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University Policy and Regional Development: Technology Transfer Offices as Facilitators and Generators of University-industry Linkages

Summary
This article focuses on the role of Technology Transfer Offices (TTOs) in regional development in three Austrian regions that represent different types of regional economies. TTOs can be defined as "bridging institutions" between academia and business. The value added by this approach emerges due to empirical results demonstrating that the variety of TTO functions and their respective spatial profile of activities depend heavily on the regional context. Regional economic structure and regional policy systematically shape the spatial profile of TTO activities.

The distinction between active and passive TTOs emerged as an important one regarding their potential regional economic development impact. While passive TTOs merely facilitate already existing contacts of the academic staff, active TTOs generate new university-industry linkages. These additionally created contacts are heavily biased towards the regional level. Intellectual property rights (IPR)-related TTO activities show a rather weak regional impact. This might prove problematic for policy makers that foster the patent-oriented commercialization of knowledge as a means to intensify knowledge spillovers from the universities to regional or national firms.

Zusammenfassung
Der Beitrag diskutiert die Rolle von universitären Technologietransferstellen in der Regionalentwicklung am Beispiel von drei unterschiedlich strukturierten Regionalökonomien in Österreich. Der Mehrwert des dargestellten Zugangs besteht in der empirisch fundierten Erkenntnis, dass räumliche Muster und Reichweiten unterschiedlicher Transferkanäle des Wissens bzw. unterschiedlicher Funktionen der Technologietransferstellen eine starke Abhängigkeit vom jeweils spezifischen regionalökonomischen und regionalpolitischen Kontext aufweisen.

Als bedeutsame differentia specifica hinsichtlich potenzieller regionalökonomischer Effekte zwischen den Technologietransferstellen stellte sich die Unterscheidung in aktive und passive Technologietransferstellen heraus. Während erstere aktiv neue, additive Kontakte zwischen dem Universitäts- und dem Unternehmenssektor anbahnen und gestalten, sehen letztere ihre Hauptfunktion in der effizienten Abwicklung von bereits bestehenden Kontakten. Dabei zeigen die empirischen Ergebnisse, dass sich die von den aktiven Transferstellen geschaffenen Kontakte

signifikant auf die jeweilige Standortregion konzentrieren. Transferaktivitäten auf der Basis von Intellektuellen Eigentumsrechten erweisen sich in der Regel als räumlich dispers mit eher geringen regionalen Spillover-Effekten.

1 Introduction

The "second academic revolution" has transformed an ever increasing number of universities into entrepreneurial universities; economic and social development emerged as a "third mission" besides the traditional university functions of teaching and research (ETZKOWITZ 2004). Perhaps one of most visible phenomena, amongst these developments and the intensification of university-industry interactions, is the founding of new institutions in universities such as science parks, incubators, or university technology transfer offices (TTOs). TTOs can be defined as "bridging institutions" between academia and business. This article, then, focuses on the role of TTOs in regional development in three Austrian regions. Tasks frequently undertaken by TTOs comprise: the management of the university patent portfolio, providing support for spin-offs, consulting faculty on IPR issues and contract design for co-operative research projects and information as well as organizational support for privately and publicly externally-funded research projects. TTOs appeared at European universities (generally not before the mid-1990s) as a result of a proliferation in Bayh-Dole-like legislations in several European countries (WRIGHT et al. 2008).

Several arguments have been put forward as economic rationalities for TTOs (MACHO-STADLER et al. 2007). One pertinent argument concerns the rather different cultures of the business and university sectors (MOWERY and SAMPAT 2005), and the potential for market failures in the market for scientific knowledge. As a result, "systemic failures" are highly probable. This leads to poorly connected elements of the innovation system and deters the smooth operation of the innovation system as a whole. Therefore, the set-up of "bridging-institutions" that improve the efficiency of knowledge diffusion seems justified from an innovation system perspective. Notwithstanding the economic rationalities for TTOs, some empirical and policy-oriented studies refute the efficacy of TTOs. FRITSCH et al. (2008) argue that TTOs lack the necessary trust and the engagement in subject-specific networks to initiate relevant contacts. Indeed, WRIGHT et al. (2008) report that small informal contract-research projects between academia and business have almost disappeared at the K.U. Leuven as they ought to be formalized since the implementation of the TTO.

TTOs are interesting for regional and innovation policy agents, as well as from an economic geography perspective. The policy relevance stems from the potentially beneficial effects arising from knowledge from academia to private-sector firms for the competitiveness and innovativeness of firms and regions (FRITSCH and SLAVTCHEV 2007). University-industry linkages (UIL) are , still, however, perceived as relatively weak in Europe ("European Paradox"). Additional interest from policy makers on TTOs stems from successful examples of university-based regional development that are based on close UIL and from potential revenues resulting from commercialization activities of universities (MOWERY and

SAMPAT 2005). Research on the spatiality of TTO activities can contribute to literature on spatially-mediated knowledge spillovers. TTOs may directly impact the spatial-profiles of KT-channels. Moreover, research on regional innovation systems (RIS) can be enriched by focusing on the role of TTOs in connecting different elements of the RIS (FRITSCH et al. 2008; FRITSCH and SLAVTCHEV 2007). However, the effects of European TTOs on the geography of UIL and on the commercialization of academic knowledge remain largely unknown (BERGMAN 2009).

