MOTIVATION AND SUCCESS OF ACADEMIC SPIN-OFFS: EVIDENCE FROM HUNGARY

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Abstract: Universities today are expected to play a major role in contributing to economic competitiveness and especially through the process of commercializing research results. There is much evidence that firms started by university researchers are effective channels of knowledge from the academic sphere to the private sector. To encourage the creation of university spin-offs, first we have to understand the goals and motivations of academic entrepreneurs. This paper includes the empirical study of 80 Hungarian spin-off owners, who run their own firm besides retaining their position at the university. The purpose is to explore the motives that drive academics to start their own business and to test the relationship between motivations and entrepreneurial success. Success is measured from both objective and subjective aspects. The former refers to quantitative indices related to business performance such as firm revenue, change of revenue, number of employees and firm age. The latter refers to the self-evaluation of one's success as an academic entrepreneur. Subjective success is measured on the one hand by the researcher's own entrepreneurial success criteria, while on the other hand by the perceived degree to which his or her knowledge has been commercialized on the market. The results show that the dissatisfaction with the university salary (necessity) is the most important motive for starting a venture in the academic sphere. The studied entrepreneurial motivations, except for necessity, have a significant relationship with subjective success, but a weaker or no relationship with objective success. The results also highlight the importance of research-related motives, which have a relatively strong link with subjective success (mainly with the subjective success of technology transfer), and are also related to some objective performance indicators of the venture such as revenue. Although the need for achievement and the need for independence are not key motivations for starting a spin-off venture, they have a relatively strong relationship with subjective entrepreneurial success.

Keywords: entrepreneurial motivations; success; academic entrepreneurs; higher education

JEL classification: L26; I23; O32

1. Introduction

Although higher education institutions (henceforth: universities) accommodate 42% of the researchers in Hungary (HCSO, 2012), universities are not transferring their research results to the business sphere with sufficient intensity (Papanek and Borsi, 2001). The moderate market-sensitivity of university research is mainly due to historical reasons. After the Second World War, the Hungarian research and development (R&D) sector was tailored to the Soviet model: the autonomy of universities practically disappeared, research institutions were placed outside the academic sphere and universities' industrial relations weakened. After the regime change, state-owned corporations were liquidated or privatized, and innovation fell out of the priorities of the government and the business sphere. Informal technology transfer (journals articles, conferences, informal discussions)

was the dominant form of university-industry co-operation throughout the 1990s, while firms did not consider universities as an important source of marketable knowledge (Inzelt, 2004). In the first years of the new millennium the ratio of innovative firms indicating cooperation with universities was even smaller than a few years before: 21.6% and 13.7% in the period of 1999-2001 and 2002-2004 respectively (Havas and Nyiri, 2007).

Supporting the objectives of the Lisbon Strategy, the government initiated the reform of the national innovation system in 2003. Similar to several other OECD countries, Hungary has changed its research policy and related legislation according to the US technology transfer model (Novotny, 2008; Novotny 2010). The Research and Technological Innovation Act (effective as of 2005), which is indeed a Bayh-Dole-type legislation, breaks away from the 'open science model' and urges universities to retain title to inventions rising from research pursued within the framework of the university. The Act requires universities to implement an intellectual property (IP) management policy and allows them to set up so-called 'technology utilizing firms' (spin-off firms) with the participation of academics.

The 'spin-off movement' is not new to the Hungarian university sector, however, the university participates in very few of the academic ventures. A nationwide survey focusing on almost 1,600 academics from engineering, medical, natural, and agricultural faculties of 14 Hungarian institutions revealed that the university had a share in less than one out of 10 ventures run by university researchers (Novotny, 2013). Spin-off firms hence rather serve individual interests than that of the whole institution.

Despite a broad consensus concerning the necessity of intensified technology transfer between the university and the industrial sector, the realization of such goals are hindered by several factors including the following (Novotny, 2013; Novotny and Papanek, 2012):

- The intra-role conflict caused by the various aspects of academic work (education, research and entrepreneurship) and the lack of specialization of academics tasks. Academics find it increasingly hard to comply with the growing number of responsibilities at the same time.
- The one dimensional motivation system ('publish or perish') and the conflict between the rules of promotion and those of government research policies.
- The inflexible, bureaucratic university organizational structure that prevents timely decision making required for the cooperation with the business sector, along with a distrust of university support organizations such as the technology transfer office.
- The lack of explicit income distribution policies that satisfy both the university and academics, and the absence of shared decision making practices.

