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Conference Paper

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50th Congress of the European Regional Science Association: "Sustainable Regional Growth and Development in the Creative Knowledge Economy", 19-23 August 2010, Jönköping, Sweden

Provided in Cooperation with:

European Regional Science Association (ERSA)

Suggested Citation: Erdos, Katalin; Varga, Attila (2010) : The Academic Entrepreneur: Myth or Reality for Increased Regional Growth in Europe?, 50th Congress of the European Regional Science Association: "Sustainable Regional Growth and Development in the Creative Knowledge Economy", 19-23 August 2010, Jönköping, Sweden, European Regional Science Association (ERSA), Louvain-la-Neuve

This Version is available at:
https://hdl.handle.net/10419/119196

The Academic Entrepreneur: Myth or Reality for Increased Regional Growth in Europe?

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Keywords: university, spin-off, academic entrepreneurship, regional university technology transfer

JEL codes: I23, O18, O33, R11

Abstract
Knowledge flows from universities to the regional economy can take different forms ranging from formal research collaborations to consultancy and informal personal connections. One of the knowledge communication channels drawing substantial interest of both researchers and regional policy makers is academic spin-off firm formation. According to the concept of the "academic entrepreneur" (Etzkowitz) university spin-off firm formation has grown naturally from the academic culture of the US where professors traditionally behave very much like entrepreneurs while setting up and maintaining research labs, hiring research assistants, "marketing" research results in conferences and publications or networking with colleagues and funding agencies. Spinning off a company is just a step forward from such entrepreneurial tasks of academics. Thus according to this concept academic motivations are main drivers in university spin-off firm formation in the US. Despite this challenging view the empirical literature pays relatively little attention to the particular "academic" features of university spin-offs and rarely considers the specificities of university entrepreneurship most notably the role of scientists as entrepreneurs. Empirical evidence suggests that Europe performs less successfully than the US in transferring knowledge from university labs to the regional economy via spin-off companies. One potential reason behind this difference is that institutions that determine the continental European research system hold back the emergence of academic entrepreneurs. Thus it is the main research question in our paper whether those specific "academic" drivers behind university spin-off firm formation are present at all in the continental European context. The related question is whether professional characteristics of the academics, their social capital, the norms of academia and the academic and business environment support or hinder these academic motivations? This paper is based on interviews carried out with university researchers who actively participate in firm formation in Hungary. Hungary is an excellent European case since the features of its university system are rooted in the continental (mainly German) tradition, but it also inherits some characteristics from the even more centralized socialist (soviet) tradition.

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1. Introduction

Knowledge flows from universities to the regional economy may take different forms ranging from formal research collaborations to consultancy and informal personal connections (Varga 2009). One of the knowledge communication channels drawing substantial interest of both researchers and regional policy makers is academic spin-off firm formation. The ultimate driver of university spin-offs is the "academic entrepreneur" as first portrayed by Etzkowitz (1983).

The concept of the "academic entrepreneur" is rooted in the American system of research organization (Etzkowitz 2003, Franzoni and Lissoni 2009). It is because in the US academics traditionally act like entrepreneurs as they are involved not only in research but also in multiple activities that are typical for entrepreneurial managers. That is academics should acquire funds to set up and maintain their laboratories, hire assistants, network to have access to additional resources. They "sell" their products at conferences, journals to enhance their reputation among fellow academics and they also take positions in editorial boards to influence directions of academic research. They interact with politicians and industrial partners as well and may take seats in managerial boards of companies to ensure the acknowledgement of their scientific discipline and their research field. Etzkowitz (1983) even characterizes research labs as quasi-firms, since their existence depends on the ability to gain funding, recruiting the most talented people, and principal investigators have to provide similar efforts and skills by managing their laboratories as businessmen by managing their enterprise.

What is a special "academic" motivation behind these entrepreneurial activities is that the crucial aim is to support academic career. Spinning off a company is just a step forward from such entrepreneurial tasks of academics. The commercialization of research results via spin-offs can enhance scientific activity in the research lab through ensuring additional funding for university research. Also there is a potential synergy between basic research carried out at the university and applied research that is undertaken in the firm. Additionally, employment in spin-offs can keep talented students near the university.

Empirical evidence suggests that Europe performs less successfully than the US in transferring knowledge from the university labs to the regional economy via spin-off companies. One potential reason behind this difference might be that institutions determining the continental European research system hold back the emergence of the "classical" (in the Etzkowitzian sense) academic entrepreneurs (Franzoni and Lisssoni 2009). Differences between the US and the continental Europe in the status of researchers, the role of competition and mobility and the organization of research funding are among those institutions that is supposed to significantly influence whether a firm is spun-off by the "classical" academic entrepreneur.