To my knowledge, only three papers on TTOs exist that explicitly adopt a spatial perspective on TTOs. In the first, FRIEDMAN and SILBERMAN (2003) apply regression analysis on data from 83 US research universities to investigate the effects of a favourable economic environment (e.g. a high concentration of technology-oriented firms) on license income and other output- related variables of TTO activities. The results strongly confirm the expected positive effects of a favourable economic environment on KT-outcomes. In the second, BELENZON and SCHANKERMAN (2007) investigate the impact of various university objectives on KT-activities by TTOs. For our purpose, their attempt to gauge the implicit costs of a dominant local economic development objective of TTOs is of significant interest. Universities with strong local development objectives (which are more likely to license to an in-state rather than an out-of-state company) generate around 30 percent less income per license. The third, by WRIGHT et al. (2008), provides, inter alia, evidence on how TTOs' KT-activities contribute to regional industrial change. Relevant findings are as follows: TTOs mainly transfer codified knowledge; successful collaboration takes time to develop and is commonly rather bottom-up phenomenon; professional IP management is vital to attract company investment in embedded laboratories on a campus.

In short, two research gaps are identified: firstly, European TTOs have been insufficiently researched, as yet; secondly, little is known about the spatial-profile of TTO activities and the influence on it by policy actions and regional context. Accordingly, based on regional policy research and an RIS approach, two research questions are examined: What is the potential influence of TTOs to contribute to regional development, especially the development of regional clusters? How does regional policy and regional economic context influence the spatial range of TTO activities?

This paper is structured as follows: the following chapter develops a framework for the analysis of TTOs in RIS and delineates the study's design. Section 3 gives a short overview on UIL in Austria and the main policy programs behind the set up of TTOs in Austria. Sections 4 and 5 report the main empirical findings. Finally, section 6 discusses the results and relates them to regional innovation policy strategies.

2 Data and Methodology

The study which is most akin in the methodology applied, is WRIGHT et al. (2008). They researched several transfer channels and institutions including TTOs in six universities spread over four European countries, each located in a different region.

However, their regions were selected by the principle of similarity. Contrary to WRIGHT et al. (2008), we selected regions along the lines of dissimilarity to capture the influence of different regional economic and political contexts on TTO activities. The value added by this approach emerges due to empirical results demonstrating that the variety of TTO functions and their respective spatial-profile of activities also depend on the regional context.

A total of 14 TTOs out of 11 universities in three Austrian regions were interviewed via semi-structured interviews (Table 3). Three different university types are part of the survey: technical, medical and general universities; only public universities are included. The interview partner was either the KT-expert or the head of the TTO. All TTOs from all public universities in the three respective regions were included. Hence, the entire population was surveyed. Since there is only one more TTO in Austria at the University of Linz, the data may even give a good overall picture of TTO activities in Austria.

The study's design and the questionnaire were built upon a framework depicted in figure 1. This framework aims to highlight the main knowledge links of a TTO in an RIS. Following a regional policy perspective, the TTO-augmented RIS framework emphasizes the difference between inter-regional and extra-regional knowledge links. The paper focuses on the contact of TTOs with the regional and extra-regional business sector and the policy programs implemented by national or

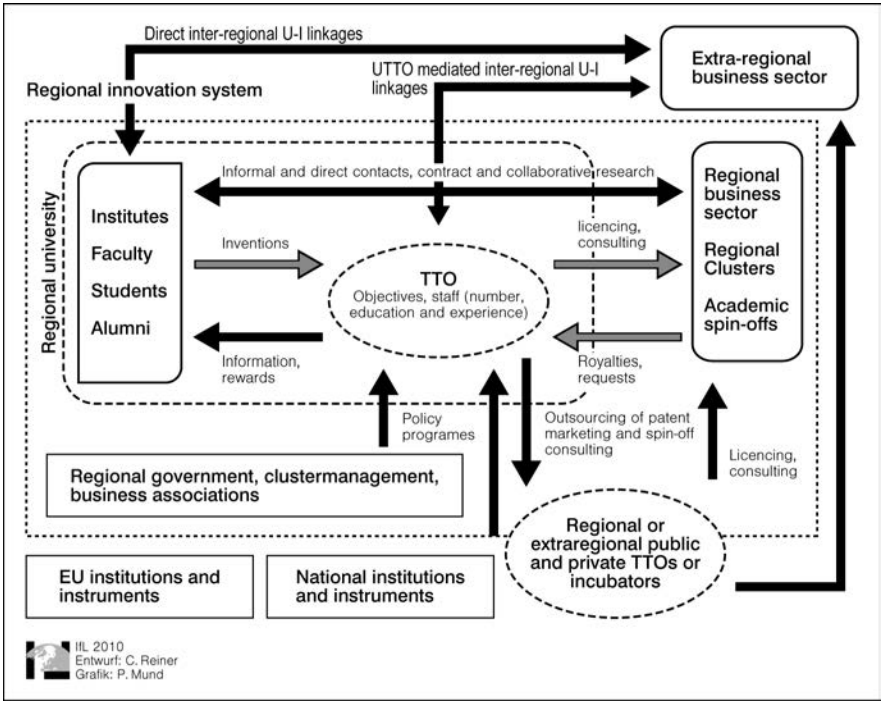

Fig. 1: University-industry interfaces and the role of TTOs in intra- and extra-regional knowledge transfer

regional governments and business associations. AUDRETSCH et al. (2006) report empirical findings from the US that a substantial number of scientists avoided cooperation with the TTO and took the direct route of commercialization via entrepreneurship.

