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University-Industry Knowledge and Technology Transfer: Isomorphism of university technology transfer organizational units (Working Paper)

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Abstract

Commercialization of university knowledge in form of organized and intentional activity has been promoted since the introduction of Bayh-Dole Act in the U.S. in the beginning of the eighties. Initially, the research in university-industry technology transfer focused on its effects and providing basis for policy making that would enhance the factors behind the success, among them the creation of university units specialized for commercialization, the technology transfer offices (TTOs). Studies on the TTOs or other technology transfer intermediaries established by universities also examined their efficiency. Nevertheless, only few studies have looked into the organizational aspects and reasons for the intermediaries? organizational model isomorphism. This paper hopes to fill this gap by examining the organizational models of TTOs in Europe and understanding why a certain model was selected or formed. Moreover, the paper will study whether the similarities in the models are perceived as leading to same effects.

The paper builds on the theory of new institutionalism, more specifically the types of isomorphism developed by Powell and DiMaggio which are examined with the types of technology transfer intermediaries, focusing on the TTOs and their activities. The case studies of six European universities will provide the overview of how the organizational forms at selected universities were created. The results will contribute to the understanding of the different organizational models and provide examples for deciding how universities should organize their commercialization intermediaries.

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Working Paper

Abstract.....	3
Keywords.....	3
1. Introduction.....	4
2. Literature review.....	6
University-industry technology transfer unit.....	6
Institutional theory overview.....	8
3. Theoretical framework.....	9
Characteristics of university-industry technology transfer unit.....	9
Institutional isomorphism.....	11
4. Methodology.....	14
Case studies selection.....	14
Data collection.....	15
5. Conclusion.....	15
6. References.....	15

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Keywords

Commercialization, technology transfer office (TTO), isomorphism, organizational structure, European universities

1. Introduction

The role of universities and their contribution to the society through knowledge and technology transfer has been a research topic since the middle of the 20th Century (Rothaermel et al. 2007; Etkowitz 2008). However, the interest increased significantly after the introduction of the Bayh-Dole Act in USA in 1980 and the subsequent increase in the formation of agreements on University-Industry Technology Transfer (UITT).

The model, which underlines knowledge and innovativeness of both organisations and individuals as a key for change and development in the knowledge society, was seen as an efficient and proper path in the EU member-states to support regional and national development. The EU and numerous universities included the commercialisation and exploiting of academic knowledge in their policies. EU members changed their national innovation policies according to the US example by changing the ownership of the results stemming from publicly financed research, thus entrusting the universities with intellectual property (IP) management, and supporting intermediary units that provide support for the UITT process. Universities were especially incited to establish Technology Transfer Offices (TTOs), responsible for managing the knowledge and technology transfer (Mowery & Sampat 2005, Debackere & Veugelers 2005, Bercovitz & Feldmann 2006, Abreu et al. 2008, Geuna & Rossi 2011): patenting, licensing, spin-off creation, consulting and others.

With the initial legal and structural framework changes, the research on knowledge and technology transfer focused on the productivity and efficiency of the processes and TTOs (EIMS 1995, Henrekson & Rosenberg 2001, Friedman & Silberman 2003, Link et al 2006, Grimpe & Hussinger 2008, Conti & Gaulé 2009, OECD 2010). As the practice expanded from patents and licensing of technology towards the non-IP services such as consulting and human resources mobility (Agrawal 2001, Perkmann & Walsh 2007, Göransson et al. 2009), the form and functioning of UITT-units¹ should have followed. However, the research on the structure of these units, let alone on its development in line with the change of UITT-concept, is rare, focusing mainly on TTO's staff, size, experience and autonomy (Bercovitz et al. 2001, Link et al. 2006; van der Heide et al. 2008, European Commission 2009, Geuna & Rossi 2011, Grimaldi et al. 2011).