There are major differences in the status of researchers between the US and the continental Europe. University faculty members in the US are university employees whereas in the continental Europe they are civil servants or state employees (Franzoni and Lissoni 2009). This naturally has an effect on the salary of researchers. In the US system compensation is

determined in a decentralized manner, while the centralized European systems do not reflect productivity differences directly in salaries (Bonaccorsi 2005).

Related to the status of researchers there is a fierce competition among universities for the most talented researchers in the US (Bonaccorsi 2005) as they can attract additional public funding to the universities. Consequently in the US there is a high mobility of researchers and short term moves between academic and non-academic environments are also permitted. On the contrary, the continental European system seems to offer less mobility and competition that inhibits systematic collaboration across institutional boundaries impeding technology transfer (Franzoni and Lissoni 2009).

Regarding the level of decision making for research, the US system is a multilayer, decentralized system where the sources come from several political levels (federal, state, local etc.) and from several types of agencies in terms of governance (public, private, third sector, foundations) and time horizons (short or long term). To the contrary in the centralized continental European system important funding sources are allocated at few levels and there is only low variety of funds with almost zero private donations. The allocation of R&D resources in the US follows an evidence-based decision making process while in the continental European system decision making is the result of a political compromise about equivalently competing claims. The former system leads to concentration of funds favouring long term large scale funding while the latter usually results in equal distribution of funds, attracting short term and limited size funding. (Bonaccorsi 2005)

All of these differences suggest that the academic entrepreneur does not fit into the European system. However, there are successful spin-off cases in Europe as well (Wright et al. 2007) especially in the UK, but also in the centralized, hierarchical university system of Germany as well. A possible explanation for the existence of successful spin-offs in Europe can be that there are some non-academic incentives (e.g. personal financial gain, need for independence, need for autonomy) that play a more important role to create a firm. The other option is that the academic entrepreneur is also present in continental Europe despite all those supposed institutional barriers.

Thus it is the main research question in our paper whether those specific “academic” drivers behind university spin-off firm formation are present at all in the continental European context. The related question is whether even within this less supporting institutional setup what additional factors might support or hinder academic motivations behind spin-off firm formation. The factors investigated include professional characteristics of the academics, their social capital, the norms of academia and the academic and business environment.

This paper is based on interviews carried out with university researchers who actively participate in firm formation in Hungary. Hungary is an excellent European case since the features of its university system are rooted in the continental (mainly German) tradition, but it also inherits some characteristics from the even more centralized socialist (soviet) tradition. The paper is structured as follows. The second section outlines those factors that might support or hinder academic motivations in spin-off formation even within the continental European institutional system. The third section presents the results of the empirical research. Summary concludes the paper.

2. Factors influencing the realization of academic motivations behind spin-off firm formation

In the focus of our study is the researcher who decides to set up a company. A special emphasis is given to his or her motivations, beliefs and to the factors that can hinder or support the realization of the motivations. Even against the above mentioned characteristics of continental European institutions which are assumed to impede academic entrepreneurial activities there are some successful spin-off cases in Europe. Based on the literature we found four groups of factors that might support entrepreneurial activities within the academia even though institutional factors are unfavourable. The survey is based on literatures that are related to academic entrepreneurship at large, including consultancy, patenting, licensing, and spin-off activity as well.

The first group of these factors is related to the *professional characteristics of the faculty member* who finally decide to set up a company. Publication and citation records, position in the university hierarchy, the existence of a role model, business education and business experience belong to these characteristics.

Publication is a common way of knowledge transfer (Agrawal and Henderson 2002, Landry et al. 2006) and case studies demonstrate that academic innovators usually aim to perfect academic research and publish their work towards the scientific community, which is related to the "publish or perish" mentality (Vohora et al. 2004). Publication records are important in the sense that more successful researchers tend to be more active in establishing spin-offs (Di Gregorio and Shane, 2003). Publication record is also a general measure of scientific quality that correlates with the probability of patenting (Renault 2006) that can actually result in establishing a firm. However, Landry et al. (2006) found that the number of publications did not have an impact on the spin-off creation by researchers and also Agrawal and Henderson (2002) argued that patents are not good predictors of the number of publications but the importance of them as measured in citations. Lowe and Gonzales-Brambila (2007) found that faculty entrepreneurs are usually star scientists, who are more productive in terms of publications and citations.

The position of the individual researcher in the university hierarchy had a modest effect on patenting activity with somewhat deeper involvement of full professors however tenure faculty had somewhat lower rates than non-tenure faculty (Morgan et al. 2001). This is in line with previous findings that entrepreneurship can be an alternative job option for scientists with temporary employment contracts (Helm and Mauroner 2007).

Koschatzky and Hemer (2009) found that successful role models can have a positive effect on entrepreneurial engagement of faculty. There is a common belief that university faculty lacks the necessary skills and knowledge to run a business, so business education would be beneficial to increase the performance of spin-off companies.