In order to capture regional differences and the influence of different RISs, TTOs from universities in three Austrian regions were investigated. Table 1 provides an overview on the three regions: Styria, Tyrol and Vienna (including the national level).

Region	Styria	Tyrol	Vienna	Austria
Population in millions[1]	1.20	0.70	1.67	8.31
GDP p.c.[2]	26,900	32,500	41,500	31,100
GERD [3] as % of GDP	3.47	2.45	3.54	2.46
Professors (full time equivalents) [4]	346.6	206.8	714.6	1,565.3
Employment in high-tech sectors as % of total employment [5]	3.91	2.41	5.87	4.10[7]
High-tech patent applications to the EPO [6]	20	13	49	24

Tab. 1: Regional economic structure and performance

Data: Eurostat, Yearbook of Statistics Austria 2009, Hochschulstatistik; [1)] 2007, [2)] 2006 current prices, [3)] Gross expenditures on R&D 2006, [4)] Excluded are universities for business and arts, private universities and the university of Krems, [5)] 2007: high-tech manufacturing and high-tech knowledge-intensive services, [6)] average number of applications per million inhabitants 2000–2005, [7)] 2005

The Austrian capital, Vienna, performs best on all cited innovation and GDP indicators. Conversely, Tyrol seems to have the most unfavourable regional economic context, at least from a knowledge economy's perspective. The employment in high-tech sectors is an important proxy for the absorptive capacity of the regional business sector. Whereas Styria's figures almost match the national average, Tyrol is far beneath this. A classification of the three regions may portray Vienna as a metropolitan region, Styria as an old industrial region and Tyrol as a "normal" region without clear specialization patterns or economic trajectories. In table 1, Vienna is seen to possess the highest potential for dense UIL, while Tyrol points to the opposite.

3 University-Industry linkages and University Policy

Several studies on UIL in Austria confirm a relatively low interaction-intensity among universities and private sector firms (POLT et al. 2001; FISCHER and VARGA

2003). After applying spatial econometric techniques to test for spatial knowledge spillovers from university research in Austria, FISCHER and VARGA (2003, 315) deduce the need for "policy strategies to facilitate the flows of knowledge within Austrian regional systems of innovation". Recent studies, though, demonstrate that a change is under way, pushing Austrian universities closer to the needs of an embryonic but growing high-tech sector (TRIPPL and TÖDTLING 2008). For the purpose of our study, the high degree to which this development is policy-driven in nature is important. This observation also applies to the implementation of TTOs in Austrian universities.

Austria introduced Bayh-Dole-like legislations in 2002, assigning universities the right to exploit research results from academics. A policy program called "uni-invent" was set up to support universities in implementing the new law (Table 2). As a result, the majority of universities established a TTO; most of the interviewed TTOs were built with the program's financial support.

Spatial level	Policy actions and programs	Description
EU	Proton (European knowledge transfer organisation)	Founding of Proton as a European support organisation for TTOs
	Guidelines and standard setting for IPR-issues, collaborative research and knowledge transfer	Development and commission of studies on standards and best practice examples in TT-activities
Nation	Uni-invent I (2004–2006) Uni-invent II (2007–2009)	Support for universities to establish institutions (TTOs) for the commercialization of university-produced knowledge
	Tecma	Assistance for inventors in the commercialization of research results
	A plus B	Supports university spin-offs by funding incubators (AplusB-centers) located in every federal state in Austria
Region	Styria: "Scienec fit"	Networking initative to proactively connect regional SMEs with four out of five universities or other "problem solvers" financed by the city of Graz, the regional government and the EU
	Tyrol: Support for TTOs	Financial support and integration into regional development strategies of two out of three TTOs
	Vienna: "Expertinnen der TU Wien beraten Wiener Unternehmen"	Advice for Viennese SMEs by researchers at the technical university of Vienna, financed by the Viennese chamber of commerce

Tab. 2: Policy actions regarding TTO activities in Austria

However, as is shown in Table 1, the activities and design of TTOs depend on several policy programs implemented at different spatial scales. “AplusB” is a relevant program for the design of TTOs at a national level . Under this program, each federal state in Austria has founded one incubator and hence most TTOs have outsourced parts of their spin-off assistance to these incubators. Regarding regional policy influence on TTOs, it has to be stressed that academia is generally beyond the scope of regional policy-makers in most countries (e.g. Germany as a prominent exception). Austria has a centralised university system and TTOs as part of the universities are generally subject to the national level university policy. Nevertheless, regional policy agents have also tried to utilize TTOs for the sake of regional economies. The approach of the programs differs greatly. On the one hand, the Styrian program “Science fit” aims to create new contacts between SMEs and all Styrian universities (excepting the Medical University of Graz) through TTO officers who pro-actively contact and visit SMEs to network them with the university for problem-solving research co-operations. On the other hand, the Viennese program (financed by the regional chamber of commerce) finances a TTO-mediated consultancy of firms which contact the Technical University of Vienna for technological advice. Hence, the Styrian program is based on an “active TTO” model, while the Viennese program builds on a “passive TTO” model. The closest integration of TTOs into regional policy strategies might be present in Tyrol, as the two largest TTOs are financially supported by the regional development agency and integrated into regional development strategies.

