

BUDAPEST UNIVERSITY OF TECHNOLOGY AND ECONOMICS (BME)

Entrepreneurial Universities in Hungary: Academics' Technology Transfer Activity and Attitude

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Summary of PhD Thesis

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1. Background

In the past few decades, as a result of several interacting economic, social and political developments, the socio-economic role of higher education institutions, or the way stakeholders view these public institutions, have undergone fundamental changes in the world and especially in Europe. Besides the basic functions of education and research, a third set of tasks or function has appeared in the mission statement of universities: the need for commercializing research results. The primary motivation for these changes, as reckoned by the European Commission (COM, 2006), is that European universities “are not currently in a position to achieve their potential in a number of ways”. To become successful and even to survive in the global competition, institutions require new governance and management systems, need to formulate clear missions and strategies, overcome their fragmentation and target efforts collectively, increase their autonomy from the nation state as well as their accountability for performance and relationships with the society and especially with the business community (Maassen & Olsen, 2007).

The new requirements are largely sustained by the admiration of the American higher education system and particularly those few examples (MIT, Stanford) that can be considered exceptions even in the U.S. because of their special economic geographical environment and resources (Wright, Clarysse, Mustar, & Lockett, 2007). Accordingly, European governments have started to emulate selected elements of the U.S. education and research policy, without taking into account the old continents’ unique socio-economic and cultural background. The most preferred measures borrowed by OECD countries are the restructuring of research subsidies (in favour of applied research and development) and altering or creating regulations with regard to intellectual property (IP) (Nowotny, Scott, & Gibbons, 2003). In its Communication entitled “The role of the universities in the knowledge of Europe” (COM, 2003) the Commission argues that

Co-operation between universities and industry needs to be intensified at national and regional level, as well as geared more effectively towards innovation, the startup of new companies and, more generally, the transfer and dissemination of knowledge. From a competitiveness perspective it is vital that knowledge flows from universities into business and society. **The two main mechanisms through which the knowledge and expertise possessed and developed by universities can flow directly to industry are the licensing of university intellectual property, and spin-off and startup companies.** (COM, 2003, old.: 7)

In line with the principles advocated by the Commission, the reform of the Hungarian innovation system in 2003-05 also resulted in the emulation of U.S. research policy tools and regulations. To comply with the new Innovation Act, Hungarian universities have worked out IP policies, to be entitled for the grants of the newly created Innovation Fund they launched applied research programmes with business partners, and some even established technology transfer offices, technology parks and spin-off companies. The most important element of the new techtransfer model is the university ownership of academics’ IP, although in exchange, the institution is required to do its best to commercialize research results in favour of the society, the university, and the researcher.

2. Research questions

The focus of my research is more narrow than the ongoing reform of the European university system, as I only analyze its aspects pertaining to university-industry relations and especially to the entrepreneurial activity of universities and academics. In the meanwhile however, allowing for the characteristics of the macro and the microenvironment, the higher education system and the organization of universities, seems to be inevitable. My research is thus less connected with the literature of university-industry technology transfer than those of entrepreneurial university and academic entrepreneurship (AE), although these categories exhibit some overlap: the entrepreneurial university is a broader concept compared to AE and university technology transfer, as it showcases organizational characteristics as well, such as culture, structure, and management (Yusof & Jain, 2008). Therefore it can primarily contribute to the field of management and sociology. AE on the other hand is realized at individual level and can be studied by concepts and tools used by entrepreneurship research and psychology. While the term AE points to the business-type mentality emerging in an increasing number of research labs, the literature of technology transfer refers to the technical side of university-industry relations, i.e. the formal and informal mechanisms that link the academic sphere with the corporate sphere and the market.

On the basis of the above considerations, **the main aim of this research is to analyze the individual outcomes of the efforts to integrate academic entrepreneurship into the mission and strategy of the university.** The integration of the third mission would entail its institutionalization (professionalization and centralization), similar to the current U.S practice. My further questions are as follows:

- (1) How active are Hungarian university faculty members in technology transfer? Do they accept / welcome the third mission as a new academic norm?
- (2) What factors influence faculty's technology transfer activity and the university's capacity to integrate and institutionalize the third mission?
- (3) Is institutionalization necessary, or can technology transfer be carried out on an *ad hoc* / individual basis? Is the U.S. techtransfer model appropriate for European universities?
- (4) Are the traditional academic values and the basic university functions (education and research) at stake as a result of increased attention on the marketing and commercialization of university research?

All these are important questions regarding European universities' long-term success in the global competition, as well as their social and economic role. However, the key factor of successfully integrating the third mission still lies in whether the university is able to bring forth a mutually fruitful relationship with faculty regarding AE, and under what conditions are faculty motivated to disclose its inventions to the university and cooperate with it in commercialization. This time I was looking forward to an answer from the individual faculty member, who is "at the heart of the technology transfer", and who is "motivated by a set of personal and institutional incentives" (Bercovitz & Feldman, 2006, old.: 180).