Not only formal business education but also business experience and industrial cooperation can be very useful in the spin-off process by supporting the identification of opportunities (Bodas Freitas and Verspagen 2009), and also later on in the development of the company as this view is strengthened by Helm and Mauroner (2007) where a positive relationship between growth of the spin-off and start-up experience was found.

Social capital is often mentioned as an important factor that influences the development of companies, and this is also the case for academic spin-offs. Social capital increases the likelihood of spin-off formation (Landry et al. 2006) as it is important in the processes of gaining funds, acquiring and hiring surrogate entrepreneurs, accessing information and knowledge (Vohora et al. 2004). Since spin-off founder faculty usually has insufficient network outside academia (Vohora et al. 2004) in our view it is important to make a distinction whether social capital is about academic or business networks. External markets, technology and supplier contacts are all important regarding the growth of the firm (Lawton-Smith and Bagchi-Sen 2008).

Empirical evidence suggests that *academic and scientific norms* play a significant role in the process of technology transfer (Ndonzuau et al. 2002, Goldstein 2009). Etzkowitz (1998) argues that there is a normative change in science and faculty not to believe in the necessity of the ivory tower anymore. However, there are some risks associated with the entrepreneurial turn of universities. Secrecy and publication delay can threaten the norms of open science. Louis et al. (2001) found that the more entrepreneurial scientists are more likely to withhold information from others. Goldstein (2007) strengthens this view by finding that the negative effect of entrepreneurial activities on the exchange of scientific results works against spin-off formation. Also Bok (2003) found that overwhelming secrecy is disadvantageous. The decline in scientific productivity measured by publications of the faculty might be a good proxy for publication delay. Buenstorf (2009) found by investigating Max Planck directors that there was even an increase in the number of publications after invention which is in line with the findings of Lowe and Gonzales-Brambila (2008).

Departmental norms seem to have a crucial effect on entrepreneurial activities (Louis et al. 1989) which is in line with the results of Renault (2006) who found that since tenure and promotion decisions are made at the departmental level it has a bigger influence on entrepreneurial activity of researchers than university policy.

Factors in the *academic and business environments* in general can also exert a significant effect on entrepreneurial activities. Grants and support programs to increase technology transfer seem to be a good device to facilitate knowledge transfers (Vohora et al. 2004), but there are some risks that should be kept in mind. Koschatzky and Hemer (2009) found that direct grants for start-ups can result in companies that operate in non-commercial environment. Meyer (2003) also found that after several years of spin-offs support may not result in self-sustained companies. Easily available significant financial support may results in the establishment of excessive infrastructural and personal capacities.

There is a common belief that the Bayh-Dole Act[1] opened the door for American universities to be engaged in entrepreneurial activities especially in the field of licensing. However not all of the universities took a chance on this as they did not increase significantly their activities while others implemented strategies to influence the behaviour of faculty (Goldstein 2009) and set up TTO to fully exploit the opportunity. Thus there are significant differences in the entrepreneurial policy of universities. Renault (2006) highlighted the importance of incentives (like revenue share) but also Klofsten and Jones-Evans (2000) argued that university pressure can exert even a negative effect on firm establishment. Feldman et al. (2002) found by analyzing the technology transfer strategy of American research universities that universities with greater technology transfer experience tend to have more and more equity instead of

[1] According to the in 1980 accepted regulation universities own the intellectual property rights of federally funded research results (Franzoni and Lissoni 2009).

licensing that can be rooted in the fact that they are aware of the advantages that are included in the alignment of the interests of the university and the firm, even though the return is slower and riskier in case of equity holding.

As mentioned above after 1980 the passage of the Bayh-Dole Act the number of university technology transfer offices in the United States boosted. These organizations are aimed to facilitate knowledge transfer, and their experience and expertise have an even greater importance if university-industry relations are weaker (Colyvas et al. 2002). Also the organization and financing of the technology transfer office can play a role, since self-sustaining TTOs tend to prefer licensing due to the immediate income.

Science parks aim to support technology transfer, promote regional development, create income to the university and enhance networking of research institutions and industrial partners (Kleinheincz 2000). They can be important elements of the innovation system if they are part of a "non-linear heterogeneous network of incubation, research, innovation, business and social goals" (Etzkowitz et al. 2005; 423. p.). They played a role also in the success of the Oxfordshire region that has the most of these institutions among British counties (Lawton-Smith and Bagchi-Sen 2008).

Lack of access to venture capital (VC) is a major impediment faced by spin-off companies that is rooted in a mismatch of the demand and supply sides of the VC market as TTOs would welcome VC early on but venture capitalists prefer to invest after the seed stage (Wright et al. 2006).