4 Organizational structure and objectives of TTOs

TTOs differ widely between universities and regions. Table 3 presents some of the important organizational characteristics of the interviewed TTOs. The second column depicts the size of the TTOs proxied by the full-time equivalents (FTE) of TTO officers preoccupied with KT. Summing up the number of FTEs per region reveals that Styria has by far the highest number of TTO officers (21.5); Tyrol (15) and Vienna (16.5) have similar numbers. Given that Vienna has twice as many university professors as Styria does, and about three times that of Tyrol, a very different picture concerning regional TTO activities emerges.

The majority of TTOs were founded in 2004 as an outcome of the uni-invent program. Characteristically, the technical universities were already implementing their TTOs in the 1980s. With regard to regional embeddedness, the context of the foundation of the TTO has to be considered. A particularly interesting history is displayed by the foundation of the Industrial Liaison Office of the Montan University Leoben: the biggest Austrian TTO. Its founding year was characterized by the heydays of the crisis of the mature, old industrial region where the university is located. It became clear that only new innovations would improve the declining competitiveness of the region's industry. By searching for the innovative potential in the region, the university emerged as the main institution that would provide the knowledge needed for a new technological trajectory. To develop this new role of the university and to accelerate the knowledge link between regional firms and the university, the Industrial Liaison Office was founded. Another TTO that founded

Region	University	TTO (TTO Officers FTE) [1]	Year of foundation	Cooperation partners (location)
Styria	University of Graz	Office of Research Management and Service (1.0)	2004 [2]	AWS (Vienna), Science Park (Graz) [3]
	Medical University of Graz	Research Management and Research Funding (2.0)	2004	BDC (CH), Science Park (Graz) [3]
	Graz University of Technology	Technology Exploitation Office (5.0) Technology Transfer (2.5)	2004 1986	AWS (Vienna), BDC (CH), IPB (DE), Steinbeis (DE), Ocean Tomo (US), LES (global network), Science Park (Graz) [3]
	Montan University Leoben	Industrial Liaison Department (11.0)	1987	
Tyrol	University of Innsbruck	Projekt.Service.Büro (2.5) Transidee (5.0)	2004 [2] 2002	Cast (Tyrol) [3], BDC (CH)
	Innsbruck medical university	Center for Academic Spin-offs Tyrol (Cast) (7.5)	2002	Ascenion (DE), Max Planck Gesellschaft (DE), Frauen-hofer Gesellschaft (DE)
Vienna	University of Vienna	Research Services and International Relations (1.25)	2004	AWS (Vienna), TTO (DK), INITS (Vienna) [3]
	Medical University of Vienna	Research Support Unit (Technology Transfer) (3.5)	2004	BDC (CH), Technology Exploitation Office (University of Graz)
	Technical University of Vienna	Extension Center (Technology Transfer) (7.4)	1985/2004	BDC (CH), TTO (DK), INITS (Vienna) [3]
	University of Veterinary Medicine	VetWidi (1.5) Office of Technology Transfer and Research Management (1.0)	2004 2003	BDC (CH)
	University of Natural Resources and Applied Life Sciences	Research Service (1.5)	2004	AWS (Vienna), Tecnet (Lower Austria), BDC (CH), INITS (Vienna) [3]

Tab. 3: TTOs and cooperation partners

Data: [1)] Excluding administrative and organisational staff; [2)] Both TTOs where established around 2000 but they only started with TT-activities in 2004, [3)] AplusB centers for academic spin-offs

before 2004 is that of the University of Innsbruck: Transidee. The foundation was part of a regional development strategy for IT industries called "Informatik-offensive Tirol". To connect a newly created university institute for ICT with the regional private firm sector, Transidee was founded through the financial support of the regional development agency of Tyrol. Contrary to these two TTOs, the bulk of TTO-foundations around 2004 were neither linked to regional needs nor to regional policy actions.

TTOs cooperate with a number of cooperation partners, especially in the field of IPR and spin-offs. This cooperation, with international firms and associations specialized in the marketing of patents, can contribute to the delocalization of UIL. For example, a TTO manager is a member of an international organization for IPR issues which brings together suppliers and buyers of technologies on a global level. As a consequence, the intensity of informal contacts to internationally-based private sector firms of that TTO are higher than to regionally- or nationally- based ones.

The aims of TTOs are illustrated in Figure 2. Apparently there is a substantial divide between the three regions. However, there are also certain similarities: it is almost as a matter off course that the diffusion of science and technology is perceived by all TTOs as one of the most important goals. On the other hand, and probably in contrast to what would be expected from a university policy perspective, income generation is the least important goal in all regions.

