Role of university-industry-government relations, knowledge transfer and Triple Helix mechanisms in Budapest

(On the road to set up research problems)

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Abstract
In this paper we will write down a way to collect research problems for a study in terms of local innovation systems in Hungary, a transition country. First we shortly introduce the general view on universities in the literature, the importance of the Triple Helix model. In the second part we show the way how we evolve a model of knowledge creation in the Triple Helix. Then built on previous research experiences we shape up three levels of research problems.

1. University-Industry-Government relations in terms of regional-, local innovation systems

The local feature of knowledge has got more and more into the viewpoint of regional science focusing on knowledge spillovers (Feldman, 1999; Goldstein and Renault, 2004; Acs, Anselin and Varga 2002) and urban studies more reflecting on interactions among local agents (Asheim and Gertler, 2005; Boschma, 2005). The wide variety of regional and local innovation models – innovative milieu, industrial district, new industrial spaces, clusters of innovation, regional innovation systems, learning region – shows that there are more dimensions to explain local interactions (Moulaert – Sekia 2003). While most of the economical views consider universities as external sources for the firms’ innovation processes, the school of regional and local innovation systems gives us the opportunity to handle university-industry interactions as two-way “back and forth” processes (Tödtling and Trippl, 2005).

The changing functions of universities are widely investigated from the regional point of view (Lundvall 2002, Maskell- Tönnqvist 1999), new challenges and features are defined (Charles 2003, Etzkowitz et al. 2000). From the economics side it is widely accepted that universities have two kinds of regional multiplier effects on the economy (Armstrong and
Taylor, 2000, p. 19):

- Short-run multiplier effects, backward linkages in the university inputs: demand for local businesses, improvement of local government initiatives, increase in local household income.
- Long-run effects on economic development of region, university outputs: human capital (graduates, skill level of workforce, new firm formation), knowledge (R&D, joint ventures), attractiveness of local economy to entrepreneurs (inward migration of capital and highly skilled workers).

Regions and their universities compete in output effects: university inputs are automatic in every region; those are visible in each university cities without having a concept of competition. On the other hand output effects are not automatic; they need an active economic policy to provide advantages in the regional competition. In our point of view the output effects influence each other: the higher is the skill level of workforce and quality of R&D outputs, the higher is the attractiveness of local economy etc. In terms of this kind of competition we follow Cooke (2002, 2004), saying that regions have constructed advantages as a common artefact by local economical and social factors and public policy institutions. This assumption allows us to focus on “untraded relations” (Boschma, 2004; Budd and Hirmis, 2004): formal and informal co-operations, informal networks, cognitive-, cultural- and institutional settings.

We consider the Triple Helix model of university- industry- government relations as an evolutionary model of local interactions (Etzkowitz and Leydesdorff, 2000), a way how constructed advantage is achieved (Cooke and Leydesdorff, 2005). According to Leydesdorff (2001, p. 7.), the Triple Helix is a “post-institutional model of cultural evolution”. In this sense there is a contrast between “Mode 2” model of innovation and Triple Helix (Mowery and Sampat, 2005): the first shows innovations as an outcome of cooperation among paradigms, agents etc.; while the second highlights the changes in organisational culture, the takeover of norms, routines etc.

In order to understand knowledge creation in local university- industry relations we will have a theoretical attempt in the next section using knowledge management terms. Our logic let us to start from the individual level, to touch organisational models, then try to broaden them to an inter-organisational knowledge-creation model of local university-industry relations. We even try to shape up a framework of knowledge creation and institutional change in the Triple Helix.
2. Knowledge creation in the Triple Helix

The knowledge transfer among universities, companies and governmental bodies have to be dealt on two levels: knowledge of individual agents and the knowledge of organisations. The properties of knowledge transfer and the common knowledge creation can be understood only this way (Inzelt 2004). We suggest that relations on individual level (ad hoc-, informal meetings, lectures) are easily isolated considering the complexity of local- and regional innovation systems. On the other hand they can be really effective in knowledge sharing if they are supported by organisational relations (common research equipments, common research projects etc.).

*Individual knowledge*

Regional science seems to get used to the knowledge management terms. Malecki (1999) categorises individuals’ knowledge in terms of the object of knowledge: know-what (literacy, awareness), know-why (causalities, correspondences), know-how (experience, practice), care-why (motivation to create new knowledge). We can say building on Michael Polányi’s tacit knowledge concept (Polányi, 1994), that know-what and know-why are easier to codify, while know-how and care-why are harder.