3. Empirical analysis: In search of the "classical" academic entrepreneur behind university spin-off firm formation

In our study we investigate researchers' scientific motivations behind spinning off a firm and the factors that influence the realization of these motivations. To eliminate the differences between scientific and entrepreneurial fields we tried to focus on one area; biotechnology. Based on the websites of the Hungarian Biotechnology Association, the Hungarian Spin-off and Start-up Association and that of technology transfer offices we prepared a list of companies that was completed and corrected by suggestions of consultants from different fields. The twenty two companies chosen cover the majority of companies operating in the country and meet our selection criteria (biotechnology, academic founder). We made interviews with eighteen researchers (three faculty members could not participate in the research in the interviewing period due to international or other programs and one researcher refused to participate). We interviewed five entrepreneurial researchers in Budapest and thirteen from the countryside based on a structured scheme. Duration of the interviews varied between thirty and ninety minutes. Researchers in the capital are affiliated with the Eötvös Loránd University, Szent István University and Semmelweis University. We met with five researchers at the University of Debrecen, five at the University of Pécs, and three at the University of Szeged. All of them filled a CEO or a CSO (or equal) position in the firm, there are physicists, chemist, veterinarians and more than third of the interviewees are medical doctors. The oldest firm was established in 1992, the youngest in 2008. It is interesting that four of the five firms in Pécs were created in the first half of the '90s, whereas the youngest companies were found in Debrecen where all of them were established in 2005 or later. Fields of the companies are biotechnology and medical devices. The age of the founders is various;

one third of them are under age 40, eight of them are between 41–60 and four of them are above 60.

Three of the companies are operating in the field of medical devices (surgery, gastrotonometrics and allergology), one of the companies is active in the field of medical biology, biotechnological research and bioinformatical software development, one in genomics, three of them develop diagnostic devices, molecules, one of the companies is active in the field of toxicology, two of them are related to food industry, six of the companies are connected to pharmaceuticals and cancer therapy and one company is involved in gamete and embryo manipulation.

In nearly half of the companies there are 2 or fewer employees which can be related to the fact that either these are relatively young companies and/or they have subcontractors, but in five companies there are more than 10 employees. It is hard to measure how successful these companies are, especially since some of them are very young. Since biotechnology is not a typical big employer, we can argue that those five companies that have more than 10 employees are very successful, furthermore – based on the interviews – we assume that four further companies are profitable or stable self-sustaining. Two of the companies are still in the developmental phase but have really breakthrough ideas in their field of operation.

3.1 The „Classical" academic entrepreneurs

Eight classical academic entrepreneurs are identified in the sample. Most of these researchers have excellent publication and citation records and their scientific work is widely known internationally. They are usually positioned in the upper segment of the academic hierarchy and most of them lead their own research groups. Their aim with spin-off establishments is to further extend scientific activity. Firms might focus on the development of a product or technology originated in a single idea or on the creation of broader product ranges. If the company provides services too that is not the main activity as it also supports scientific research. Financial motivations do not play a crucial role though one of them mentioned that it is a significant incentive. Monetary rewards are usually considered as measures of success in the business world.

Academic and firm activities are symbiotic with each other. As one of the academics highlighted:

"There is a huge synergism between university and enterprise."

Almost all of them prefer academic work though the firm is also very important. They enjoy the atmosphere in academia and some of them work at the university even after retirement. Some others assume that they will work in the firm more intensively after going to be retired.

Usually the CEO position is hold by them or by their MBA partners or both of them at least at the beginning but at a certain stage of firm development they usually extend their management with appropriate experts and sometimes they hire professional management. The most often mentioned reason for this was not the lack of necessary knowledge. Though most of them did not take business education the majority had prior business experience in forms of contract research with industry or consultancy services. Additionally all of them have project management experience thus they already have an insight into financial administration,

contacts to accountants and lawyers. The most important reason of hiring a professional management was shortage of time that is faced by most of the scientists after a while. Usually they feel that managing administrative and financial issues of the different projects demand too much time and at a certain stage of the development of the company it is wiser to hire a professional management.

"In the second stage management and professional tasks must be divided."

Most of the academics in this group studied or even worked abroad for longer or shorter periods and still today are in contact with their foreign partners. Some of them have met role models abroad, and this is even more important if we consider that there are only a few of them in Hungary. However those few try to help their colleagues and may hold a consultant position in the firm of the younger researcher.

It is important that several members of this group are deeply embedded in international research networks and have regular interactions with their colleagues abroad. These contacts usually originate from visiting positions at such excellent scientific centres like Karolinska Institute in Sweden, University of California in San Francisco, University of Wisconsin in Madison or at firms like Genentech. One of them had the chance to work together with a Nobel-prize winner scientist.

Academic networks play important roles in the start-up process. Sometimes the idea of establishing a firm occurs during conversations with academic colleagues. In other cases development of the firm happened through academic networks and contacts. We also observed cases where academic contacts were business contacts as well where the foreign academic is a spin-off founder and cooperates with the company. The intensity and extension of academic contacts often do not decrease, but increase after the establishment of the firm, since it generates cooperative research and co-publications. In some cases business networks resulting from former contract works with industry appear significant in the start-up phase as well.