3. Scientific novelty and possible applications

The novelty of my research can be traced back to the followings:

First, I examine the phenomenon of AE in an Eastern European post-socialist country. Although the literature of AE is rather international, it mostly focuses on the transition of North-American and Western European universities, thus it is far from clear whether institutions located in a different (e.g. post-socialist) socio-economic context follow the same patterns of entrepreneurial transformation as their counterparts in more developed countries (Rothaermel, Agung, & Jiang, 2007).

Second, the unit of analysis is the individual faculty member, which is rather uncommon in the literature and uncharacteristic of the papers published in the highest prestige higher education journals (Mars & Rios-Aguilar, 2009). With very few exceptions, authors use national, regional, organizational and professional/disciplinary level of focus to study AE but rarely individual.

Third, authors in general do not make use of the entrepreneurship theories of more established fields of science (e.g. economics, management). My research involves some novelty in this aspect too, as I approach the problems of institutionalizing AE through the transaction cost theory of Coase (1937) and Williamson (1981). I use transaction costs theory to understand the peculiarities of the university, which is indeed a loosely connected collection of independent faculty members: the transaction costs of marketing a technology are sometimes lower if the researcher commercializes IP by his/her own, while other times they are lower if the university techtransfer staff manages the transaction.

Fourth, to my knowledge, AE has not been investigated in this respect or in this way in Hungary (see next chapter about the method). The most comprehensive study in the area so far is presented by Hrubos et al. (Hrubos, Polónyi, Szentannai, & Veroszta, 2004) who on the basis of the framework recommended by Clark (1998) use qualitative methods to scrutinize the nature of the entrepreneurial transformation of three Hungarian and four foreign universities. As the authors prepared their case studies before the changes in the Hungarian innovation policy, they could not take account of the problems arising from the implementation of the new (institutionalized) techtransfer model in Hungary.

The Hungarian *status quo* offers another novelty to my research: the paradox of the Hungarian situation is that the new market-oriented innovation and university research policy has been applied to a higher education system with market-socialist characteristics, i.e. where institutions are owned and mostly financed by the state and are thus not required to exhibit entrepreneurial behavior. However, in this respect it is even more reasonable to examine AE in Hungary, where the third mission has not been institutionalized yet, thus faculty members wishing to market their IP are forced to be entrepreneurial in the classic meaning of the word.

The results of my research can be useful for university decision makers on the one hand and technology transfer office staff on the other, in increasing the efficiency of IP management systems and regulations, as well as that of the cooperation with faculty members. Policymakers can also profit from the results, which may highlight the difficulties of adopting the EU propagated techtransfer model in Hungary, and which can point to other more profound problems of the Hungarian higher education system too.

4. Method

My research consisted of three parts: literature review, empirical research and data analysis (Figure 1). In the exploratory phase, I visited tech transfer offices (TTO) at seven prominent Hungarian universities¹. During the literature review I explored the characteristics of the institutionalized university tech transfer model, while by the interviews with university tech transfer staff I identified its embryonic form at the Hungarian universities. Following the interviews, I expanded the scope of the research to 14 state universities, and used more stringent methods to gain further understanding of the features of AE in Hungary.