<table>
<thead>
<tr>
<th>Knowledge categories</th>
<th>Codification</th>
<th>Creators of knowledge</th>
<th>Dissemination of knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Know-why</td>
<td>Codified</td>
<td>Researchers</td>
<td>Scientific papers</td>
</tr>
<tr>
<td>Know-what</td>
<td>Codified</td>
<td>Researchers, technology transfer experts</td>
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<td>Care-why</td>
<td>Tacit</td>
<td>Communities of researchers and businessmen</td>
<td>Embedded in communities, contacts</td>
</tr>
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</table>


In the university-industry relations we can distinguish the knowledge creation processes according to the categories of individual knowledge (Table 1), different
participation is needed, different ways of dissemination are used. *Know-why* can be created at universities without business presence: the results of basic research are published in scientific papers. *Know-what* can be typically written down in patents, researchers and technology transfer managers have to work here together. *Know-how* from the university knowledge-base can be transferred researchers mobility, only those can transfer it who also applies, “learns it by doing”. The care-why, the engine of knowledge creation, is a socialized type of knowledge, cannot be transferred, it’s embedded in communities of researchers and businessmen.

*Organisational knowledge*

Boutellier, Gassman and von Zedtwitz (2000) distinguish four types of organisational knowledge from the codification point of view: socialized, experienced, documented knowledge and knowledge embodied in products. They think, that these knowledge types are built on each other, the explicit elements on tacit ones:

- **Socialized knowledge** can be understood as values, organisational routines, the culture of the firm; it is embodied in organisations.
- **Experienced knowledge** means the skills of people, their personal experiences, personal routines. These are tacit types of knowledge: hard to communicate, cannot be written down, and are embedded in experiences, personal contexts.
- **Documented knowledge** contains manuals, project descriptions, patents.
- **Knowledge embodied in products** is the category that motivates all the other underlican already be sold: we can think of technologies, patents, products, services here.

If we think on university-industry relation in these terms we can assume that socialized knowledge knowledge embodied in products and documented knowledge can be transferred between the two spheres easily, experienced knowledge is transferable by the mobility of people. But socialized knowledge still remains embedded in organisations which we suspect cannot be transferred, only changed.

One of the most known knowledge creation models – SECI – by Ikujiro Nonaka is based on the continuous interaction between personal and organizational tacit and explicit knowledge (Nonaka et al 2000). The most extraordinary element of Nonaka’s model is the concept of ‘Ba’ that provides the different contexts for the knowledge creation processes.
The concept of 'ba' introduced by Kitani Nishida in the beginning of '90-ies is much closer to topos than to chora (Nonaka et al 1998). 'Ba' – providing the physical and virtual presence – is necessary for the knowledge transfer and knowledge creation. We think it has crucial importance to work with this concept, and therefore would like to translate into English as “Relation Space”. Relation space is such a collective concept that includes physical, social, cultural and historical contexts. While tacit knowledge needs proximity and simultaneity explicit knowledge can be transferred to big distance and long future. It is very important in the knowledge creation, especially in the externalisation and socialisation that the actors could develop such a common place and time where knowledge can be shared with the overlap of personal contexts. Relation space collects all the knowledge elements to a common place and time that these elements cannot be understood without.

Relation space can be classified along two dimensions (Figure 1): type of interaction between actors (individual, collective) and mode of communication (face-to-face, virtual).

**Figure 2: Creation of knowledge in organisations**

![Diagram of relation space classification](image)

Comments: I: Individual, T: Team, O: Organisation

Relation spaces changes in a spiral form, and are based on each other and are the ground for the four knowledge creation processes (Nonaka et al 1998):
- **Originating relation space** need physical proximity and high frequency of interactions to have same experiences in embedding tacit knowledge elements.

- **Interacting relation space** means that there is special rule in the organisation which helps the individuals to articulate and codify their tacit knowledge.

- **Cyber relation space** consist mainly ICT tools, databases that helps the transfer of explicit knowledge.

- **Exercising relation space** consists individual and virtual elements helping explicit knowledge to become tacit knowledge of actors. Tacit knowledge will be embedded in our knowledge base through learning by doing.

In Nonaka’s point of view knowledge creation is a bottom-up process and can be managed in organizations by providing the proper relation spaces inspiring knowledge conversions. Relation spaces can come into being in two different ways: they can be established by managers or come off spontaneously. In establishing relation space we have to think of rules of externalization, ICT processes in combination etc.