Consequently, policies regulating the cooperation between the researcher and the university should focus on academic entrepreneurs, in order to utilize their valuable experience in technology commercializing and also to promote mutual confidence between the institution and the researcher. The first step in this process is to understand academic entrepreneurs' goals and motivations. While most scientists are primarily motivated to pursue technology transfer by the extra income it provides (Novotny, 2013), international findings point to its indirect advantages, such as increased prestige and reputation, the positive effect on research and education, or the acquisition of research infrastructure (Slaughter and Leslie, 1997). The aim of this paper is to examine why Hungarian university researchers spin out a firm and how their personal motivations relate to their success as an entrepreneur. Analyzing the success and motivations of spin-off firms would help government officials, university managers and university technology transfer staff to refine university IP management policies and to make the academic career more attractive and rewarding for prospective and present scientists respectively.

2. Spin-off motivations

Economists regard profit maximization as the ultimate goal or motivation of businesses. The spin-off literature also emphasizes the prospect of higher income as an important motivation of starting a firm (Franklin, Wright and Lockett, 2001; Egeln et al, 2003; Shane 2004). On the other hand, not all empirical findings support the priority of financial benefits. In academic settings the application and expansion of knowledge and gaining ideas for new discoveries are also regarded as key drivers of firm creation (Morales-Gualdrón, Gutiérrez-Gracia and Roig Dobón, 2009). The role of academic career related benefits such as obtaining research funds, laboratory equipment and research grants, as well as higher prestige and status are highlighted by Italian studies (*Baldini*, *Grimaldi and Sobrero,* 2007). There are two opposing approaches in literature (D'Este, 2010): one believes that academic entrepreneurs are primarily motivated by commercialization, while the other suggests that academics collaborate with industry to support their research. Motives can also vary by fields of science. In life sciences for example, where patenting is more common, financial incentives are more important in firm creation than in natural sciences, where the positive effect of entrepreneurship on research is more dominant (Owen-Smith and Powell, 2001).

In addition to utility-maximization and science related objectives, other personal motivations, such as the need for achievement and the desire for independence can also incentivize spin-off formation (Morales-Gualdrón et al, 2009). Despite the fact that most R&D projects are team-based today, the propensity to act autonomously can be a key motivation of spin-off creation (see for example Roberts, 1991). To spin-out of the university and contact market actors independently may even be a stronger motive in countries where universities are highly bureaucratic.

On the basis of McClelland (1961) many authors suggest that entrepreneurs are 'high achievers', i.e. they seek challenges, want to do a job better, accomplish results, and find solutions to problems. The achievement motivation can be important in academic settings, where entrepreneurs have to perform in multiple domains at the same time including education, research and research commercialization. As university organizational culture is usually weak, academics' innovation performance can be higher outside than inside of the university (Szabó, 2013). There is evidence that both the need for achievement and the desire for independence are positively related to spin-off formation and success (Roberts, 1991).

Authors who examine entrepreneurial motivations tend to group them. One of the most widely used dichotomies is between 'push' and 'pull' motivations (Pirnay, Surlemont and Nlemvo, 2003). Concerning spin-off ventures, the need for independence, market opportunity, building one's career and status are among the pull factors, while job-related dissatisfaction or the pressure to engage in academic entrepreneurship is on the push side (Weatherston, 1995; Chiesa and Piccaluga 2000; de Silva, 2013).

The study of entrepreneurial motivation is important concerning both spin-off creation and success. In academic context entrepreneurial success can be approached by three different ways at least. First, in technology transfer terms (e.g. delivered technologies, economic impact) (Choi and Lee, 2000), second, by market indicators such as revenue, profit, number of employees and firm age (Helm and Mauroner, 2007) and third, in a subjective way, i.e. based on personal feelings. The importance of measuring subjective success is that not all entrepreneurs are motivated by wealth and growth in the first place. Motivations are probably more closely related to subjective success than to objective success or business performance. As motivation is a desire to do something based on one's needs and wants, when the underlying needs are satisfied one feels successful. For example, academic entrepreneurs motivated by the research-related benefits of

technology commercialization may feel successful if they can gain new ideas, equipment or relationships for further research.

Although this study borrows some theories and motivations from the general entrepreneurship literature, it aims at contributing to the spin-off literature in the first place. In general university spin-offs refer to the formation of new firms or organizations in order to exploit the results of the university research. There is no widely used definition in literature of spin-off firms, but there are several classifications. For example Nicolaou and Birley (2003) differentiate among orthodox, hybrid and technology spin-offs, and also between academic exodus and academic stasis, but none of these categories capture the approach of this paper. In our perspective, spin-off founders retain their place in the university, but simultaneously participate in the running of their own company. Therefore we exclude firms in which the university researcher maintains no connection with the spin-off, or leaves the university to be able to work full time in the firm.