¹ We use the term "UITT-unit" to depict an organizational unit that provides university's technology transfer services. As the trends have shifted from commercializing IP to entrepreneurial university (Etkowitz & Leydesdorff 1997, Etkowitz et al. 2000, Siegel et al. 2003), the services this unit provides, expanded. The term is hypernym for units such as "TTO" or "technology-licensing office", "technology transfer centre" etc. In the continuation of the text, the terms UITT-unit and TTO are used as synonyms.

The research is ample in examining US and Western European examples of organizational models, while comparison of the Central and Eastern European cases with the established role-models is limited. However, with the OECD and EU policies on innovation, competition and science and higher education, the states have been changing their IP regulations and providing for the establishment and functioning of technology transfer intermediaries, such as incubators, science parks and TTOs. The latter have been introduced also in Central Europe, many co-financed by the EU contribution, yet their results are not seen as satisfactory (Tihany and Roath 2002, Crowley 2004, Bučar & Stare 2006).

On the other hand, Mowery & Sampat (2005) explicitly question the appropriateness of same or similar organizational model (i. e. the TTO) for universities from different countries and traditions. The difference between European and US situation, often examined as the “European paradox” (Dosi et al. 2006, Decter et al. 2007), focuses on the effect of the intermediary organizations or the technology transfer process, yet the comparison of European TTOs with their US counterparts often assumes their organizational homogeneity within Europe (Henrekson & Rosenberg 2001, Conti & Gaulé 2009). The reasons for similarities in the TTO models and whether adopted model is even appropriate for individual university are not researched. This shows that the concept of organizing and implementing UITT through university-based or initiated units is taken for granted (Jepperson 1991). Therefore, we assume that the organizational units are not formed solely on the theory of efficient and effective UITT, but have become a form that accompanies the policy, with little regard for local specificities. DiMaggio and Powell (1991b: 78) observe “//ess efficient organizational forms do persist”.

As Etzkowitz (2008) states: “organizational capacities of the transfer office and university culture are essential ingredients of success. /.../ These elements may be more important /.../ than the nuances of particular intellectual property regimes.” Our question is how a TTO or other university intermediary unit is organized, why this model was chosen, and which form of financing is adequate to support the selected (organisational) structure of UITT-units?

The paper will in the following section present the literature review of university-industry technology transfer intermediaries. It will be followed by the section on theoretical framework from the new institutionalism, providing basis for the research on the TTO organizational models by defining the expected characteristics and variables which will designate the similarity between the examined cases. Section 4 will present the plan for case studies.

2. Literature review

Research on the structure of UITT-units is a relatively recent field of study, leaving interesting open issues, still to be thoroughly analysed. As there is no consensus on the definition of technology transfer and thus on the activities that are to be performed by the intermediary, this is not surprising. However, the TTOs perceived as primarily providing the following activities:

- a) Type A: valorisation and IP-services,
- b) Type B: entrepreneurial support,
- c) Type C: contract research with industry and research funding, and to increasing level also
- d) Type D: consulting (Agrawal 2001, Amesse & Cohendet 2001, Gorman 2002, Debackere & Veugelers 2005, Holi et al. 2009, Clarysse et al. 2010).

The literature predominantly focuses on the protection and commercialization of IP and the services for creation of spin-outs. However, there is rise in the research on UITT-units' functions in the field of less tangible knowledge, such as entrepreneurial education and training, faculty consulting, project management. Technology transfer has become more than just mere transfer of technologies which initially resulted in patenting and licensing and has transformed to the knowledge transfer. Moreover, while key partners remain university and industry, civil society and non-profit sector are also seen as beneficiaries and partners (Bozeman 2000, Mowery et al. 2004, Barton 2007, Lam 2010). In short, the literature proves the change in the process, in the activities and in the functions of UITT-units. However, how do European universities organize this process in their units, why they selected a given model, and how do they finance it?