Nonaka and his colleagues worked out a model of organizational learning from external sources that is coherent with SECI processes, and based on the relation space concept (Nonaka et al 2000). In this model the (1) transfer of explicit knowledge (patents) takes place in a virtual relation space, physical proximity is not critical, the gap of presence can be overstepped in the cyber relation spaces (ICT facilities, databases). The (2) embedding external explicit knowledge is parallel with internalization: there might be changes in organisational routines after internalizing new knowledge elements, it is necessary to provide exercising relation space (trainings, rotation) that can help knowledge embedding. Articulating and codifying tacit knowledge not only happens inside an organisation, there is a wide variety of (3) externalization with the partner (relation management, customer club). In the case of local innovation systems interacting relation space can be built up inside the firm, or the close environment can be encouraged, involved in the knowledge creation (innovation forums, social dialogue, formal meetings). A (4) common understanding, share of experiences are crucial to exploit the untraded advantages of local networks, innovative milieu etc. To understand the local tacit knowledge, a high frequency of interactions, and physical proximity are needed; originating relation space has to be provided. Common research projects, mobility of experts and managers, informal occasions can be very fruitful to create trust among local actors.
We adapt these thoughts to describe university-industry knowledge transfer. Similarly to Nonaka’s knowledge transfer model we define four elemental process of **knowledge creation among universities and firms**: transfer of explicit knowledge, embedding, expanding, share of tacit knowledge. Certainly these processes have to be suited to the specialty of university-industry relations (Figure 2).

**Figure 2. Knowledge transfer among university- and industry knowledge bases**

![Knowledge transfer diagram](image)


Patents could be one good example of explicit knowledge transfer between the two spheres (transfer of know-what). The surveys, research results created at the university including explicit knowledge elements have to be embedded into the firms’ tacit knowledge base, meanwhile through development plans, consultancy universities tacit knowledge is transformed into the firms’ explicit knowledge (know-why). We have to divide the two types of tacit knowledge elements: experienced knowledge can be transferred by personal mobility between the two spheres (professors, students, companies’ experts – know-how), while common understanding needs an overlap of the university-industry socialized knowledge (care-why).

Having the ambitions to shape up a theoretical framework of knowledge creation in the Triple Helix we have to follow a two way thinking. First we have to **identify groups** where we can write down, and maybe even measure the knowledge creation with the help of the organisational models. In expanding the experiences we had in the groups we have to investigate the relations among the circumscribed groups with the help of the knowledge...
transfer model above (Figure 2). We can assume here that we need to be aware how the organisational routines from different spheres have influence on each other; also there is a great importance of individual knowledge in the relations of agents. This way we can reach the adequate knowledge creation framework of the higher ontological level, we have the opportunity to see how the knowledge spirals in each group influence each other.

On the other hand we cannot forget about the structural point of view. As the knowledge creation process is a typical bottom-up method, in the Triple Helix model we need the top-down aspect as well to identify the roles and duties of each sphere (Table 2). We try to describe clear activities connected to the knowledge creation processes that help each other and shape the Triple Helix relations.

Table 2. Tasks managing knowledge creation in the Triple Helix

<table>
<thead>
<tr>
<th>Socialization</th>
<th>University</th>
<th>Government</th>
<th>Industry</th>
</tr>
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<tbody>
<tr>
<td>permanent relation</td>
<td>Identifying market needs</td>
<td>Identifying scientific and economical trends</td>
<td>Identifying break-out points</td>
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<td></td>
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<tr>
<td>Externalization</td>
<td>R&amp;D projects</td>
<td>Policy making</td>
<td>Strategy making R&amp;D projects</td>
</tr>
<tr>
<td>Regular relation</td>
<td></td>
<td>Call for proposals</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Central Agreement</td>
<td></td>
</tr>
<tr>
<td>Combination</td>
<td>Patenting</td>
<td>Promoting ICT, Media Region Marketing</td>
<td>Financial Support Patenting</td>
</tr>
<tr>
<td>systemic relation</td>
<td>Univ. Tech. Transfer</td>
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<td></td>
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</tr>
<tr>
<td>Internalization</td>
<td>Education</td>
<td>Evaluation</td>
<td>“Learning by doing” Products, services</td>
</tr>
<tr>
<td>Casual relation</td>
<td>Publications</td>
<td>Political messages</td>
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Source: Self-edited (based on the discussions with prof. Imre Lengyel)

Interpreting the Table above we can say that each sphere has its own knowledge creation method. Going down in the vertical columns we can see it in a rough chronological order. In the Triple Helix relations it is much more interesting how strong are the connections among the spheres (Leydesdorff 2001), how they are horizontally shaped up.

In the Triple Helix knowledge creation the result of Socialization processes mean the overlap of tacit knowledge among the three spheres. According to Polányi, identifying
scientifical problems, market breakout points the embedding of information is based on the people’s tacit knowledge. In many success stories we could read that different types of skills were needed: management skills, scientifical talent and interest have to be matched here (Drejer–Jørgensen 2003). We can say that in this phase the connection between the spheres has to be strong, permanent; close physical proximity, presence is needed

In the Triple Helix relations we have to investigate the university R&D activity and the Externalisation of the industrial sphere at the same level. As R&D and knowledge creation means external and long-term effects the governmental sphere must play a key role synchronising the externalisation of university researcher’s, businessmen’s tacit knowledge. Here the aim in all spheres is to create know-what, know-why, documented types of knowledge. That can be easily transferred, it is enough clear to work with in a more unbounded relation. The contacts here have to be formal, only regular feedbacks are needed at formal meetings.