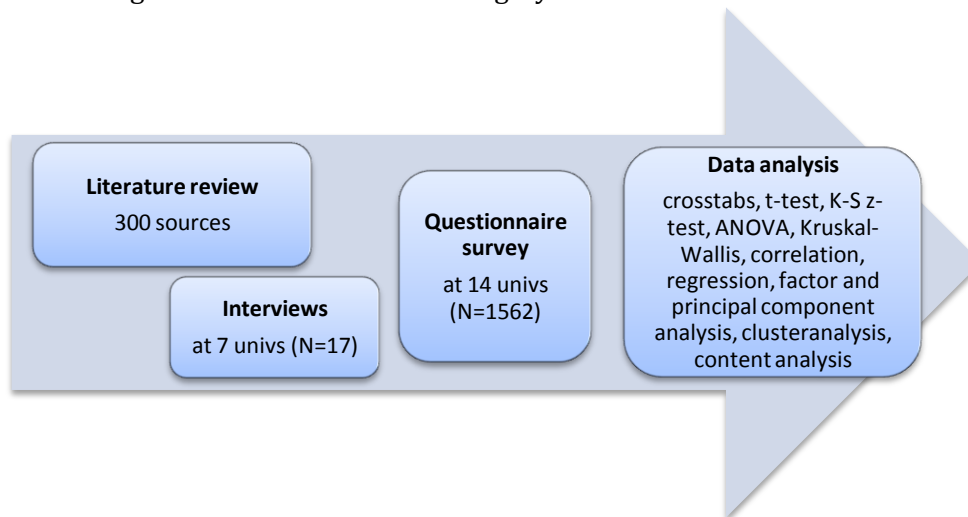


Fig. 1. Research process and research tools

The first phase of the research was empirical in nature, as the literature on AE in Hungary is rather scarce. Former surveys regarding the innovation performance of the country mainly focused on SMEs, while much less attention has been paid to the factors affecting universities and faculty members in meeting the new challenges. To gain a better understanding of the practices, barriers and the institutional milieu of university entrepreneurship I conducted face-to-face interviews with TTO managers and staff at seven major universities, and also participated in forums and trainings organized for university TTO staff. During the interviews, I asked newly recruited tech transfer officers about their responsibilities, experiences, decision making practices, and about their relationship with researchers, the university administration, government agencies, other technology transfer organizations and private businesses.

In the second phase of the empirical research (May/June 2009), I administered a web-based survey to more than 7,000 university scientists of engineering, medical science, natural science and agricultural science (EMNA).² The findings presented are based on the answers of 1,562 EMNA faculty members at 14 Hungarian state-owned universities (Figure 2).

¹ Budapesti Corvinus University, Budapesti University of Technology and Economics, Debrecen University, Eötvös Loránd University, Miskolc University, University of Pécs, Semmelweis University

² I selected all state universities that embrace faculties in which both the traditional (publications and conferences) and the formal mechanisms (e.g. patents, spin-offs, sponsored research) of tech transfer are relevant.

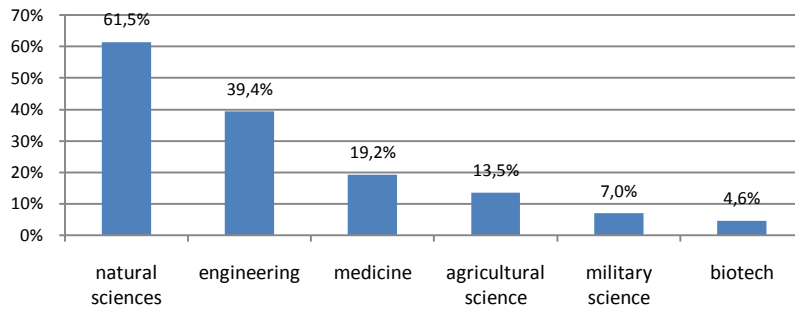


Fig. 2. Distribution of faculty members by research field (multiple answer was possible)

I used the information available on university web sites to make up a list of 7,103 faculty members at the 53 EMNA faculties. The sampling frame was almost identical to the population, supposing that the majority of researchers publish their electronic availability on the departmental web sites. After a second invitation 1,605 researchers answered all my questions (22.6%), however, I left 43 academics out of the final sample, as their research area did not belong directly to the observed fields. Respecting the relatively large number of respondents and the wide scope of sampling, the final sample can be regarded representative of the population. This is also supported by the high similarity between the distribution of the sample and that of the population by academic positions.

I tested the relationship between faculty members' tech transfer activity and their personal and environmental characteristics based on five hypotheses. Before testing relationships, I refined the structure of the variables measured by Likert-scales. I measured AE in three ways: in a continuous variable that summed faculty members' activity in the various (formal) tech transfer mechanisms, and by a binary variable gained from the continuous one with the help of the two-step cluster technique. I also registered researcher's participation in spin-off companies. The relationship of the latter two variables is shown in Figure 3.

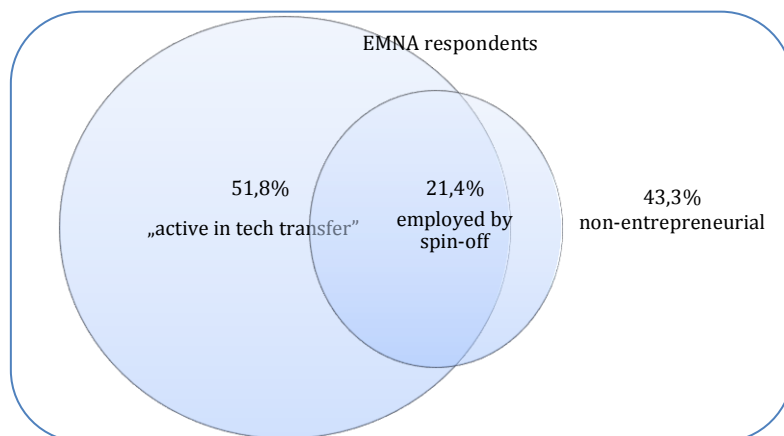


Fig. 3. Distribution of researchers by the binary variables of entrepreneurial activity

Respondents could add comments to the majority of the closed questions. I interpreted the nearly 1,400 remarks by content analysis. I identified and grouped content categories and compared observations to the quantitative results. The length of commentaries varied to a great extent: most of them comprised only a few words or phrases, while some respondents wrote lengthy paragraphs.

