change in the technology sphere are rather unfavourable. Its regional GERD was 23.8 M Euro in 2007, which is only 2,5% of Hungary's total. The region has one of the poorest R&D capacities in Hungary (in 2007 with only 4.1 % of the Hungarian R&D employees). The region has large public RTD infrastructure mainly based on the two universities[7] absorbing more than four fifth of regional GERD, therefore the HEI[8] sector plays dominant role in R&D performance. Unlike the public RTD sector, the visibility and the performance of the business sector is very low, even in comparison with the national average. The RTD creation of the business sector in Southern Transdanubia is limited (3.4 M € BERD in 2004). Universities are the major employers of RTD personnel. The orientation of the knowledge creation activity of the region is based to a great extent on the profile of its universities, which have the strongest potential in life science (biotech) research and they also have a good reputation with measurable RTD outputs in laser physics, environmental and

[7] University of Pécs (est. 1367) and University of Kaposvár (est. 2000).
[8] Higher Education Institute

animal cytology research.[9] 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.

*Figure 2 Key indicators on Southern Transdanubia's knowledge base development in comparison to the national average, in percentage**



Source: calculated by the Author based on EUROSTAT and KSH (Hungarian Statistical Office) data[10]

Note: The following years were used for BERD, GERD, HERD GOVERD1999, 2003; R&D personnel 1999, 2004; HR 1997,2004; Patents 199s, 2003 and Lifelong learning 1999, 2004.

In South Transdanubia there is a clear mismatch between the knowledge-production specialisation and the economic structure. In order to detect these differences of economic impacts of knowledge creation and the spatial variations of knowledge spillovers within the European regions ERAWATCH report grouped the surveyed regions into seven and the CEE

[9] The relative strength of biotech research base is demonstrated by its large share of total input-output indicators and also by the increase of RTD spending in this field (64.8m in 2004). In addition, the 11 university spin-offs in the biotech sector are tightly connected to the Medical School (MS) which has 48 employees and produces a turnover of €3 million (2004).

[10] **BERD= Business expenditure on Research and Development; GERD= Gross expenditure on Research and Development; HERD= Higher Education expenditure on Research and Development; GOVERD= Government expenditure on Research and Development.*

regions into three categories (restructuring industrial, reindustrializing and predominantly agricultural) in terms of the collected indicators describing their techno- economic conditions (Dory 2008). Our survey found that contrary to the restructuring industrial regions surrounded the capital cities in the Czech Republic and Hungary where research specialisation is generally aligned with their economic specialisation, the reindustrializing regions in the same countries are in intermediate stage. Despite their long-standing industrial traditions, the close match between the regional knowledge base and the needs of industry are often not the case and the absorption capacity of local economy is hindered by several factors.

The economic structure of this region type is characterised by the important role of manufacturing in low-to-medium technology sectors. Medium-to-high-tech and high-tech sectors have taken a larger role only in some of these regions as a result of multinationals relocating production – and in few cases also some R&D – to these regions (Jihozapad in the Czech Republic).[11] Long-standing industrial traditions, the close match between the regional knowledge base and the needs of industry are among the main features of these regions. Nevertheless, this type of development is only possible if the regional RTD supply matches the needs of the local industry. This is a major issue for those regions where transnational companies occupy dominant positions in manufacturing but are still heavily reliant on their own technologies, usually brought from outside the region.

Thus, the mismatch between the knowledge base and the needs of the regional economy often hinders spillovers and exploitation of research results. Our survey on South Transdanubia identified the main reasons for the poorer performance in RTD transfers. On the one hand, the mismatch between the economic and research specialisations, 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-owned) companies and, to some extent, the lack of the necessary knowledge supply in the region in certain fields (Gál and Csonka 2007). For instance, a lack of research capacity in science and engineering can be a serious obstacle to the modernisation of the regional industrial structure. A few large enterprises in high tech electronics have been

[11]As long as these regions have some strong research facilities, at least in their national context, the RTD policy measures usually aim at upgrading and further developing the existing regional R&D capacities. These capacities can be also exploited by foreign companies relocating into the region. Foreign investors have established some R&D centres and they are developing some links to the regional research community thanks to the networking and cluster initiatives (e.g. *Jihozapad* in the Czech Republic*)*.

engaged in high-tech activities, but their influence on the local RTD sector is considered to be marginal, as they usually rely on the in-house RTD activities of their parent companies importing the technology from outside the region. These factors, together with other mismatches in economic and RTD specialisation, 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 in South Transdaniubia it can be concluded that establishment of the local knowledge base in some cases (e.g. laser research) did not take the existing sectoral specialisation of industry into consideration. In other cases, the extensive agrarian research base (Kaposvár University), 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's research teams and university spin-offs at the Pécs University, 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 (Gál and Csonka 2007).