Combination in the Triple Helix means knowledge transfer of explicit knowledge among the three spheres. Duties differ on account of the different values that the spheres can trade with: universities have to safeguard and promote their usable research results. Patenting and IPR issues are very important, and also marketing activity has to be in the forefront of University Technology Transfer Offices attention. From the business side various forms of financing are needed: seed and venture capital has to appear, also the timing of financial support has to be set to the optimal research method (Langberg 2002). In this phase of knowledge creation governmental bodies have clear duties: the ICT infrastructure, the adequate media has to be provided to make the knowledge transfer faster. The separate work can be connected through systems: patenting-, information-, financing systems etc.

We believe that the different interests of the three spheres can be satisfied in the Internalization phase. Scientifical results can be published, appear in the higher education; the evaluation of the R&D policy, programs can be used for political messages; the “learning by doing” of firms effects organisational dynamics, innovative products, new services etc. It is done separately in all the spheres (except education of course), only casual relations are needed when the know-how type of knowledge is created, internalized.
3. Research problems, questions arising in a transition country

In the section we introduce shortly some of our previous experiences that can be considered in the case of the PhD work as preliminary research to find relevant problems and questions. We believe that the stage of the Hungarian economy, its’ openness, the reforms in process in the higher education system provides many interesting research problems. The structure of our thinking remained: you will find issues on the level of triple helix, level of institutional change and organisational/personal routines as follows.

What is the driving force of Triple Helix mechanisms in Hungary?

In a paper under preparation we try to point out that multinational firms have a crucial role shaping the territorial knowledge base of the Hungarian economy (Lengyel B. and Leydesdorff, 2007). In the Hungarian analyses we follow precisely the same methodology as the previous two studies (Leydesdorff et al., 2006; Leydesdorff & Fritsch, 2006) using the mutual information in three dimensions: geography, technology, organisation. This probabilistic entropy can add to or diminish the uncertainty in an economy. Our question was: are the hypotheses provided by these two studies also valid for the Hungarian economy?

1. medium-tech manufacturing can be considered as the drivers of the knowledge base of an economy more than high-tech;
2. knowledge-intensive services tend to uncouple the knowledge base of an economy from its geographical location.

Our data consist of micro-information at the firm level. The postal code of the firm is used for indicating the location, the NACE code as a proxy for the technology, and the firm size as a proxy for the organization.

- The geographical dimension was investigated at the NUTS-4 level of sub-regions. Hungary as a whole is defined as a NUTS-1 unit according to this EUROSTAT classification. Within it, seven regions (NUTS-2) are distinguished; 20 counties at the NUTS-3 level; and 168 subregions at the NUTS-4 level.
- Like in the Dutch and German studies we use the sectorial classification of the OECD for measuring the knowledge intensity and the technological level (medium or high-tech) of economic sectors. Since various sectors of the economy can be expected to use different technologies, the sector classifications can be used as a proxy for the technology. The OECD distinguished the various sectors in terms of their knowledge
intensity at the two-digit level of the NACE codes (Laafia, 2002). We were able to classify each enterprise in Hungary in terms of its first activity at the two-digit level. The main difference in the data mining among the three studies is that in Hungary our data only contain the high- and medium-tech sectors and knowledge intensive services while in the Netherlands and Germany all firms were included in the database.

• The organisational dimension can be operationalized by the size of enterprises and measured in terms of the number of their employees. Like the Dutch data—but differently from the German one—the Hungarian register of enterprises contains an additional category with zero or unknown employees, which will also be taken into consideration.

Our first results suggest that the strong differentiation in terms of regions can be verified using the Triple Helix model: the knowledge base of Budapest and its agglomeration becomes visible as central to the country’s economy. A further differentiation among the sectors has relevancy among high-and medium-tech sectors as a whole and knowledge intensive sectors. More than in Western-Europe, the question is about the differences in knowledge production and knowledge adaptation, since one can expect that the knowledge base in Hungary is strongly dominated by the knowledge created abroad. The multinational firms located their sites mostly in Budapest and to the North-western part of Hungary, we argue that this process had a dominant effect on the mutual information in the three dimensions in these areas. On the other hand one could expect on the grounds of the mutual information a prospering economy in the Northeast, however, the unemployment rate is the highest in this part of the country. There is a contradiction between the values of mutual information and the stage of county development in Eastern Hungary; the special case of knowledge intensive services has to be expounded.