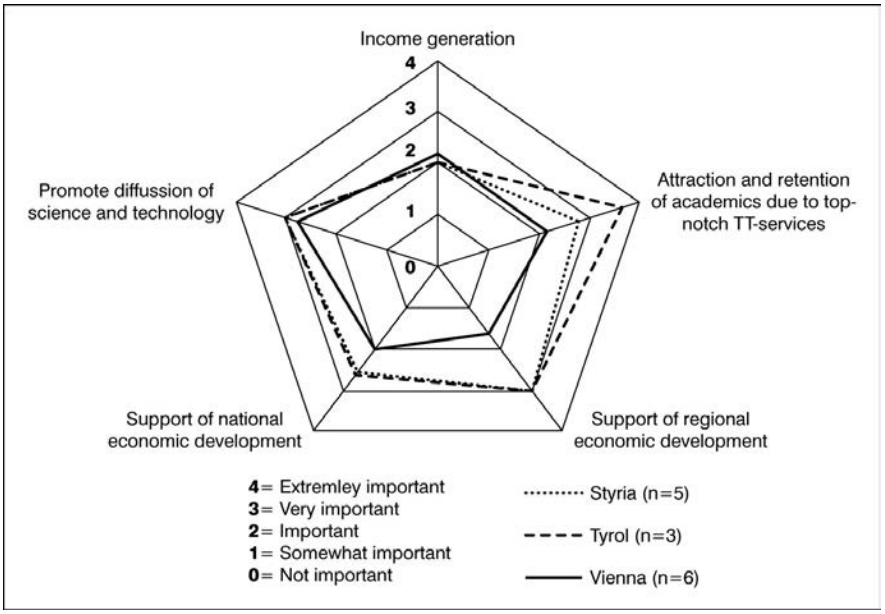

Fig. 2: Objectives of TTOs (mean values)

The main differences between Vienna and the other two regions concern the support for regional economic development. Here, the average Tirolean and Styrian TTO perceives this aim as "very important", where, in contrast, the average

Viennese TTO judges this engagement in regional development issues between "somewhat important" and "important". In terms of support for national economic development, the differences are lower with an unaltered rank-order. The largest divergence between the regional TTOs occurs in the relevance of TTO activities serving to attract and retain academic talent: where Tyrolean TTOs perceive this to be the quintessential goal, TTOs in Styria judge this to be as important as the support for regional development. Taken together, a clear difference can be observed in regional development objectives of TTOs in Vienna, and in the two other regions investigated. Furthermore, as will be demonstrated below, similar patterns of other variables suggest a systemically different role of TTOs in different regions.

Following FRITSCH et al. (2008), TTOs should concentrate on the facilitation of contacts established by academics. Figure 3 documents the degree to which TTOs restrict their mission to this "passive role" as opposed to a more active role in establishing additional contacts. TTO officers were asked if most of the contacts they manage have already existed The spatial-profile of UIL of universities with a passive TTO are shaped by the contacts of faculty and the TTO contacts mirror these contacts in a one-to-one way. However, even in this case TTOs might have an influence by changing the relative transaction costs between different types of transfer channels. AUDRETSCH et al. (2006), for example, reported that researches with an effective functioning TTO in place tend to chose licensing as the main way commercialization whereas in the presence of a bad-functioning TTO they are more geared towards founding spin-offs as a commercialization strategy which, in turn, clearly has a higher degree of regional impact.

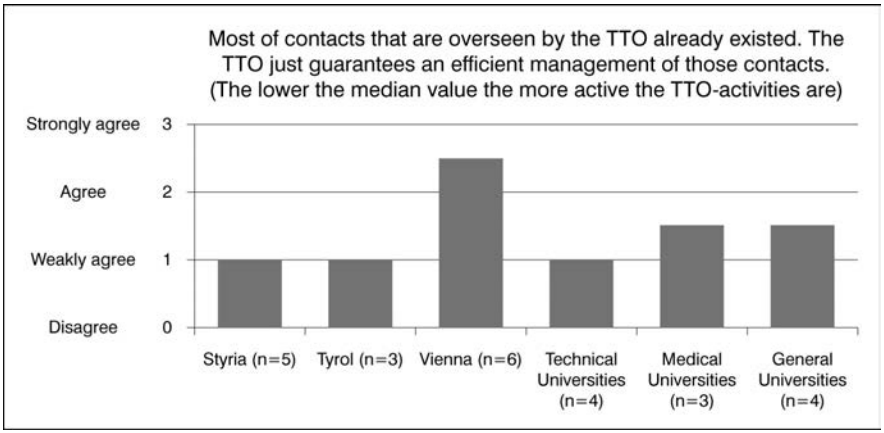

Fig. 3: Generating or just supporting U-I linkages? (median values)

The TTOs from Vienna are more or less passive TTOs. Those in Styria and Tyrol, however, are quite the opposite, and argued that their role and activities are heavily shaped by the aim of contact creation instead of just contact facilitation. In analyzing the distribution of "passive versus active" TTOs by university type, technical universities prove to be the most active ones. The highly active character

of the TTOs in Tyrol stands out in that Tyrol possesses a general and a medical university, as both belong to university types with TTOs of a rather passive nature. Rank-correlation between the degree of "activeness" of TTOs and regional informal contacts with firms as well as with a "regional embeddedness" index variable, results in a positive correlation of about 0.5 at a significance level of 0.10. Accordingly, the more active a TTO the higher the orientation towards the regional level is. This shows that TTOs in Styria and Tyrol are more integrated in the RIS and play a more active role in connecting the different RIS elements. In both regions, regional policy actions are an important explanatory factor for these patterns (see Table 2).