The conclusion can be drawn from the findings of the survey that R&D investment is not necessarily a decisive element of regional growth, which resembles the main findings of the nation-wide case study introduced earlier. It should be emphasised that the region needs to build on existing capacities rather than attempting to build their strategies by reference to as yet undeveloped or non-existent technologies, industries or fields of research. In this case industrial traditions and path-dependent development do really matter, as there are no outstanding success stories without antecedent achievements. 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 attract new plants into the region.

The analysis presented that investments in RTD activities has had most impact in those developed regions that have high absorption capacities and an economic structure whose innovative actors are able to exploit transferred research results. In the light of the cases examined, even increased RTD investments in selected areas might have limited impact on economic performance of their regions. This is particularly true for the less developed transition regions with traditional, less knowledge intensive sectors (e.g. agriculture, food processing or tourism) need to be aware that RTD investments might have only a limited impact on their economic performance, at least in the short to medium term. It should be accepted that these regions are specialised in activities that are not highly research intensive,

therefore increased R&D expenditures cannot be easily exploited by local businesses. In these situations, setting up new research base that are not linked to the needs of the regional economy could be like building "*cathedrals in the desert*" as they are unlikely to be able to develop knowledge transfer and spillovers with local economic actors (Dory, 2008).

Research bases in science & engineering 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. Nevertheless, recent policy measures are now aimed at supporting the establishment of spin-off companies, public-sector research and the development of regional knowledge centres that match the specialisation of public research base. But 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 modernisation and economic restructuring of the regional economy (Table 2).

Table 2. Strengths and weaknesses of the regional innovation system of South Transdanubian region

	Strengths	**Weaknesses**
Knowledge creation capacity	– 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	– Weak and biased RTI base, – Low match in knowledge & economic specialisation – 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 – Low & Medium Tech sectoral dominance in the case of
Knowledge diffusion capacity	– The region has developed technology and business park infrastructure – High-tech oriented university spin-offs only in Biotech	– Technology transfer/liaison infrastructure still in its initial phase and lacks resources to supply all needs of SMEs
Knowledge absorption capacity	– General HR endowment of the region is close to the national average	– Participation rate in Lifelong 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
Interaction of main actors	– Huge variety of collaborative programmes from informal networks, cluster initiatives 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 utilisation of results – Weak communication among the different sectors / potential partners
RTDI Governance capacity	– Reorganised RTDI governance structure following EU re-commendations, growing regi-onal awareness	– Centralised policy-making but rather weak coordination among the different national and regional bodies – Lack of legislative and decision- making rights and financial resources of the regions

Source: edited by the authors based on interviews and Gál & Csonka 2007

Recent paper in spin-off formation brings cases of the Central and East European academic entrepreneurialism (Erdős and Varga 2009). Interviewing university spin-off firm founders in the Hungarian biotechnology sector the survey has found that the academic entrepreneur does exist even within the context of the continental European institutions. While spin-off incentive policies of the universities surprisingly do not show sensible impacts on the emergence of these "classical" academic firms supportive departmental attitudes are crucial in their success. In the absence of a friendly environment at the department or the necessary business knowledge and financial resources academic entrepreneurs hindered and the established company does not enrich scientific activities at the university lab. Surprisingly the Hungarian spin-off research found that despite university policies supporting spin-off firm formation does not result in "classical" academic entrepreneurial firms but rather in companies with limited business-academia synergies (Erdős and Varga 2009).