The uncoupling effect of knowledge intensive services (KIS) is less obvious in Hungary than in the Western European studies, as KIS has a role in the counties more important than medium- and high-tech manufacturing, though the services provided in Budapest dominate the population. We have to consider high-tech services in a way different from Western Europe. Their effects of strengthening the knowledge base appear only in Budapest and Csongrád. The latter county (in the south-east of the country) has a strong university centre. The reasons for these two effects are different: while Budapest has an increasingly strong knowledge base in the business sphere (for example in a developing
informatics sector), *Csongrád is relatively strong in basic research* (the university has the first position in Hungary according to many world-ranking systems). However, the high-tech services emerge in this region within a relatively weak economic sphere. The effects of high-tech services are negative on the knowledge base in all the other counties. We suggest that this is because the underdeveloped stage of the NACE category 64 ("telecommunications and post") in Hungary: these services are not yet high-tech in the various regions while they are considered like that in the OECD/Eurostat classification.

We suggest here that the heritage of the etatistic model of Triple Helix configurations in terms of university-industry-government relations during the communist regime still has a significant effect on Triple Helix dynamics in transition countries (Etzkowitz & Leydesdorff, 2000). The countries in Eastern Europe entered their transition period and faced the challenges of globalisation during the same period of time (Enyedi, 1995). *Thus, one has to consider both processes when analyzing the knowledge base in Hungary: the mechanisms that prevailed in the “existing socialism” still remained dominant in the knowledge intensive services; the change in the relations were much faster in sectors, regions where foreign owned firms became heavily involved.*

Questions emerging here:

- Are the multinational firms who drive the triple helix mechanism in terms of university-industry-government relations? Are there sectoral differences?
- How can the different selection mechanisms effect each other? Do the market-led selection represented by the multinational firms effect selection mechanisms at universities and governmental bodies? Do have our model of knowledge creation in the Triple Helix relevance in this sense?

*How do institutional changes take place at Hungarian universities caused by university-industry relations?*

In one of our previous studies (Lengyel B., Lukács and Solymári, 2006) we investigated with several case studies the relations among the three output effects of universities on local economy (Armstrong and Taylor, 2000). We assumed that the output of knowledge and human workforce influence the attractiveness for entrepreneurs. We made interviews with university professors and multinational company managers in three regional centres: Gy_r, Miskolc and Szeged and tried to draw up how relations in education and R&D
on individual and institutional levels among effect each other (Inzelt, 2004). We found two different patterns:

- Audi was settled in Gy_r in the beginning of ’90-ies led by low labor costs. The relation between the university (considered to be little with a polytechnic profile) and the company can be characterised as follows: Audi needed well educated people, they co-operated in the educational manner. The time being personal relations became strong to have common institutional settings as well: an Audi department was established. This department was added with an R&D portfolio as well in 2006 when it became a bigger entity at the university as Audi Institution. A similar pattern seems to evolve in Miskolc, where Bosch have its own department at the university: the relations in education can lead to relations in R&D.

- University of Szeged considered as one of the best universities of Hungary have a different pattern. The appearance of multinational firms is low, though professors have their connections to multinational companies through research projects. The companies (Siemens, GE Healthcare) decided to have divisions in the town mostly on the base of the former research connections, co-operation in education appears slowly in the case of Siemens.

The experiences in regional centres lead us to investigate the institutional changes in Budapest universities caused by multinational companies. In Budapest there is a bigger concentration of multinational companies, universities and research institutes. Each company having research activity in the city – EGIS, Ericsson, GE Lightning, Hungarian TeleCom, Richter, Sanofi-Aventis, Siemens etc. – has good individual connections to the universities, their experts mainly have lectures, even courses at universities.

Questions emerging here:

- Can we consider the company-university relations as coupling mechanisms? Have the relations of multinational company and university properties of knowledge transfer or knowledge acquisition?

- How do sectoral specificities modify a general terms on university-industry relations in the case of institutional change? In Budapest we can find ICT and pharmaceutical sectors emerging.
Can regional differences be considered by the models provided above? Can the role of governmental bodies pointed out in a way: providing the necessary relation spaces for multi-university relations?

Some relation spaces have to be provided (ICT, media, formal meetings), but the others (personal contacts) have to be realized and helped (informal meetings, mobility). The differences between the governmental bodies in an underdeveloped and developed region have been emphasised in a Swedish study (Jensen and Trägårdh, 2002).

Can changes in organisational routines in the three spheres in the case of knowledge creation be explained with our model?

One should expect different routines in knowledge creation mechanisms at universities and companies. Visser and Boschma (2004) cited Nooteboom (2002) emphasised the importance to consider the mechanisms of scientific discovery and local, market led knowledge mechanisms as parallel processes. The risk in scientific discovery is mainly to have closed inertia systems or to have chaos in the results. We think that the hierarchical organisational structure of Hungarian universities leads easily to inertia, while the new challenges before scientists can end up in chaos.

We think that the change in routines and in the portfolio of individual knowledge sources is an appropriate unit of analyses; this can be the micro approach of Triple Helix mechanisms. In this sense we would analyse university departments.