University-industry technology transfer unit

Gaining momentum after the year 2000, the research of UITT-units focused on examining the organisational factors behind successful TTOs. Scholars have recognised different characteristics of a successful UITT-unit from the viewpoint of organisational structure: the importance of autonomy and level (Siegel et. al. 2007); the contrast between matrix and multidivisional forms (Bercovitz et. al. 2001); the centralization of the UITT-unit (Markman et al. 2005), and the importance of networking, thus developing research and critical mass at universities (Wright et al. 2008).

The relationship of the structure of UITT-units at universities in USA and their efficiency is analysed by Bercovitz et al. (2001) who outline four forms depending on the dimensions of centrality of the joint office and autonomy of the divisions: functional form (centralized with departmentalized structure and decision-making by the executive team), multidivisional form (strong central office with semi-autonomous divisions), holding form (weak central office, strong autonomy of divisions), and matrix form (combination). The efficiency of forms depends on form's information processing, coordination capability and incentive alignment.

Siegel et al. (2003) accepts that aside from institutional and environmental factors, the productivity of TTOs depends also on organizational factors, such as faculty reward systems, staffing and compensation practices, and cultural barriers between organizations and firms. ProTon Domain Synthesis Report (ProTon 2003) similarly defines UITT-unit forms on the dimension of autonomy and centrality: university can have the UITT performed by one or several units, they can either belong to university (legally independent, but with the university representative in the board) or be completely independent (i.e. university outsources the UITT activity).

Further research on influence of organizational structure of the TTOs and the university performance is implemented by Markman et al. (2005) who identify traditional university structure (TTO as department within university, low autonomy), non-profit research foundation (separate legal body, with university representatives on the board), and for-profit private extension (separate legal body, highest autonomy). Debackere & Veugelers (2005) provide an example for a combination of activities that is performed by several UITT-units, underlining the importance of university UITT policy.

This review shows that most of the research is done on the examples provided by US universities. As indicated by Mowery & Sampat (2005), they cannot serve as a model for the European universities, which have a different history and university culture (especially issues on commercialization of knowledge). Moreover, the entrepreneurial culture and legal framework is significantly different. The creation of UITT-units and activities at universities in Europe thus should make allowances for these differences, as well as take into account the importance of university's clear policy on the issue. However, to our knowledge, there is little research covering the issue of how the term and the content of TTO which emerged after the Bayh-Dole legislation has become used by European universities, considering the differences in the educational systems (Mowery & Sampat 2005, Esterman & Nokkala 2009).

Institutional theory overview

The main aim of new institutionalism is to explain the homogeneity of organizations (a formalized arrangement) and stability of institutionalized components (DiMaggio & Powell 1991a) and their practice which can be observed despite the numerous legal and functional forms of organizations. The institution is seen as a set of fundamental principles and models, rules and classifications, defining the nature and purpose of actors and action, and as inherent features of reality (Boli & Thomas 1999; DiMaggio and Powell 1991a, Jepperson 1991). Formal organizations are formed by social, cultural and symbolic factors and seen as “arrays of standardized elements” (DiMaggio & Powell 1991a, 14), or as “the depiction of a structure of roles, activities, and interrelationships in an explicit and unified way” (Meyer 1992, 264). Organizations are thus the representation of accepted behaviour and conformity to the rules and routines prevailing on a given issue-area. Their primary motive is gaining legitimacy on adhering to the said rules, which enables their survival. Instead of targeting for efficiency, organizations are pursuing strategies to conform to the social rituals and myths (DiMaggio & Powell 1991a, Meyer & Rowan 1992), thus becoming more similar.

Organisational change and homogenisation is a result of institutional pressures which according to DiMaggio & Powell (1991b) stem from coercive isomorphism, normative isomorphism and mimetic isomorphism. These types are not always empirically different, as they serve mainly for analysis. Coercive isomorphism is the result of political influence and the quest for legitimacy. Standard responses to uncertainty, i. e. organizations copying practices of other organizations that are perceived as successful and legitimate, cause mimetic isomorphism with, while normative isomorphism is change caused by the following and fulfilling standards of the profession.