5. Results

I summarized the main results of my thesis in four statements, which are based on the hypotheses of the empirical research as well as on the literature review (the second thesis primarily relies on the literature, while the others mostly build on the empirical results).

First thesis statement: on academics' tech transfer activity and attitude

Although the majority of Hungarian EMNA faculty members³ are not active in AE, they generally accept and support the third mission as a new academic norm. While more positive attitude to AE is coupled with greater AE activity, the relationship between attitude and activity is weak.⁴

About half of the faculty members in the sample never cooperated with companies in the past five years, while only one academic out of ten filed patent application at least once in this period. Thirteen percent is frequently or continuously active in tech transfer and two in ten academics works for a spin-off company. Despite relatively low activity in AE, the majority of academics accept and even support the new mission, and with the exception of its negative impact on basic research and the central role of money in tech transfer, they do not agree with the threats or problems raised by the literature. Those having a more positive attitude to the third mission regard its threats less problematic and are more active in AE. However, the relation between attitude and behaviour is weak. This is not surprising in the light of the fact that the acceptance of the third mission is much wider in the academic community than the participation in it (Figure 4). We can conclude that AE does not primarily depend on faculty members' attitude, but other personal and institutional factors, which I study in the next thesis statements.

Nevertheless, this result does not contradict international experience. Even at the most entrepreneurial universities of the U.S., two thirds of academics is not active in AE (never disclosed inventions) and only 2 percent report inventions regularly to the TTO (Thursby & Thursby, 2005). Although disclosure activity increased year by year at the observed universities, it only concentrated in a few faculties (medical, engineering and natural sciences). It should be noted that less than half of faculty inventions with commercial potential are disclosed to the university as said by TTI staff (Thursby, Jensen, & Thursby, 2001).

³ University Faculties of Engineering, Medicine, Natural sciences and Agricultural sciences.

⁴ Relevant publications: Novotny Á. (2010). *Egyetemi kutatók tudományos vállalkozói attitűdje* – egy empirikus kutatás háttere, kérdései, módszertana és néhány eredménye (Entrepreneurial Attitude of University Scientists – Design and Some Results of an Empirical Research), *Marketing & Menedzsment*, accepted for publication. Novotny, A. (2008). *Academic Entrepreneurship and Faculty Attitude to Technology Transfer in Hungarian Universities - PhD Research Project Design and Preliminary Results*, "Austauschprozesse: Extracting the Value out of University-Industry Interaction." *Conference Proceedings*, Muenster University of Applied Sciences, Germany, ISBN 978-3-938137-15-4

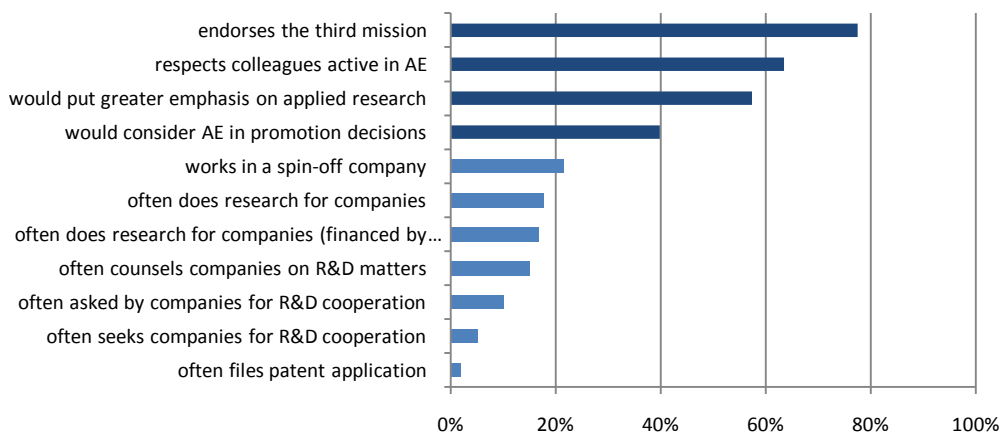


Fig. 4. Distribution of faculty members by their attitude towards AE and their activity in the various means of tech transfer (N=1562).