Questions emerging here:

- Are the changes of routines in discovering visible at organisational or individual level at the university departments that are in close cooperation with multinational companies? Are there differences between the intensity of changes among the pioneer departments and the ones lagging behind in terms of industry relations?
  
  We think that in this sense we have to view the knowledge creation processes from the SECI approach.

- Are the sources of personal knowledge changing? Are there differences between departments with different performances?
  
  We think that knowledge maps are worth to draw. This tool allows us to add objects like databases to the personal networks. This way the sources of individual knowledge can be mapped.
References


Polányi M. 1994: Személyes tudás. Atlantisz, Budapest


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Structure of the presentation

1. Introduction: University- Industry- Government relations

1. Knowledge Creation in the Triple Helix

2. Research problems in Hungary as a transition country
1.1 Spatial Innovation Models

- Innovative Milieu
- Industrial district
- New Industrial Spaces
- Clusters of Innovation
- Regional Innovation System
- Learning Region

{ Networks, contacts of regional actors }
1.2 University in the regional innovation system

1.3 Triple Helix and constructed advantage

- Advantage of a region is shaped by economic (knowledge intensity of production) and social (creative workforce) elements, and also governmental issues.

Untraded relations (Boschma, 2004):
- formal and informal co-operations, informal networks, cognitive-, cultural- and institutional settings

Mode 2 vs Triple Helix (Mowery and Sampat, 2005):
- innovations as an outcome of cooperation among paradigms, agents
- changes in organisational culture, the takeover of norms, routines
Knowledge Creation in the Triple Helix

- Individual knowledge
- Knowledge of Organisations
- Knowledge Creation in and among organisations
2.1 Types, creation and dissemination of university-knowledge – Individual level

<table>
<thead>
<tr>
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<th>Creators of knowledge</th>
<th>Dissemination of knowledge</th>
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<td></td>
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</tr>
</tbody>
</table>

2.2 Knowledge base of organisations – Knowledge pyramid

Source: Boutellier, Gassmann and von Zedtwitz, 2000, p. 208
2.3 Knowledge creation

- Explicit and tacit knowledge
- SECI: knowledge conversion
  - ‘Ba’: system of contexts
    - Originating
    - Interacting
    - Cyber
    - Exercising

Source: Nonaka, Reinmoller and Senoo, 2000, p. 90.
Comments: I: Individual, T: Team, O: Organisation
2.4 ‘Ba’ - Relation Space

- Physical, cultural, social contexts.
- It collects the knowledge elements into common space and time.
- Relation space comes off *spontaneously* (originating, exercising), or can be *built up* (interacting, cyber).
2.5 Knowledge creation among organisations

2.6 Relation Space among organisations

- Transfer of explicit knowledge – **Cyber relation space**: ICT, databases, Patenting
- Embedding – **Exercising relation space**: Training, rotation
- Expanding processes – **Interacting relation space**: Formal meetings, innovation forums, social dialogue
- Common understanding – **Originating relation space**: Mobility of experts, informal occasions
2.7 Knowledge Creation Among Universities and Firms

Explicit knowledge

Tacit knowledge

University

Firm

Patents

Surveys

Development plans

Trainings

Teachers, Graduated students

Common understanding; Share of experiences

Practice

Experts, researchers
2.8 Relation Space Among Organisations in Tampere

<table>
<thead>
<tr>
<th>Originating relation space</th>
<th>Interacting relation space</th>
</tr>
</thead>
<tbody>
<tr>
<td>- mobility of experts</td>
<td>- themathised meetings</td>
</tr>
<tr>
<td>- „sauna evenings”</td>
<td>- forums</td>
</tr>
<tr>
<td>- common events</td>
<td>- media</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Exercising relation space</th>
<th>Cyber relation space</th>
</tr>
</thead>
<tbody>
<tr>
<td>- common education</td>
<td>- surveys, investigations</td>
</tr>
<tr>
<td>- „mentored projects”</td>
<td>- virtual systems, ICT</td>
</tr>
<tr>
<td>- learning by doing</td>
<td>- patent system</td>
</tr>
</tbody>
</table>

To draw up knowledge creation we need to:

- Identify the relevant groups, internal processes
- Relations: how the spirals influences each other

Consider

- Individual processes (know-what, know-why…)
- Relation spaces etc.
2.9 Knowledge creation in the Triple Helix
## 2.10 Tasks managing common knowledge creation

<table>
<thead>
<tr>
<th></th>
<th>University</th>
<th>Government</th>
<th>Industry</th>
</tr>
</thead>
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<tr>
<td>Socialization</td>
<td>- Identifying market needs</td>
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<td>- Regional marketing</td>
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<tr>
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<td>- Education</td>
<td>- Evaluation</td>
<td>- “Learning by doing”</td>
</tr>
<tr>
<td></td>
<td>- Publications</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Lengyel B. 2005
Main problem

- Special knowledge creation methods, patterns in the three different spheres.