"Business contacts evolved through personal relations, international research networks, publications and professional contacts."

Publication delay occurs naturally from time to time in patent protection. Sometimes this is mentioned as a problem, but in most of the cases it is accepted as necessary and not regarded as a big impediment in scientific work.

"There can be some delay that is explained by the patent protection process, but we publish everything."

No tensions are reported with respect to secrecy even though in some cases there is formal secrecy policy at the companies. Academics usually share their ideas with their university colleagues (who are often colleagues in the firm as well) since trust-based atmosphere is crucial for scientific research. In some cases they better share their firm-related research only with firm colleagues. However, it is well understood by their university colleagues and does not lead to tension or mistrust. This might be related to the fact that there is a division of labour between applied research carried out at the firm and basic research at the university laboratory thus university colleagues do not feel to be in a disadvantageous situation by not being informed about firm-related knowledge. Free flow of information and knowledge

exchange are advantageous to a certain extent also for the entrepreneurial scientist since there is a huge accumulated general and specific knowledge at the universities and it can easily happen that a specialist university colleague can solve a question arisen in a certain field. One of the academic entrepreneurs pictures the intellectual environment as follows:

"The Hungarian mental and intellectual atmosphere is beneficial for the biotech firm."

With respect to norms at the university department academics in this group describe them as favourable for entrepreneurial activities. Some of the colleagues support the company while academic entrepreneurs submit project proposals together with the university.

State supports and grants play significant roles in the establishment of companies. The other important source of income is contract research. Most of the companies would be able to completely exist on sales and service incomes only two of them need state support as they are not on the market yet with their otherwise promising technologies. These are the only companies in this category where business angel and venture capital financing are present. For the rest of the academic entrepreneurs almost all of them are a bit sceptical about VC as they usually try to avoid it. The main reason is that they are afraid of loosing control over their firms what would be harmful for their original academic intentions.

There is sometimes a very limited, but not typical cooperation with the university technology transfer office at companies established in the beginning or middle of the 2000s. University equity holding is not typical (it happens only in one case), though parent universities are theoretically active in entrepreneurial activities. It seems that science parks, an often mentioned actor of the technology transfer process do not play a significant role for academic entrepreneurs as only two researchers mentioned their importance.

3.2 "Unbalanced" academic entrepreneurs

In contrast to "classical" entrepreneurs where activities in the university laboratory and in the firm are in a close symbiosis for this type of researchers either research (three cases) or the company (one case) gets the dominant focus though both of the activities are present.

Half of the researchers in this group limited their activity to science from the beginning on and did not participate in the management of their firm that was established together with a surrogate entrepreneur or with a company. The reason – next to shortage in time – is that they are only interested in the development of the product which is based on their idea and not in the business operation of the firm. Sometimes they do believe that more intense, deeper entrepreneurial engagement would be harmful for their scientific activity. One of these researchers admitted that it might result in loosing control over the firm but he also believes that it is normal because the industry's task is to develop the product.

"I prefer academic work. […] It is difficult to relinquish from a part of the firm, actually from the majority […] but it has to be accepted."

The difference here with the first group might be rooted in the fact that three of these companies develop medical devices and the professors are medical doctors in all three cases with their primarily interest in healing. They are very successful and acknowledged scientists, half of them have outstanding publication and citation records. They are placed in the highest

levels of the academic hierarchy. Academic entrepreneurial role models were not mentioned. Also the three researchers attached primarily to academia did not have any formal business education.

Products are clinically tested at university laboratories. Academic network connections are utilized to get feedbacks about the appropriateness of the product and to gain advice for potential further developments. University devices and facilities are used during product development. Research results are often published in scientific articles.

"Also a portion of publications in leading international journals were born in co-authorship that also enhances the image of the university."

The fourth researcher represents the opposite side: he is stronger as entrepreneur than as an academic. He used to be a faculty member but while working at a company abroad he had already decided to quit his job and start a company. Though he is primarily motivated by business he was already involved in the research line where the company is operating in when he held a position at the university. He still maintains close contacts with universities. Besides his academic network his business network also played a very important role by giving advice and lending interest-free loan to establish the company.

"… I was still abroad when I quitted the university in 1993, but I knew already that I rather would like to be involved in entrepreneurship when I return home."

Even though three of the professors are dominantly interested in academia, researchers of this group did not mention either secrecy or publication delay as a problem that would keep them back from being engaged in entrepreneurial activities in the future.

"Industrial research is different from the academic one in the sense that publication must be delayed for example until acquiring patent protection, but it did not have a real influence."