Boli & Thomas (1999, 5) underline that “structural isomorphism /.../ operates increasingly via ‘top-down’ rather than ‘bottom-up’ processes. It is the consequence of actors enacting cultural models that are lodged at the global level and linked in complex ways to other levels of organization, with increasing penetration of even most peripheral social spaces”. This is similar to classification by DiMaggio & Powell (1991b), where the top-down approach is typical of coercive isomorphism, exercised predominantly by the state determining the legal framework (Goldfarb & Henreksen 2003), whereas the bottom-up processes are more typical of mimetic isomorphism. Organizations namely unintentionally or explicitly respond to uncertain situation by adopting behavior and practice that a central organization uses. Finally, normative isomorphism can be seen as a combined approach where the professionals and organizations of

professionals define standards that are not imposed by the state, but are seen as models to mime in order to obtain legitimacy within the profession.

“The point is not to discern whether institutions are efficient, but to develop robust explanations of the ways in which institutions incorporate historical experiences in to their rules and organizing logics.” (DiMaggio & Powell 1991a, 33).

Briefly, the new institutionalism provides for theoretical background on examining the similarities in organizational units and the reasons for the establishment of a specific UITT-unit at universities. We assume that despite the difference in higher educational framework and academic culture, the UITT-policy of states and of universities was formed as a result of three types of isomorphism, not as a follow-up of rational selection between the models which would best fit the conditions and existing polity in the environment. In a field which is defined as one of the sources for economic growth and sustainable development in competitive society, this is an interesting inconsistency.

3. Theoretical framework

In this section, the elements of UITT-units and the possibilities of their examination under the proposed DiMaggio & Powell (1991b) analytical categories are defined.

Characteristics of university-industry technology transfer unit

Though there is no organizational form that would have same efficiency in all environments, the impact of the structure on unit's performance is significant. Following the above mentioned literature, the characteristics of the UITT-unit which will enable their study and comparison will be designated. As we will research the reasons for selection of certain UITT-unit form, our focus will be the formal organizational unit and formal UITT process. Specifically, building on the characteristics of formal organizational structure, we will be interested in the centrality / autonomy, specialization, standardization / routine, exclusivity, and professionalization of the UITT-unit. Additional dimension we introduce is funding, as we are interested in the (in)dependence of organization from other actors.

Centrality / Autonomy

Following Markam et al. (2005) and van der Heide et al. (2008), the degree of autonomy is the power the UITT-unit has to make decisions regarding UITT. It and can be low (meaning the unit

is not independent in decision-making, thus not autonomous) or high (the unit is independent in its decision-making). Centrality refers to the level of decision-making: if a unit has to present their decisions for approval to higher levels, it is centralized. When the unit is the only level of decision-making, it is considered as decentralized.

Specialization

The units can perform all or just a mix of UITT activities. To analyse this, the specialization dimension which indicates how the tasks in the units are distributed, is used. A unit providing for valorisation and IP-services, that is type A of UITT activities, is highly specialized, whereas a unit which is responsible for all four types of UITT-activities, is integrated. The combination of two activities represents medium integration.

Standardization / Routine

The term routine (Belt & Rip 1987), that defines the ways an organization functions and determines what to do, refers to both formal and informal decision-making. However, we are interested in the formal procedures and thus in their standardization. Standardization represents the level of fixing the UITT-activities. An activity is fixed when the procedure for its implementation is clear and performed solely by one unit within the same university following a specific procedure. As the overview of literature has shown, the UITT process has widened to include new activities. There is no uniform and exhaustive definition of UITT activities. Thus, the continuum is set between low (informal) and high (formal) standardization, depending on the practice and self-evaluation of the UITT-unit.

Exclusivity

Exclusivity determines whether the unit provides services for one university (exclusivity), a combination of them (e.g. PVAs – patent and valorisation agencies), or if its services are available to any organization.