Besides academia–industry cooperation and spin-offs formation there are other forms of university-related knowledge transfers. Universities can also act as regional actors developing stronger partnerships between universities and the regional development agencies emphasising the key role of higher education in regional development. University based innovative actions in many western universities rely on the 'principle of helping their regions' to mobilise local knowledge in a process of collective learning in order to serve local community (Henderson and Thomas, 1999). The policy approaches and activities in CEE regions almost exclusively concentrated only on the first two missions of the universities (education & research) and the notion of regional engagement did not constitute the part of the university strategies up until very recently. Two compelling endogenous and exogenous factors are contributed to the recognition of the importance of stronger regional engagement of the universities recently. Firstly, the accumulated knowledge and the experiences of staff at the HEIs provide expertise in various fields, and this can be a very effective way of accelerating progress of collaboration through the exploitation of economic and social interactions transmitted by spin-offs and other university based consultants within the newly formed regional networks. Secondly, exogenous pressures are extorted by the crisis, new market demand and policy goals envisaged real regional and social prosperity integrating knowledge, social and human development. This latter factor facilitates connectivity among different institutions and will provide not only better funding opportunities but also a

collective learning platform for social interactions (Leyersdorf and Etzkovitz, 2001). In sustaining and generating the culture of the regional capital of South Transdanubia, the University of Pécs has played a principal role in organizing of the European Cultural Capital project, which became the ever largest exercise of community service of the local university heavily involved not only in the cultural events but in the development of the new cultural, community and educational functions of the city's newly built cultural quarter (Lux, 2010).

In this way, regional advantage generated by these new forms of knowledge transfers may be pro-actively constructed, which involves a more active role for the public sector. The lack of connectivity between different actors of regional innovation system can be regarded as market failure and public intervention can be justified. Asheim, Boschma and Cook (2009) introduce the concept of related variety: "It is a concept that links knowledge spillovers to economic renewal, new growth paths and regional growth. If pervasive, it implies that the long-term development of regions depends on their ability to diversify into new applications and new sectors while building on their current knowledge base and competences". It is impossible to copy or imitate new sectors that are strongly embedded in, and depend on region-specific related resources and assets.

However, the "related variety" is often missing in CEE regions and the development of organisational and social innovation seems to be one of the most important factors for their possible success. The South Moravian region in the Czech Republic can be regarded as an exception where both systematic elaboration and implementation of innovation policy started already in 2002. Nowadays there has been accepted the third version of the regional innovation strategy which is already focusing on distributed knowledge networks and utilizing the whole range of social and organisational innovations. Not only the regional innovation strategy has been elaborated and updated, but also negotiation mechanisms between universities and private sectors are systematically cultivated and supported. The number of spin-off companies and their sectoral accordance with the local universities are good example of this systematic collaboration as well as a big number of newly located TNC's which also discovered the potential of collaboration with universities in Brno. Active and long-lasting institutional support seems to be crucial. Other non-metropolitan regions in the Czech Republic not only miss the basic preconditions like critical mass or mismatch between the specialisation of universities and regional economy, but also systematic institutional collaboration. For example the Olomouc region, neighbouring to South Moravia, only started to elaborate its innovation strategy in 2010 and there is still not consensus between different actors about common goals and strategies.

6 Conclusions

This paper has analysed the specific role of mid-range universities in knowledge transfers and explores the knowledge flows from these mid-range universities facing a number of extra constraints in the less developed CEE regions. These constraints impede these universities to build linkages to the local economy and develop internationally recognized areas of research excellence, with the associated critical mass, and exploit the advantages of global knowledge networks. Previous models applied to Western European universities suggest that in order to attract research funding mid-range universities primarily need to focus on generating world-class research and critical mass in areas of expertise, as well as developing different types of intermediaries. Only if sufficient critical mass is created, can a sound innovation policy strategy be developed for the research department and eventually the scope of different knowledge transfer activities and spin-offs become a possible outcome (Wright at al. 2009).