State supports and grants play a very important role by creating the chance to set up a company and carry out applied research that is needed to develop a product. Lots of them mentioned that calls for university-industry cooperation projects meant a crucial step at the beginning, and they are beneficial also later on.

"… we have to admit that we would not be in this stage without the project call and support, it is due to these that the idea remained in the region."

As in the first case, the university is supportive not only at the departmental, but at a more general policy level as well, however, the TTO does not play a dominant role in any steps of the technology transfer process just like science parks and venture capital.

3.3 Academic entrepreneurs impeded by environmental factors

Their motivations and characteristics in many respects are the same as those of the "classic" academic entrepreneurs but due to some reasons they cannot fulfil both roles. Their aim with the firm is to promote their scientific work and to develop and put into practice an invention based on academic research. However due to an unfavourable departmental attitude, the

dislike of the direct superior (maybe jealousy) or lack of resources they cannot realize their original aims. We identified three cases in this group.

Scientific work of the researchers is well acknowledged by the research community. Two of them have very impressive publication and citation records even though one of them is in a younger age cohort. Despite of this none of them have the chance to set up their own research group within the university. Against their good scientific performance they are positioned at the bottom/middle level of the academic hierarchy sometimes already for a while and it is not likely to be changed significantly in the near future. Thus they do not feel to be appreciated:

"Academic career is today a non-existing career in Hungary, establishing any kind of measurable existence as a university researcher is not real. The university lecturer-researcher does not have a prestige."

Two of these researchers were taken visiting researcher positions abroad where they have seen role models and found that the symbiotic relation of the spheres of academia and business is an attractive idea that is worth to follow.

Only one of these researchers had prior business experience before setting up the spin-off firm and neither of them had an existing business network that would have helped in the establishment and development of the spin-off. Even though there is sometimes a stressed relation with the university academic networks with colleagues at the university and overseas helped two of the researchers to become academic entrepreneurs.

Firms are based on a concrete idea or the recognition of the biotech trend however it is not always a breakthrough. Where the idea is a real advancement in the scientific field the reputation of the scientist increases and the success of the firm and the researcher sometimes awakes jealousy among colleagues and heads of the departments with unfortunate negative consequences. One researcher left the university because his superior did not welcome his entrepreneurial success. But these tensions arising at the academia are not rooted in secrecy or publication delay.

"By the time I filed the patent application, I pretty much hanged out from the academic group at that time going to work in industry was strange."

So it can happen that the researcher has to choose between academic and entrepreneurial engagements because university management supports entrepreneurial activities only on the surface. In fact the faculty member is continuously subject to negative discrimination at the promotion/tenure procedure. The supportive attitude of the university policy is indicated by university equity holding that occurs in one of the companies. Since the decision about tenure and promotion is made at the departmental level university regulation and the technology transfer office cannot do too much if the head of the department is against entrepreneurship. At this point departmental norms are more important than written laws.

"My scientific output is equal or higher than that of the whole department including the scientific output of any professor. I am only an assistant lecturer and as I see I always will be…The company totally sets me back."

Since in some cases there is a hostile university environment behind the seemingly supportive strategy most of these companies used the services of the technology transfer offices in a very limited manner or not at all.

"In my view lots of people would start a company if the conditions were more favourable."

There are also examples of entrepreneurial performance under expectations even though it is about a researcher with good scientific results with significant attempts to set up a company and considerable grant experience. In these cases the tension does not seem to be between scientific and entrepreneurial activities but between the company and the framework conditions. The researcher may not have the necessary business knowledge but cannot or does not intend to hire appropriate management.

The lack of specialized patent experts can also block spin-off development.

"We are unable to find experts right to the nicks."

Some insist that these experts are available only abroad and it means an enormous cost. The problem is more striking in cases of firms located on the countryside since the management always has to travel to the capital for arranging patent issues.

Also lack of appropriate financial resources can stop companies growing. At the beginning there are usually state- and EU supports which are very helpful but in some stages of the development a bigger amount would be needed that is not covered by these grants or if state support is suspended for a while it can cause considerable problems. They do not have VC in the firm. One of the researchers mentioned that they try to avoid it because of the associated risk of loosing control over the firm. One of the companies had a laboratory in an industrial park but in the others scientific parks do not play a role.

3.4 "Externally motivated" academic entrepreneurs

The three entrepreneurs in this category are different from the previous ones both in terms of motivations and characteristics. They are in the bottom/middle segment of the academic hierarchy and they do not necessarily have international experiences. Even the one we know has this experience visited a non-entrepreneurial university thus he did not meet academic entrepreneurial role models. On the other hand he has the highest publication and citation record in this group though he is in the middle age cohort while the others are at the beginning of their academic career.

Since they operate in fields of chemistry and genomics where contract research is common most of them have business experience but they do not have real business networks that would have facilitated the process of spin-off development. On the other hand academic networks can be helpful. One of the companies was established by colleagues and in another case it seems that they kind of "use" academic personnel in the firm.