Second thesis statement: on the obstacles of integrating the third mission

Although AE in theory is supported at individual, institutional and national level in Hungary, its integration to the traditional academic functions (education and research) is encumbered at every aforementioned level.⁵

I depicted the factors determining universities' capacity to integrate and centralize AE in an onion model (Figure 5). This model can also be regarded as the theoretical framework of my research. On the basis of this model, I conclude that in spite of the proclaimed commitment, Hungarian universities with a few exceptions are not suitable for integrating and institutionalizing the third mission or for increasing their technology transfer activity considerably at present: (1) the limited resources and competences of academics; (2) the mertonian, publication-centred, authoritarian and humboldtian organizational culture; (3) the fragmented-bureaucratic-oligarchic organizational structure; (4) university management that have no obligations to meet real performance requirements; and (5) the paternalistic governance of the central state do not help institutions' entrepreneurial transformation.

Albeit the university level integration of the third mission is hard to imagine at the present situation, smaller, more agile and applied research oriented departments, institutes or faculties that have entrepreneurial management are already having extensive industry relationships and the preponderance of their revenues come from third stream (market) sources. Decentralization prevalent at most universities serves their purpose, while it renders the operation of the whole organization as well as the institutionalization of the entrepreneurial function rather difficult.

⁵ KAPCSOLÓDÓ PUBLIKÁCIÓK: Novotny Á. (2009): **Az elefántcsonttoronytól a tudományos kapitalizmusig a felsőoktatási intézmények új küldetése**, *Periodica Oeconomica*, 2009(1), 76-89.o. HU ISSN 2060-9078; Novotny, A. (2008): **Academic Entrepreneurship in Hungary: Can the Bayh-Dole Model of University Technology Transfer Work in an Eastern European Context?**, *Periodica Polytechnica*, Ser. Soc. Man. Sci., 16(2), 1-10. o.; Novotny, A. (2008). **Teething Troubles: The Emergence of New Models of University Technology Transfer in Hungary**. IAMOT 2008 - 17th International Conference on Management of Technology - The British University in Dubai. *Conference Proceedings*. Dubai, U.A.E., ISBN 0-9815817-0-6

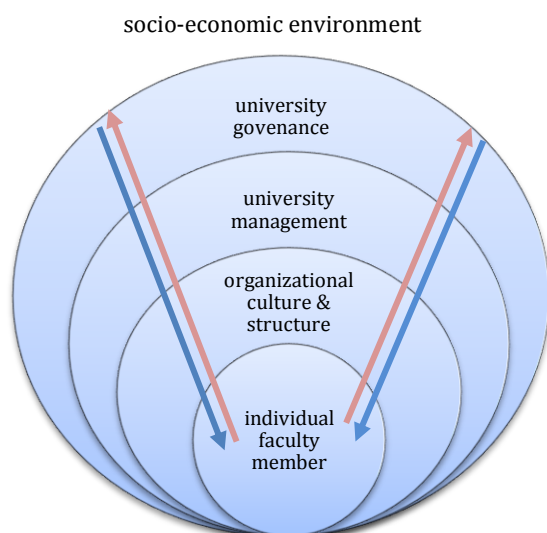


Fig. 5. Factors determining universities' capacity for AE

Third thesis statement: on the factors influencing faculty members' involvement in AE

With regard to the examined variables, academics' tech transfer activity is mostly influenced by their research orientation (applied/basic) and the entrepreneurship of their micro (departmental) environment. This result points to the importance of the research field and to the fact that the overall transformation of the university is only feasible if it embodies applied research and experimental development oriented fields (e.g. engineering and agricultural science). Spin-off creation on the other hand is better predicted by academics' attitude toward 'classic' entrepreneurship and their past industry experience. ⁶

There is a higher proportion of applied science oriented academics in engineering and agricultural sciences (approx. 70 percent) than in other fields, so it is not surprising that these fields comprise academics active in tech transfer in the highest numbers. Spin-offs owners are mostly found in civil engineering and biotechnology (37 and 31 percent resp.). According to the performed statistical tests, research orientation has a relatively strong relationship with the microenvironment (department) and with the commitment to the third mission, which highlight the importance of research field in determining tech transfer attitude and activity. All this is evidence for the fact that norms and attitudes are formulated within scientific fields (not within universities) and spread among its members by conferences, meetings and peer-reviewed journals (Alpert, 1985).