Our research supports the hypothesis that knowledge flows from mid-range universities located in CEE face a number of extra constraints in comparison with their western counterparts. The research found that not only the position of universities in the collaboration with business sector but their role in the innovation system is quite different, which is mainly due to the different development path of innovation systems and development trajectories in post-communist countries described in the paper. Because of historical path-dependence mid-range universities, unlike top-universities, are very often located in non- metropolitan regions in CEE countries where the RTD potential and "density of contacts" are much lower and possible spillovers emerge more sparsely than in capital city regions. Our case studies bring examples from less developed Hungarian and Czech regions where the number of constraints, such as the lack of critical mass in their techno-economic systems, the traditionally weaker role of university based experimental researches, the mismatch between the economic and knowledge sectors, the weak regional innovation systems and less intense university–industry links and lower possibilities of spillovers are the major impediments of knowledge transfer. Despite the fact that post-communist economies are trying to narrow the gap with the old EU countries, to overcome of the path-dependent

development of institutions and inertia of the system makes things more difficult and slower than in Western Europe.[12]

In peripheral regions, including Southern Transdanubia, increasing R&D investment does not have an automatic and immediate impact on growth and job creation. Based on our case study we found that the impact of investment in research largely depended on the regional techno-economic situation of a particular region. The paper argued that the regional techno-economic systems needed to achieve a certain degree of maturity and it may have been more important to reach a minimal critical mass both in certain researches and in building the knowledge exploiting industrial base at regional level in order to be able to determine the foci of a research and innovation-oriented regional development within the reindustrializing CEE regions. The success of knowledge spillovers depends to a great extent on the endogenous development of industries (reindustrialization) or on attracting foreign firms that build on the local knowledge-producing capacity. Particularly the first process is inevitably slow and ambiguous. However, examples from the South Moravian region (Czech Republic) shows that only long lasting and systematic regional innovation policy creating balanced knowledge networks can possibly lead to the success.

Our results confirm that in these regions, setting up new university based research directions that are not linked to the needs of the regional economy are unlikely to be able to develop knowledge transfer and spillovers with local economic actors. In peripheral situation the lack of research capacity in science and engineering RTD can be also a serious obstacle to the modernisation of the industrial structure. Universities are looking for contacts out of the regions and their contribution to the regional innovation infrastructure cannot fulfil the possible expectations. Rather, these universities need to take careful strategic decisions to build up those areas where they have the scope to make an international impact but also to differentiate investment in those areas where they can make a regional contribution.

According to literature only those metropolitan areas possess the "critical mass" of local economic activities and absorb university generated spillovers in the most efficient manner, which are located in the largest knowledge-based agglomerations. This means most of the non-metropolitan CEE regions, where the development of business sphere is under the „critical mass" and the regional innovation systems are still week, so are the university and

[12] Especially in the last decade they are trying to change their regional development pathway from being „unskilled workers of Europe in the semi-peripheries" based on Neo-Fordist (low cost labour) towards knowledge creating region based on knowledge led growth. Some of their regions are relatively successful, catching-up the train and changing their trajectories towards successful integration into the world economy.

industry links, that ambitious university-based developmental models have to be revised and the future role of universities have to be considered as potential engines of local economic development from a more realistic perspective. Economic policy practices suggest 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 less developed CEE regions where the lack of appropriate industrial base is one of the main constraints. It can be also argued that business-led networks connecting different actors have much higher importance in economically advanced regions while in the less advanced ones universities and public agencies play more significant role in network building and in catalysing activities of the key actors. If universities are embedded in a region it has a clear impact upon the intensity and nature of the relationships that can exist and hence their ability to effect tacit and codified knowledge transfers.

The paper also argues that mid-range universities in the reindustrializing CEE regions have to take on new role, which means a stronger regional engagement also in medium-tech innovations and in social & organizational innovations. The concept of “related variety” based on organisational and social innovations seems to be keystone for success of a region. Universities have to be practically relevant in the development and evaluation of regional policy that fosters 'new combinations' of partnership-based, innovation-centred approaches, which maximise the development of human capacities such as skills and mobility, and the formation of social capital through networking, collective learning and building up trust. In the less developed CEE regions there is a need for much more comprehensive and complex economic policies initiating not only the support of the university sector but also the starting of developing high tech industries, small-scale enterprises and constructing regional advantage with the stronger developmental role and community involvement of universities. This contributes towards the third mission of universities through meeting learning needs of the region. This might be achieved by exchanging knowledge between higher education and the business community or through outreach to local communities to combat social exclusion and to improve cultural understanding.

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