Concerning the criticism of FRITSCH et al. (2008) on an active role of TTOs, an additional insight can be reported. Namely, SCHARTINGER et al. (2001), report that one the main barriers for UIL in Austria is lacking information on what expertise and problem solving competencies are available at the university. Attenuating this lack of information is one of the main goals of active TTOs. In the best of cases, TTO officers possess the tacit knowledge of "know-who": who is the appropriate academic for a specific problem or research task? Therefore, TTOs should maintain very close linkages with faculty in order to function as effective and active boundary spanners. One way to secure this proximity between the TTO and faculty is to hire researchers for the TTO. For instance, the TTO Transidee of the University of Innsbruck is managed by a physicist with a habilitation.

However, a noteworthy potential drawback arises through active TTOs from the predominance of SME contacts created by TTO officers. While this might be perfectly reasonable from the perspective of regional development, a TTO officer reports that academics are not unequivocally satisfied about the numerous but unconducive and insignificant contacts. A TTO manager stated that one of the main tasks of active TTOs is to function as a "filter" between the demands of SMEs and the capacities and interests of the scientists, i.e. to "shelve" some of the potential cooperation projects between university and SMEs (MACHO-STADLER et al. 2007). Refusing inapt demands is very important to maintain effective linkages between SMEs and the university.

5 TTOs and regional economic development

Three relevant factors for the relationship between TTO activities and regional development are discussed and analyzed: firstly, the spatial-profile of different TTO activities; secondly, TTO mediated cluster-university linkages; and thirdly, matching the supply and demand of technology in the three regions is compared in order to assess the degree of regionalization of TTO activities.

Different KT-activities of TTOs are characterized by specific spatial profiles (FROMHOLD-EISEBITH 2006). The highest degree of localization arises due to spin-off support by TTOs: all consulted spin-offs founded their firm inside the region of the university. The other two classical tasks of TTOs: patent marketing and the management of co-operative research projects, show a much different geography. Figure 4 shows the regionally differentiated TTO activities and their predominant spatial range.

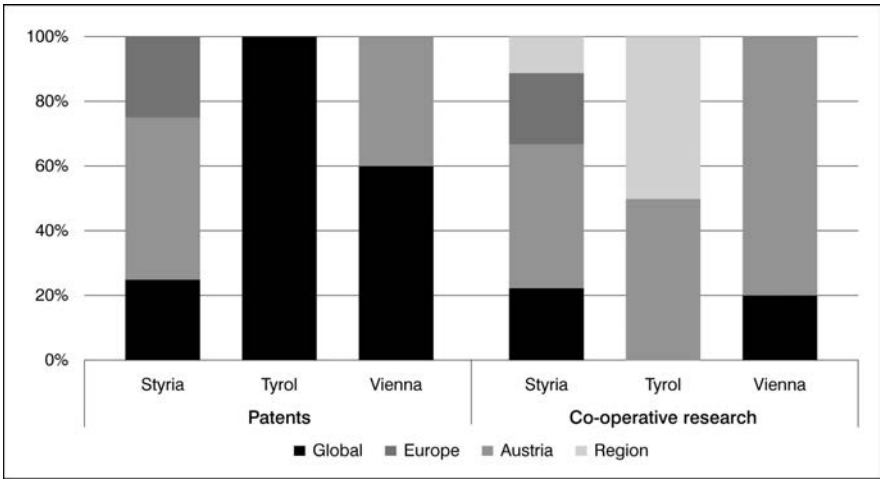

Fig. 4: Share of TTOs whose spatial range of patent and co-operative research related activities are predominantely global, continental, national or regional

As expected, no TTO has a majority of their contacts in patent marketing inside the region, and only a few in Styria have their main focus in Austria. The TTOs in Tyrol that show the highest degree of regionalization in other variables are mainly oriented towards the global level in patent-related activities. Accordingly, the potential of patent-related KT to contribute to the regional and even national development seems to be relatively small. Patenting as one of the politically most enthusiastically supported transfer mechanism appears to be the least spatially constrained one. Taking into account that most of the TTOs were founded to explicitly support the marketing of IPRs, a higher concentration of researchers on this transfer channel risk a decrease in the regional development impact of universities. It has to be stressed that the majority of IPR-marketing activities are shaped by research projects between academia and business. The IPRs for the results of the project are defined in contracts ex ante, and the main task of the TTO is to secure that the university receives a "fair" share of royalties without any influence on the spatiality of these contacts. Furthermore, the discrimination of foreign firms (e.g. by selling the patent more cheaply to national or regional firms) because of regional development objectives, is prohibited by EU law. Nevertheless, even if the TTO has the task to proactively search for a buyer of university IPRs, the strategy of TTOs as described by a TTO officer demonstrates a systematic de-regionalization: "The higher the rated novelty of a patent, the larger the area of spatial search for firms as buyers of the IPR is. The greater the scope of spatial search activities, the higher the costs. The higher costs are in turn justified by higher expected returns from a patent because of the high novelty." This procedure points to a trade-off between the goal of regional development and the maximisation of income for the university (BELENZON and SCHANKERMAN 2007).