Professionalization

Professionalization represents the staff's certification obtainment as defined by the professional associations of the UITT experts. If UITT-unit requires the staff to have a certain level of education and obtain the certificate provided by the association, then the unit is professionalized. High level of professionalization is the demand for staff to have at least two years of experience in UITT, a university qualification of MSc / MA level or higher and an

obtainment of associations' certificate. Low level of professionalization is attained when staff is required to fulfil one of the three conditions. No professionalization is attained when key staff does not fulfil any of the conditions.

Funding

This dimension indicates where the organization gains funds to finance its existence and operations. The sources of funds can be donations from founders or non-refundable grants (non-market funds) on one hand, and funds gained from charging for the activities performed (market funds) on the other.

Institutional isomorphism

Based on their typology, DiMaggio & Powell (1991b, 74-77) suggest some hypothesis for isomorphic change on organizational level and field level for further investigation. As to our knowledge, they have not been tested in the field of UITT. We selected the most relevant ones from the organizational level to verify them on the UITT-units sample.

Coercive isomorphism:

DiMaggio & Powell (1991b, 74): *Hypothesis A-1: The greater the dependence of an organization on another organization, the more similar it will become to that organization in structure, climate and behavioral focus.*

Organizations are more able to resist the demands of organizations on which they are not dependent, thus the probability for isomorphic change is smaller. Coercion is implemented through the exchange relationships between organizations, e.g. investments in knowledge and equipment. In case of above defined characteristics, we propose to verify this hypothesis by examining the dimensions of centrality / autonomy, exclusivity and funding. We expect that where the centrality is high, the autonomy low, the unit exclusively performing services for one university and where the contribution of non-market funds is predominant, the organization is highly dependent on other organization, i.e. on the hierarchically superior organization. We assume this will be the same organization for all the dimensions. We thus propose the modification of hypothesis:

H1: The greater the dependence of an organization on another organization, the more similar it will become to that organization in structure.

Mimetic isomorphism:

DiMaggio & Powell (1991b, 75): *Hypothesis A-3: The more uncertain the relationship between means and ends, the greater the extent to which an organization will model itself after reorganizations it perceives as successful.*

This type of isomorphism is characteristic of change in organizations which poorly understands the key services it is to provide and the means to do so. That is why the organization copy rules and practices of those organizations they perceive as central and successful in their field. We expect this might explain the organization of TTOs especially in Central and Eastern Europe, where the universities established TTOs following changes in legal framework. For establishing the certainty, we will examine the financial dimension. When organization has the majority of its funds coming from non-market sources, the relationship between means and ends is determined as certain. When organization depends for its funding on the market sources, the relationship is seen as uncertain. We thus propose slight rephrasing of the hypothesis:

H2: The more uncertain the financial stability, the greater the extent to which an organization will model itself after reorganizations it perceives as successful.

DiMaggio & Powell (1991b, 75): *Hypothesis A-4: The more ambiguous the goals of an organisation, the greater the extent to which the organization will model itself after organizations that it perceives as successful.*

In order to increase its legitimacy and survival, the organization which has not clearly defined mission will present itself as similar to successful models. We will analyse this through the dimension of specialization and standardization / routine. When an organization has clear goals, it tends to be highly specialized for serving those specific goals. Similarly, an organization has established standards and follows routines to attain those goals. Thus, what we expect to find a relatively young organization with low specialization and low standardization, modelled or planning to model after other organizations that are perceived as successful. We thus propose the following hypothesis:

H3: The lower the specialization and standardization of an organisation, the greater the extent to which the organization will model itself after organizations that it perceives as successful.

Normative isomorphism:

DiMaggio & Powell (1991b, 75): *Hypothesis A-5: The greater the reliance on academic credentials in choosing managerial and staff personnel, the greater the extent to which an organization will become like other organizations in the field.*

By obtaining university degree, organization's staff is supposed to have internalized norms and regulations prevailing in the profession. For our research, the academic credentials cannot be the exclusive indicator of isomorphism. In the professionalization dimension, the qualifications for staff of UITT-units are defined more rigorously to include the experience and historic development of the field. We propose the change in hypothesis:

H4: The greater the reliance on professional qualifications in choosing managerial and staff personnel, the greater the extent to which an organization will become like other organizations in the field.