- Can we understood change in organisational culture, routines, norms with such a frame?

- We can be satisfied, if we can use it for describing regional differences.
Transition country possibilities

1. Ongoing analysis on territorial triple helix mechanisms

2. Experiences of institutional changes

3. Changes in knowledge creation routines
3.1 Knowledge base in Hungary

Testing two hypotheses of previous studies (Leydesdorff et. al., 2006, Leydesdorff and Fritsch, 2006)

- medium-tech manufacturing can be considered as the drivers of the knowledge base of an economy more than high-tech;
- knowledge-intensive services tend to uncouple the knowledge base of an economy from its geographical location.

Mutual information in three dimensions: geography, technology, organisation.
This probabilistic entropy can add to or diminish the uncertainty in an economy.
### Geography and Technology

<table>
<thead>
<tr>
<th>Level of territorial units</th>
<th>Number of territorial units</th>
</tr>
</thead>
<tbody>
<tr>
<td>NUTS 2 = region</td>
<td>7</td>
</tr>
<tr>
<td>NUTS 3 = county</td>
<td>19 + Budapest (capital)</td>
</tr>
<tr>
<td>NUTS 4 = subregion</td>
<td>167 + Budapest (capital)</td>
</tr>
</tbody>
</table>

#### High-tech Manufacturing
- 30 Manufacturing of office machinery and computers
- 32 Manufacturing of radio, television and communication equipment and apparatus
- 33 Manufacturing of medical precision and optical instruments, watches and clocks

#### Medium-high-tech Manufacturing
- 24 Manufacture of chemicals and chemical products
- 29 Manufacture of machinery and equipment n.e.c.
- 31 Manufacture of electrical machinery and apparatus n.e.c.
- 34 Manufacture of motor vehicles, trailers and semi-trailers
- 35 Manufacturing of other transport equipment

#### Knowledge-intensive Sectors (KIS)
- 61 Water transport
- 62 Air transport
- 64 Post and telecommunications
- 65 Financial intermediation, except insurance and pension funding
- 66 Insurance and pension funding, except compulsory social security
- 67 Activities auxiliary to financial intermediation
- 70 Real estate activities
- 71 Renting of machinery and equipment without operator and of personal and household goods
- 72 Computer and related activities
- 73 Research and development
- 74 Other business activities
- 80 Education
- 85 Health and social work
- 92 Recreational, cultural and sporting activities

Of these sectors, 64, 72 and 73 are considered high-tech services.
The method:
Mutual information,

\[ Tgto = Hg + Ht + Ho - Hgt - Hgo - Hto + Hgto \]
3.1 The mutual information among three dimensions at NUTS 3 level in Hungary
Unsatisfactory results…

<table>
<thead>
<tr>
<th>Regions, counties</th>
<th>GDP per capita (EU25=100, %)</th>
<th>Employment rate (population aged 15-64, %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hungary</td>
<td>59.9</td>
<td>56.8</td>
</tr>
<tr>
<td>Central Hungary</td>
<td>96.5</td>
<td>62.9</td>
</tr>
<tr>
<td>Central Transdanubia</td>
<td>55.4</td>
<td>60.3</td>
</tr>
<tr>
<td>Western Transdanubia</td>
<td>64.4</td>
<td>61.4</td>
</tr>
<tr>
<td>Southern Transdanubia</td>
<td>42.9</td>
<td>52.3</td>
</tr>
<tr>
<td>Northern Hungary</td>
<td>38.3</td>
<td>51.6</td>
</tr>
<tr>
<td>Northern Great Plain</td>
<td>39.1</td>
<td>50.4</td>
</tr>
<tr>
<td>Southern Great Plain</td>
<td>40.7</td>
<td>53.6</td>
</tr>
</tbody>
</table>
3.1 The mutual information considering the high- and medium-tech sectors at NUTS 3 level in Hungary
### Distribution of foreign stake in foreign owned companies, Hungary=100 (%)