Academics' activity in tech transfer and spin-off companies show similar relationship with independent variables, which can be explained by that fact that one third of the researchers active in tech transfer also work in a spin-off company (see figure 4). In

⁶ Relevant publications: Novotny Á. (2010). **Egyetemi kutatók tudományos vállalkozói attitűdje** – egy empirikus kutatás háttere, kérdései, módszertana és néhány eredménye, *Marketing & Menedzsment*, accepted for publication; Novotny Á. (2008): **Academic Entrepreneurship and Faculty Attitude to Technology Transfer in Hungarian Universities - PhD Research Project Design and Preliminary Results**, "Austauschprozesse: Extracting the Value out of University-Industry Interaction" Conference Proceedings, Muenster University of Applied Sciences, Germany, 1-2 October, ISBN 978-3-938137-15-4

three characteristics however, we should make a distinction between the broad and the narrow interpretation of AE (Figure 6). First, though scientific quality (productivity) is a positive linear function of tech transfer activity, those working in a spin-off are not different from their colleagues with regard to productivity. Second, while the relationship of tech transfer activity and age is linear and positive (older academics are more active in tech transfer), spin-off owners are more representative among academics aged between 40 and 49. Third, although tech transfer activity is not associated with the attitude to institutionalizing AE, spin-off owners have a significantly less positive (or more negative) attitude toward sharing IP and income resulting from commercialization with the university (Table 1). This latter relationship is discussed in the fourth thesis statement.

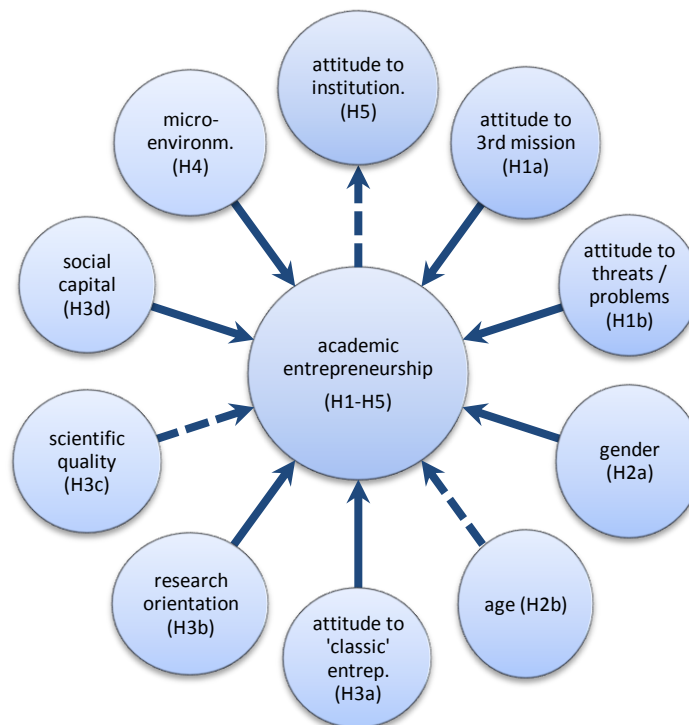


Fig. 6. The results of hypothesis testing (relationships not fully supported by the results are marked with broken line).

Table 1. The relationship between tech transfer activity and (independent) variables identified in the hypotheses (p-values, the strongest relationships are marked with bold)

| number of hypothesis | independent variable | ANOVA F-test sign. | K-W khi-square sign. | correlation sign. (Pearson) | lin. regression F-test sign. |
|----------------------|---|-----------------------|----------------------------|--------------------------------|---------------------------------|
| H(1a) | attitude to 3 rd mission | p=,000 | p=,000 | p=,000 | p=,000 |
| H(1b) | attitude to problems | p=,000 | p=,000 | p=,000 | p=,000 |
| H(2a) | gender | p=,000 | p=,000 | p=,000 | p=,000 |
| H(2b) | age | p=,000 | p=,000 | p=,000 | p=,000 |
| H(3a) | attitude to 'classic' entrepreneurship | p=,000 | p=,000 | p=,000 | p=,000 |
| H(3b) | research orientation | p=,000 | p=,000 | p=,000 (2.) | p=,000 (1.) |
| H(3c) | scientific quality | p=,000 | p=,000 | p=,000 | p=,000 |
| H(3d) | social capital | p=,000 | p=,000 | p=,000 (3.) | p=,000 (3.) |
| H(4) | university environment | p=,000 | p=,000 | p=,000 (1.) | p=,000 (2.) |
| H(5a) | attitude to cooperating with university | n.s. | n.s. | n.s. | n.s. |
| H(5b) | attitude to sharing IP & profit with university | p=,018 | p=,028 | n.s. | n.s. |

Fourth thesis statement: on academics ' attitude toward institutionalizing AE

Academics working in a spin-off company have less positive attitude toward sharing IP and income resulting from commercialization with the university, which can be explained by the fact that these faculty members span-out as they regarded internal transactions costs (costs of bureaucracy, increased administrative work, income redistribution, etc.) to be higher than market transaction costs (e.g. costs of information, bargaining and enforcement, etc.).⁷

The basis of my final statement is the transaction cost theory developed by Coase (1988) and Williamson (1981). Their theory can also play a central role in studying organizational behaviour and intra organizational entrepreneurship (Thornton, 1999), as intrapreneurship can be highly attenuated by unfair performance evaluation systems (Chen & Xiong, 2005) or an owner who exerts strong control over residual returns (Thornton, 1999).