Table 1: Summary of hypotheses and the UITT-dimensions

Theoretical concept	Hypothesis	UITT-dimension	Type of isomorphism		
			coercive	mimic	normative
Dependence	<i>H1 The greater the dependence of an organization on another organization, the more similar it will become to that organization in structure.</i>	Centrality / Autonomy Exclusivity Funding	X		
Stability	<i>H2 The more uncertain the financial stability, the greater the extent to which an organization will model itself after reorganizations it perceives as successful.</i>	Funding		X	
Legitimacy	<i>H3 The lower the specialization and standardization of an organisation, the greater the extent to which the organization will model itself after organizations that it perceives as successful.</i>	Specialization Standardization		X	
Legitimacy	<i>H4 The greater the reliance on professional qualifications in choosing managerial and staff personnel, the greater the extent to which an organization will become like other organizations in the field.</i>	Professionalization			X

4. Methodology

To answer the research questions, a comparative research approach is used. We are namely interested in typical UITT-units models and the differences among them, as well as in the differences in reasons for selecting one or another model (Ragin 2004). We will explain the similarities within given category (UITT-unit) and the factors (selected dimensions) which explain the results (type of isomorphism) typical for the selected model. This approach was selected to underline the differences in UITT in Europe (Conti & Gaulé 2009).

The research will be conducted in several steps: first by selection of the cases, second by collecting the data, and third by interpretation and analysis.

Case studies selection

Cases of UITT-units will be selected by using purposeful sampling. Our aim is namely to select few cases in Europe which will represent all the potential organizational forms of UITT-units as defined by the interplay of UITT activities and organizational dimensions. This will enable us to build upon the institutionalism theory (Eisenhardt 1989, Patton 2001).

Among them, special attention will be paid to the UITT activities: we will include one unit for each activity, thus one where Type A is dominant etc. Additional criteria to select them and to provide for comparison will be the i) operating at least for the last 4 years (i.e. established in 2008 or earlier), ii) employment of certified staff, iii) membership in ASTP (Association of European Science and Technology Professionals), ProTon Europe (the European Knowledge Transfer Association), TTI (Technology Transfer Innovation) or similar professional association, and iv) serving the biotech and engineering departments of a given university.

The first criterion is selected because we would like to include the units that have been formed after the change of legal frameworks in certain European states²; preferably the countries where there is no professor's privilege. This refers to the assumptions of coercive isomorphism. The criteria for staff and membership will enable us to verify the suppositions of normative isomorphism while the same scientific field will enable us to test the mimetic isomorphism.

Though the unit of research is individual UITT-unit, we will ensure that each is from a different European university, and from different country. Additionally, for each of the identified forms in the Western Europe, a parallel form will be selected in the Central and Eastern Europe, namely

² Especially the changes mimicing the Bayh-Dole Act in favour of university ownership (e.g. Denmark, Germany, Norway, Austria).

in Slovenia, Slovakia, or Hungary. These countries were selected because of proximity and the parallel development of legal framework regarding technology transfer.

In such way, a total of 8 cases will be analysed.

Data collection

Semi-structured interviews will be carried out with unit's managers: the aim is to contact the managers who have worked in UITT for at least 4 years. In our aim to get the information about the reasons for employing certain decisions, their anonymity will be guaranteed. The interview-technique is selected because we have a very small population and are interested in in-depth data. Moreover, the face-to-face semi-structured interview allows for discovering new topics or insight that researcher has not included in the initial questions. To verify the data, the transcript of interviews will be sent to the interviewees with potential clarification questions.

5. Conclusion

To conclude, this working paper aimed to present the literature addressing the structuring and financing of university-industry technology transfer organizations or organizational units in order to point out its limitations when explaining how universities decide to selected certain models. Theoretical background for examining the reasons was proposed by applying the findings of new institutionalism. Feedback, especially on the suggested methodology, will be greatly appreciated.

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