<table>
<thead>
<tr>
<th>Region, county</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>Budapest</td>
<td>58.8</td>
<td>54.0</td>
<td>52.9</td>
<td>47.3</td>
<td>50.2</td>
</tr>
<tr>
<td>Pest</td>
<td>9.5</td>
<td>11.1</td>
<td>11.5</td>
<td>15.7</td>
<td>15.4</td>
</tr>
<tr>
<td>Central Hungary</td>
<td>68.3</td>
<td>65.1</td>
<td>64.4</td>
<td>63.0</td>
<td>65.6</td>
</tr>
<tr>
<td>Central Transdanubia</td>
<td>7.1</td>
<td>8.3</td>
<td>8.4</td>
<td>10.0</td>
<td>10.1</td>
</tr>
<tr>
<td>Western Transdanubia</td>
<td>10.8</td>
<td>12.4</td>
<td>11.9</td>
<td>11.9</td>
<td>11.6</td>
</tr>
<tr>
<td>Southern Transdanubia</td>
<td>2.0</td>
<td>1.9</td>
<td>2.2</td>
<td>1.9</td>
<td>1.6</td>
</tr>
<tr>
<td>Northern Hungary</td>
<td>4.7</td>
<td>4.0</td>
<td>4.7</td>
<td>5.7</td>
<td>4.0</td>
</tr>
<tr>
<td>Northern Great Plain</td>
<td>3.8</td>
<td>4.1</td>
<td>5.4</td>
<td>5.1</td>
<td>4.8</td>
</tr>
<tr>
<td>Southern Great Plain</td>
<td>3.3</td>
<td>3.2</td>
<td>3.0</td>
<td>2.4</td>
<td>2.3</td>
</tr>
</tbody>
</table>
3.1 Contribution of high-tech services to the knowledge base at NUTS 3 level in Hungary
First results, lessons

- Problem of knowledge intensity:
  Post and telecommunication, healthcare, education system

- Knowledge production or knowledge adaptation:
  The presence of foreign owned firms is not captured
3.1 Questions

- Are the multinational firms who drive the triple helix mechanism in terms of university-industry-government relations?

- How can the different selection mechanisms effect each other? Do the market-led selection represented by the multinational firms effect selection mechanisms at universities and governmental bodies?

- Do have our model of knowledge creation in the Triple Helix relevance in this sense?
3.2 University effects on local economy

<table>
<thead>
<tr>
<th>INPUTS: backward linkages</th>
<th>OUTPUTS: forward linkages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local businesses:</td>
<td>Human capital:</td>
</tr>
<tr>
<td>- demand for local services</td>
<td>- graduates</td>
</tr>
<tr>
<td>- displacement effects</td>
<td>- skill level of local workforce</td>
</tr>
<tr>
<td>Local government:</td>
<td>- new firm formation</td>
</tr>
<tr>
<td>- services and revenues</td>
<td>Knowledge:</td>
</tr>
<tr>
<td>Local households:</td>
<td>- R&amp;D</td>
</tr>
<tr>
<td>- increase in household income and spending</td>
<td>- Joint ventures</td>
</tr>
<tr>
<td>Local businesses:</td>
<td>Attractiveness of local economy</td>
</tr>
<tr>
<td>- demand for local services</td>
<td>- inward migration of capital and highly skilled workers</td>
</tr>
</tbody>
</table>

3.2 MNE – university relations in regional centres

Győr:
- Audi settled in the early ’90-ies - low labour costs.
- From the mid ’90-ies on: Strengthening institutional relations in education and R&D cooperation.
- 2006: AUDI institute at the Széchenyi István University.

Miskolc:
- 2002: Bosch as a flagship enterprise.
- 2005: Robert Bosch department at the Miskolc University.

Institutional relations:
Education _ Research/development

Szeged:
- Low appearance of MNEs
- Cooperation in research and development (Siemens, GE Healthcare)
  Education: effects on local economy (Siemens)
  R&D cooperation still in professors personal network
LocoMotive experiences in Budapest

- Interviews done: EGIS, Ericsson, GE Lightning, Hungarian TeleCom, Richter, Sanofi-Aventis, Siemens

- General view on universities
  strong personal connections to the Budapest universities: several MNE’s researchers take part in the higher education, academic life
  subject-oriented relationships; projects based on agency agreements with pre-defined target tasks;
  appearance of long-range institutional connections:
    Laboratory at the universities (BME);
    Programs to find and keep talented students
  leading role of governmental programs: consortia-agreements
    in Cooperation Research Centres, Regional University Knowledge Centre

- Weaknesses
  lack of university experts in important research areas; poor business skills difficult IPR issues
  wrong education structure
3.2 Questions

- What is the causality between the personal relations among multi and university employees and the emergence of institutional change caused by multinationals?

- Can regional differences be considered by the models provided above?

- Can the role of governmental bodies pointed out in a way: providing the necessary relation spaces for multi-university relations?
2.10 Tasks managing common knowledge creation

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<td></td>
</tr>
</tbody>
</table>
3.3 Routines in knowledge creation

Nootenboom, 2000 cited by Visser and Boschma, 2004
3.3 Questions

- Are the changes of routines in discovering visible at organisational or individual level at the university departments that are in close cooperation with multinational companies?
- Are there differences between the intensity of changes among the pioneer departments and the ones lagging behind in industry relations?
- Are the sources of personal knowledge changing?
- Are there differences between departments with different performances?
Thank you for your attention!

blengyel@gmail.com