The spatial-profile of co-operative research projects is quite different to that of patents. In line with the literature, co-operative research projects are much more spatially bounded. In contrast to IPR issues, active TTOs are much more active in influencing co-operative research projects. Again, the already observed differences between the regions emerge: the TTOs in Tyrol display the highest degree of regionalization regarding co-operative research projects, whereas no Viennese TTO is predominantly occupied with managing regional research co-operations.

Looking at the contributions of the TTOs in the three regions on regional cluster strategies, a pattern of high regional differentiation emerges. Figure 5 shows several dimensions regarding the interaction between TTOs and clusters. The higher the mean value, the higher the intensity or support of these interactions. The most striking feature is the very distinctive role of the Viennese TTOs in the support for regional cluster initiatives. The TTOs in Vienna are more or less unconnected with regional clusters, whereas the TTOs in Tyrol and Styria have a rather close relationship with cluster projects. The intensity of contacts to regional cluster management is very high in Tyrol and Styria and very low in Vienna. However, the intensity of contacts does not translate into a very high overall support for clusters. As may be apparent, the TTO contacts with branches correspond rather weakly with the branches that are organized as regional clusters. Additionally, the active support of regional clusters is no aim, as such, at most, only an unimportant one for

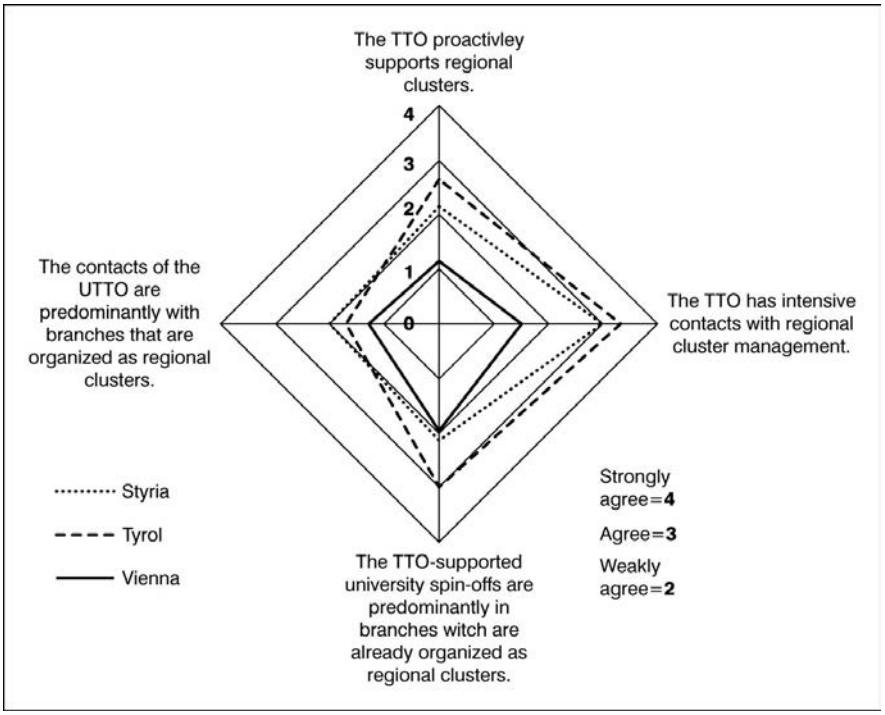

Fig. 5: TTO mediated cluster-university linkages (mean values)

Styrian and Viennese TTOs. When asked if the existence of regional clusters influences the KT-activities of the TTO, the vast majority of TTO officers reported that there was none. One TTO officer who affirmed some influence cited an example of this, stating that the decision of whether to support a university spin-off, depends, inter alia, on the compatibility of the spin-off with regional clusters.

However, the mean values in figure 5 may underestimate the actual contribution of TTOs to cluster development. Some qualitative examples complement the picture. The most active TTO in the support of clusters is the Industrial Liaison Office of the Montan University Leoben. It has been the promoter and the provider for a regional cluster based on material technology. It is not surprising that this cluster fits the knowledge produced at the university very well. A further example may be given by the comparison of the TTOs of the Medical University of Vienna and the Medical University of Graz and their linkages with the human technology cluster in Styria and the life-science cluster in Vienna, respectively. The Styrian TTO is a shareholder of the human technology cluster and the interviewed TTO officer is well integrated into the social network surrounding cluster activities. The support of the cluster figures is high on the agenda of the TTO activities. In opposition to this, the TTO of the Medical University of Vienna does not have any contact with the life-science cluster and the aim to support the cluster is irrelevant. Since the fit between the university knowledge and the regional cluster is more or less equal in the two regions, the differences have to be explained by other factors (see below).