Although academics in general would welcome the university's assistance in commercializing research results, they are less positive about offering IP to and sharing income (arising from commercialization) with the institution. Moreover, those scientists who (besides their university duties) work in spin-off enterprises foster significantly more negative attitudes toward sharing IP and profits with the university than their non-entrepreneurial counterparts (Table 2).

Table 2. The association between AE and the attitude to its institutionalization (results of statistical tests). Attitude to institutionalization has two dimensions: (1) attitude to cooperating with the university in AE, (2) attitude to sharing IP and income resulting from AE with the university.

| method | type of AE | AE's relationship to the attitude towards institutionalization |
|----------------------------------|------------------------|--|
| <i>crosstabs</i> | tech transfer activity | n.s. (both dimensions) |
| | activity in spin-off | COOPERATE: n.s.; SHARE: p=,042 |
| <i>logistic regression</i> | tech transfer activity | n.s. (both dimensions) |
| | activity in spin-off | p=,000 (Omnibus test of common model) |
| <i>t-test</i> | tech transfer activity | n.s. (both dimensions) |
| | activity in spin-off | COOPERATE: n.s.; SHARE: p=,001 |
| <i>Kolmogorov-Smirnov z-test</i> | tech transfer activity | n.s. (both dimensions) |
| | activity in spin-off | n.s. (both dimensions) |
| <i>ANOVA</i> | tech transfer activity | COOPERATE: n.s.; SHARE: p=,018 * |
| <i>Kruskal-Wallis</i> | tech transfer activity | COOPERATE: n.s.; SHARE: p=,028 * |
| <i>correlation</i> | tech transfer activity | n.s. (both dimensions) |
| <i>linear regression</i> | tech transfer activity | n.s. (both dimensions) |

* non-linear

⁷ Relevant publications: Novotny, A. (2008): **Academic Entrepreneurship in Hungary: Can the Bayh-Dole Model of University Technology Transfer Work in an Eastern European Context?**, *Periodica Polytechnica*, Ser. Soc. Man. Sci., 16(2), 1-10. o.; Novotny, A. (2008): **Obstacles to the Institutionalized Model of University Technology Transfer in Hungary**, "Austauschprozesse: Extracting the Value out of University-Industry Interaction" Conference Proceedings, Muenster University of Applied Sciences, Germany, 1-2 October, 2008, ISBN 978-3-938137-15-4; Novotny, A.: **Awakening the Entrepreneurial Spirit of Higher Education Institutions in Hungary - Implications for the Role of Internal Communications**, E. Invernizzi, T. Muzi Falconi, S. Romenti, (eds), *Institutionalising PR and Corporate Communication*, Pearson, 2009. ISBN 978-88-7192-603-2

Quantitative results supported by qualitative data pinpoint the role of transaction costs in explaining the differing attitudes of academics, who indicated that establishing spin-off enterprises is (partly) motivated by avoiding intramural transaction costs of commercializing inventions, as for example bureaucracy, administrative work and income redistribution. Entrepreneurial academics regard market transaction costs to be lower than the costs of cooperating with the university, thus it is not surprising that a relatively low percent of them start a business with university co-ownership (Figure 7). This means that universities had better consider the costs of institutionalizing the third mission from the scientists' point of view as well, as success largely depends on academics willingness to disclose inventions and to cooperate with the institution.

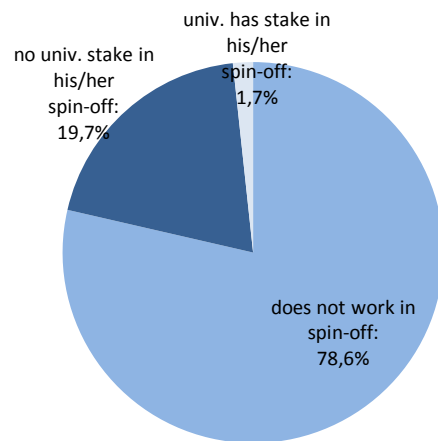


Fig. 8. Proportion of faculty working in spin-off companies (N=1562)

I have already mentioned that even at entrepreneurial US universities, most academics cannot be considered as active in tech transfer and that faculty members disclose less than half of their inventions to the TTO. In view of this, it is a highly ambitious expectation from Hungarian academics to show serious interest of cooperating with the university in the very first years of the new tech transfer model, and especially if we consider content of the second thesis statement.