"It is hard to separate who works in the firm and who does in the laboratory."

Secrecy does not play a role, academic community and information flows are rather supportive for the research in their belief and also publication delay is acceptable. The

absence of tensions between academic and entrepreneurial activities is perhaps related to the fact that the establishment was mostly initiated by the university and there is university equity holding as well.

"Science is too complex, institutes cannot work without trust."

The motivation to set up the company is rooted in the entrepreneurial strategy and practice of the university or in need for resources.

"The idea was given by a call for proposal especially for creating spin-offs. Possibly without it we would not have started."

In the university push driven case it is usually about a very active TTO that is the executor of an aggressive entrepreneurial strategy accepted by the top management of the institution. The TTO is eager to introduce entrepreneurial activities with more and more researchers to gain a deeper insight into the research carried out at the university and it might set up an own company to manage contract research works. Since inventions are filed and sometimes they put up research questions and topics that are likely to generate patents TTOs are often active initiators of firm establishment asking the PI to be the CEO. It is about companies with considerable, sometimes 100% university equity share. Sometimes there is industrial equity share as well but there is no VC in these firms either.

"The spin-off was a university initiative I was asked by the TTO."

The spinning off process can be initiated also by the researcher but with the involvement of the university. Thinning of basic research sources motivates more and more researchers to obtain money from different types of applied research grants to conduct basic research. This can be particularly true for researchers positioned in the bottom/middle segment of the academic hierarchy as in the competition for the grants they start with a significant set back compared to colleagues with high publication and citation records.

There is a "negative Matthew-effect"[2] in case of researchers in the beginning of their carriers as there are no significantly sized grants available.

"There is an inner motivation but it can also be seen as a necessity company since the sources for basic research are less and less. There were in the past grants for devices etc., today only very few and the big grants are usually not for associate professors."

Since these are usually young companies it would be hard to predict what influence of these circumstances will have on the growth and success of the firm but it is likely that with modest enthusiasm or unclear vision their growth will be slow or zero. It cannot be excluded that based on their first entrepreneurial experience the faculty will decide to establish a real firm to exploit the synergies between university and industry moving into one of the above mentioned categories depending on environmental factors.

It is very likely at externally motivated entrepreneurs that they would never have started a company in the absence of supportive university environment or that of grants so state

[2] Merton (1988) argued that due to the Matthew-effect works of already acknowledged scientist are usually higher appreciated also later on, consequently they get more trust and have access to more funds as well.

supports and grants play a major role in this group. Firms of externally motivated entrepreneurs might never be born in a hostile university environment. Even at firms that aim the utilization of an idea there is much more an institutional entrepreneurial than a personal motivation.

These firms typically do not have a professional external management there is no business angel money or venture capital in the firms but there is sometimes industrial partner and lots of industrial contract research.

One of the companies aims at the development or commercialization of certain research results while the other two – though they carry out also in-house research – are still searching their right place and one of them even admitted that they do not expect significant growth. The basic difference between these and the "classical" academic entrepreneurs is that even though in the latter one there are companies based on one idea they make the impression of having a long-term vision with the company as they target profitable, big markets. The externally motivated entrepreneurs are either mainly specialized in services or operate on a "will see" principle searching for their place and are not growth oriented. The firm is rather an alternative commercialization method of an idea as compared to licensing. This might add to the fact that they are operating with university equity support.

University pressure and equity lead to the increase in the number of firms but it can be feared that it creates a hostile atmosphere among researchers. The "everyone is guilty unless proven otherwise" is not a good approach on the side of the TTOs. The personal, trust based relationship might have resulted in the same number of disclosures but could create a better university atmosphere motivating researchers to decide about the firm formation themselves in view of the opportunities. However it must also be admitted that the purely volunteer firm formation is hindered by the lack of successful role models.

Not only university strategy but also the interest of the TTOs might induce pro-activity (that is sometimes seen by the faculty as aggression) of technology transfer offices in spin-off firm formation. This is because TTOs are established and operated by grants which are needed to sustain their operation. Thus they have to prove they right to exist and their effectiveness. Since licensing – though it usually means quick direct revenues – is not easy and it is unlikely to secure the operation of the TTO regional employment and development effects of spin-offs can be good arguments while applying for operating expenses.

4. Summary and conclusions

In this paper we were searching for the "classical" academic entrepreneur behind university spin-off formation. Specifically we tested the assumption whether the academic entrepreneur is indeed a typical US phenomenon rooted in the institutional set-up of the American research system. Interviewing university spin-off firm founders in the Hungarian biotechnology sector we found that the "classical" academic entrepreneur does exist even within the context of the continental European institutions.

Table 1 shows the effect of investigated factors on academic motivations at the different types of entrepreneurs.