FROMHOLD-EISEBITH and SCHARTINGER (2002) argue convincingly that KT-outcomes have to be evaluated against the background of several indicators. One of which concerns the matching of university-produced knowledge and the receptiveness of the business sector. Yet, what also influences the actual KT activities of TTOs is the perceived matching between regional supply and demand of technology by TTO-officers. Figure 6 shows that there are remarkable disparities between the regions. Contrary to what might be expected of the regional indicators presented in table 2, Viennese TTOs perceive the regional matching of university-produced technology supply and demand as poor. More in line with the indicators, is the result for Tyrol and perhaps a little surprising is the “good” matching in Styria. Styria, in fact, has a matching quality above the average of the 14 TTOs, whereas, the respective median values are below the average for Vienna and Tyrol. However, this result should be interpreted carefully, as Viennese TTOs also responded that they benefit from a regional concentration of high-tech firms and industrial R&D. In contrast to Vienna, all three TTOs in Tyrol stated that there is no benefit for their KT activities emanating from a regional high-tech industry. The policy implications and an explanation for these spatial-profiles of TTO activities in the three regions are provided in the following final chapter.

6 Discussion and Policy Implications

On the whole, the empirical results show that TTOs perform very differently in the three investigated regions. TTOs in Vienna are relatively weakly oriented to and connected with the regional business environment. The opposite holds true for the

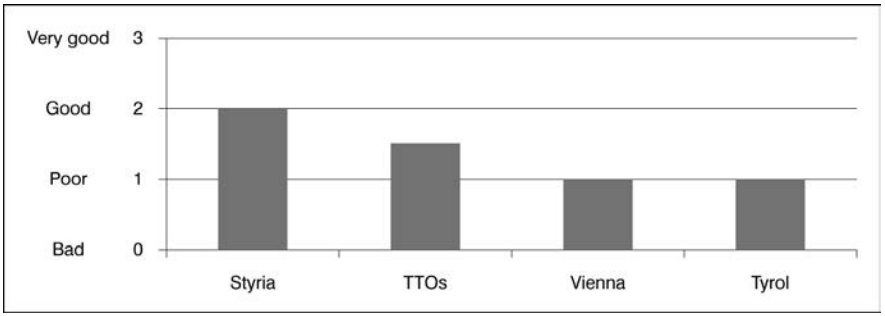

Fig. 6: The matching of regional technology supply and demand is … (median values)

TTOs in Styria and Tyrol. And by comparing these patterns with the regional economic context, which is an important variable for explaining regional KT from university to the business sector, the results shed light on very diverse patterns of collaboration shaped by additional factors than the demand by the industry.

Styria seems to provide the clearest case. The TTOs are heavily engaged in the RIS due to: policy actions that support the regional orientation of the TTOs; very good matching between university knowledge production and industry demand; and universities' strong regional mission. Hence, the activities of the TTOs contribute to, and reflect, the already dense-networked RIS.

A comparison of Styria and Tyrol reveals very similar spatial orientation with a strong focus towards supporting the regional firms and connecting them with the university, but under very different regional contexts. The receptiveness of the regional business sector in Tyrol is by far the worst among the three investigated regions. A TTO manager mentioned that the university lack the institutes of relevance for traditional industries with a synthetic knowledge base such as engineering. Furthermore, even the business sector is characterized by a rather low level of technology compared to Styria. Taking this into account, the concentration of the TTOs on regional KT-activities appears to be somewhat problematic, at least from the viewpoint of national efficiency and from the perspective of a university policy that tries to maximise income and reputation from transferring cutting-edge knowledge to the business sector. Contrary to the case of Styria, the main drivers behind this orientation are regional policy initiatives and a regional oriented university mission.

In sum, comparing Vienna with Styria delivers similar results as the study from FROMHOLD-EISEBITH and SCHARTINGER (2002). Despite a relatively encompassing endowment with high-tech industries in Vienna, the TTOs at the universities in Vienna are comparatively weakly oriented towards the own region. One explanation for this might be a disadvantage in knowledge-matching as reported by TTO officers. In addition, Viennese universities might perceive themselves as universities for Austria or Europe and not for Vienna, a judgement stated by several TTO officers. Furthermore, there might also be a general lack of attention on the part of the regional policy makers regarding the connection of universities with

regional firms. For example, a TTO officer stated that he tried to get some support from regional agencies for regional KT activities but they were not interested in it. Furthermore, the only regional program for TTOs that supports the consultancy of Viennese firms by the Technical University is based on the concept of a passive TTO. Additionally, there seems to be the problem of how to create "order from noise": Nearly every TTO manager in Vienna mentioned that there are such a lot of institutions that there is no need to contribute in a specific way to regional development goals. All this would not be a problem for the economic development of Vienna if the RIS functioned in an effective manner. Alas, this is not the case. TÖDTLING and TRIPPL (2009) assert that the RIS of Vienna suffers of fragmentation between the various elements of the innovation system. Enhancing the interaction between industry and universities might be an important strategy for the regional innovation policy. In conclusion, judging the TTO activities against this background shows that they mirror and reproduce the fragmentation of the RIS. Hence, they are evidently ineffective agents for impelling regional economic growth by improving the knowledge linkages of the Viennese RIS.

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