Owen-Smith and Powell (2001) explains faculty members' willingness to cooperate with the university by the expected returns of commercialization and the perceptions about the university environment including the savvy of the university TTO staff and the costs of cooperating with them. Results show that entrepreneurial academics in Hungary perceive the costs of cooperating with the university too high, the TTO's expertise quite limited, and the university environment non-entrepreneurial, all of which can hold them from supporting the institutionalization of the third mission.

6. Conclusion

Universities are increasingly expected to contribute to regional and national development, but they can only meet these requirements with respect to the factors depicted in Figure 3. Although some faculties and departments (e.g. engineering, agricultural science) excel in AE as compared to others, considering entire university organizations, AE is less pervasive and dynamic. Results emphasize the influence of research orientation and university microenvironment, which supports the hypothesis that entrepreneurial transformation first takes place at the level of departments, research teams or the individual, and cannot be forced on academics from above.

Even in the most entrepreneurial fields of science, less than 4 percent of researchers file patent applications often, and less than 20 percent does research for business enterprises regularly. The low level of activity can be explained by the fact that despite AE is a national research policy priority, it is not reflected in universities' incentive systems at all: promotion and tenure is based on publication activity and relationship capital. This can cause conflict of values and conflict of interests for researchers, as financial success depends on entrepreneurial activity and academic success is contingent upon publishing (relationship capital is important for both), but personal resources (time, energy, money) are rather limited. If we consider the sharp increase in the number of students in the past two decades, it becomes clear that Hungarian faculty members have to face important trade-offs during their career. The temporal (or permanent) separation of academic tasks (education, research and entrepreneurship) would increase the quality of all, as academics would not have to concentrate on all of three at the same time and would not suffer any drawbacks for neglecting one or the other. Allocating sufficient resources (human and physical) to all three functions would also help faculty in dealing with multiple responsibilities (many respondents complained about the burdens of administrative work that consume a high percentage of their time).

Another lesson may be that the success of tech transfer does not primarily depend on formal measures borrowed selectively from countries with more developed and market oriented higher education systems. Barriers to more efficient AE are rooted in the running of the higher education system, i.e. its ways of governance and finance. The admired success of the U.S. innovation system can be put on the longstanding and close relationship between universities and industry, as well as on the high level of autonomy of universities, and much less to the regulations formalizing university tech transfer (the Bayh-Dole Act was more of a result than a cause of increased university-business interactions). Instead of selectively emulating international research policy, national decision makers and university management should develop the three missions with respect to each other and not at each others' expense. So that all researchers, entrepreneurial or not, could fulfil their career goals, the students could profit from the multiple profile of the institution, and the companies of the region would willingly cooperate with the university.

Universities have to take into consideration that many academics know little about the role of AE in economic development, the process of tech transfer or the role of IP protection in commercialization, so they need to be trained and informed on the

different aspects of AE. Since most university TTOs are in a very nascent state of development, trainings and experience sharing is not only important for academics but for TTO staff as well. But in the first place, the university has to decide whether establishing a university TTO or purchasing tech transfer services on the market is more efficient (the third choice is when the TTO operates as a university owned spin-off). Developing TTOs and especially their human resources can be vital, as tech transfer requires scientific and market experiences at the same time, hence it can hardly be carried out by university clerks effectively, but by academics with market experience and entrepreneurial mindset. TTOs in their present state can mostly perform complementary services effectively, such as grant seeking, patent administration, legal advising or organizing tech transfer trainings, which can also ease the burdens on academics.

A conflict of interest can be seen between entrepreneurial academics and the university. A fundamental problem is to determine the rent of university infrastructure, the intellectual background provided by the institution, and its image. These assets are usually undervalued by academics and overvalued by the university. Leaving all the revenues of commercialization at the unit (department or research team) who developed the technology creates conflicts within the institution, while a high degree of income redistribution negatively influences the level of entrepreneurship in the long-run.

Cooperation between the university and academics is pivotal, as they depend on each other: the competitive advantage of entrepreneurial academics is their university status, while the university can directly influence regional development through entrepreneurial academics (not to mention tech transfer revenues that are important for both of them). Therefore, it is worth to reconsider university IP policies and make sure it reflects the interest of both parties. Entrepreneurial academics should be invited to advise TTOs, as they have more knowledge about the peculiarities of university-industry relationships and the pitfalls of AE, and after all, it is mainly about them.

The basis of AE is that academics understand its importance and agree with it. Then the university should make the necessary channels and tools available for them. University managers should also make faculty members motivated and reward AE accordingly, otherwise academics will always be forced to choose between scientific and entrepreneurial career. If this latter does not happen, then the third mission will get stuck at the periphery of the university or even outside of its boundaries and remain the characteristic feature of those few academics, who are entrepreneurial in the classic meaning of the word.

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