Table 1: Factors influencing the realization of motivations at different types of entrepreneurs

Factors		„Classical" academic entrepreneurs	„Unbalanced" academic entrepreneurs	Academic entrepreneurs impeded by environmental factors	„Externally motivated" academic entrepreneurs
Professional characteristics of the faculty member	Publication and citation record	Outstanding	Outstanding	Outstanding	Outstanding/ low
	Place in the university hierarchy	High	High	Medium/low	Low
	Role model	+	0	+	0
	Business training	3/8	0/4	0/3	1/3
	Business experience	5/8	1/4	1/3	1/3
Social capital	Academic networks	7/8	3/4	2/3	1/3
	Business networks	5/8	2/4	0/3	0/3
Academic and scientific norms	Secrecy, publication delay	0	0	0	0
	Departmental norms	+	+	-	0
Academic and business environment	Grants, support programmes	+	+	+	+
	Entrepreneurial strategy and practice	0	0	0	+
	Technology transfer offices	0	0	0	+
	Science parks	0	0	0	0
	Venture capital	0	0	0	0

Notes:
– Impeding
0 Does not have a significant effect
+ Supporting
x/y It played an important role in case of x persons among y group members

Eight out of the eighteen cases clearly show the characteristics of the firm established by the "classical" (in the Etzkowitzian sense) academic entrepreneur. The main motive behind the formation of these firms is to enhance the carrier of the academic researcher by maintaining a synergic relationship between the university lab and the spin-off firm. It was also shown in the paper that there are important factors that determine if a firm is spun-off by a "classical" academic entrepreneur or the spinning off process results in different types of companies.

"Classical" academic entrepreneurial firms are spun-off by well established, internationally recognized scholars with rich academic network connections. The existence of role models appears to be critical in the emergence of these companies. It was also shown that academic and business relationships can significantly increase the success of firm formation. While entrepreneurial policies of the universities do not show sensible impacts on the emergence of these "classical" academic entrepreneurial firms supportive departmental norms are crucial in their success. In the absence of a friendly environment at the department or the necessary business knowledge and financial resources academic entrepreneurs become "impeded" in the sense that a successful company does not enrich scientific activities at the university laboratory. On the other hand specificities of the product and missing role models could lead to the formation of the "unbalanced" type of entrepreneurs where the integration of the firm into scientific research becomes limited as the firm exists "on the side" of the activities of the

academic. Surprisingly we found that aggressive university policies supporting spin-off firm formation within the continental European institutional context does not result in "classical" academic entrepreneurial firms but rather in companies with limited business-academia synergies.

Thus we found that under specific circumstances the "classical" academic entrepreneur can indeed emerge and becomes successful even within the context of the seemingly not supportive continental European research institutions. As such the power of academic motives in firm formation is clearly shown by the empirical analysis. We did not find evidence that policies commonly applied to motivate academic spin-off formation such as increasing TTO activity could be really beneficial in the context of continental European institutions of research organization. On the contrary our results imply that institutional changes in the European research system would be beneficial for academic technology transfers via university spin-off formation. Based on our empirical findings we suggest that financial autonomy of universities, real competition among academic institutions in attracting highly qualified researchers or the introduction of a multilayer system of research funding could significantly enhance the success of already existing academic entrepreneurs as well as provide further incentives to spin-off companies motivated by strong academic goals.

Acknowledgements

The research leading to these results has received funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 216813. Previous versions of this paper were presented at the 49th Congress of the European Regional Science Association (Lodz, 2009), at the 3rd Central European Conference in Regional Science (Kosice, 2009), at the Culture of Business – Capital of Culture conference (Pécs, 2009), at the workshop on Cooperation and Participation in Technoscience in the Socialist and Post-Socialist Space (Graz, 2009), at the second IAREG progress meeting (Vienna, 2009) and at the Seminar of the Department of Economics and Regional Studies, Faculty of Business and Economics, University of Pécs (Pécs, 2009). Comments received by participants of the above mentioned events are gratefully acknowledged. We would like to express our special thanks to the useful comments and suggestions by Zoltán Bajmócy, János Barancsuk, Attila Buday-Sántha, Edward Bergman, Pablo D'Este, Javier Revilla-Diez, Harvey Goldstein, Simona Iammarino, Annamária Inzelt, Jan-Philipp Kramer, Gunther Maier, Gerd Schienstock, Sabine Sedlacek, Helen Lawton-Smith, Zoltán Szabó, László Szerb, Franz Tödtling, Michaela Trippl, Nick von Tunzelmann, and also for the experts and consultants who offered their help by providing contacts to interviewees: Norbert Buzás, Kata Dobay, Arnold Fehér, Kinga Homolay, Zsolt Makra, Lenke Rónaszegi, Marcell Veidner, and of course to all of the researchers who agreed to be interviewed.

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