3. Method

The main entrepreneurial motivations identified in the spin-off literature were examined empirically among Hungarian academic entrepreneurs. The studied motivations are as follows:

- the prospect of higher income,
- the need for achievement,
- the need for independence and
- research-related benefits.

The survey population consisted of academics working at university faculties of engineering, medical science, natural sciences and agrarian science. The survey was based on a database of more than 1,500 university academics created in 2009 by the author (see Novotny, 2013). The sample of this study is 80 academic entrepreneurs from 10 Hungarian universities.[18] The data on entrepreneurial motivations and success was collected online in March and April 2014.

A seven-point Likert-scale was used to measure motivations. The scale contained 20 items that were elaborated based on literature analysis. The final model was formulated with the help of factor analysis (Principal Axis Factoring) as the data was significantly non-normal. Success was measured with both objective and subjective indicators (Table 1).

Table 1: Indicators of entrepreneurial success used in this study

Objective success	revenue
	change in revenue
	number of employees
	firm age
Subjective success	Based on your own success criteria, do you regard yourself as a successful academic entrepreneur? (1= absolutely unsuccessful; 7= absolutely successful)
	How satisfied are you with the degree to which your knowledge was commercialized / utilized in the market? (1= absolutely dissatisfied; 7= absolutely satisfied)

[18] Budapesti University of Technology and Economics (26 participating academics), University of Debrecen (14), Szent István University (13), University of Pécs (10), University of West Hungary (5), University of Szeged (4), Eötvös Loránd University (3), University of Miskolc (3), Universirty of Kaposvár (1) and Semmelweis University (1).

After performing factor analysis to the data to clear the structure of motivation dimensions, the indicators of motivation and success were correlated. Both Pearson's and Spearman's correlation coefficients were applied depending on the measurement level of the variables.

4. Results

In order to evaluate the relationship of entrepreneurial motivations and spin-off success, first motivations have to be identified and then the link between motivations and success has to be verified. The proposed model of motivations was assessed and adjusted by exploratory factor analysis. The results are as follows.

According to the measures of sampling adequacy the data were suitable for factor analysis, KMO =0.803, λ^2 (120, n=80)= 636.3, p= 0.000. In the final model, presented in Table 2, all factors with eigenvalues greater than 1.0 were retained, which solution was also supported by the scree test. Although the fourth factor (Necessity) contained only two items, it carried important information about respondents. On the basis of the subject to item ratio (5:1), the communalities (0.4-0.82) and the factor loadings (0.5-0.85) the results were accepted. The total variance explained by the four factors is 58%. The standardized alpha for the 16 item scale was 0.89, indicating a high degree of reliability regarding internal consistency. The Achievement subscale consisted of 6 items (α= 0.83), the Independence subscale consisted of 4 items (α= 0.84), the Research subscale included 4 items (α= 0.80), while the Necessity subscale included 2 items (α= 0.79).

Table 2: The Pattern Matrix of spin-off motivations (Principal Axis Factoring, Promax with Kaiser Normalization)

Factors	Items	Factor loadings	Item means
Achievement	to identify and exploit new market opportunities	0.795	4.06
	to exploit my knowledge for financial gain (Pull)	0.661	5.04
	to get rich (Pull)	0.616	2.54
	to have higher prestige and reputation	0.616	3.29
	to build my own business	0.574	3.76
	to have more challenge at work	0.498	3.90
Independence	I could best make use of my skills by working independently	0.821	4.19
	to work and make decisions on my own	0.757	4.51
	to be my own boss	0.628	4.13
	to solve scientific problems myself	0.623	3.94
Research	to further develop research results towards application	0.818	4.84
	to complement my research activities	0.709	5.09
	to put my ideas into practice	0.587	4.84
	to have more funds and better equipment for my research	0.549	3.60
Necessity	I needed extra income to provide for an acceptable quality of life (Push)	0.853	5.33
	I could not make ends meet from my university salary (Push)	0.760	5.44

The items related to the prospect of higher income were split up by the factor analysis. 'Push' items loaded on the fourth factor called Necessity, while 'pull' items loaded on

Achievement. Achievement thus has been complemented by the 'desire to get rich' and 'exploit knowledge for financial gain', which makes sense as high achievers are presumably pulled by the potential reward of getting rich (rather than being pushed into entrepreneurship).

The mean value of the factor variables shows that Necessity is the strongest motivation in starting a spin-off, followed by the research-related benefits, the desire for independence and the need for achievement. A paired samples t-test revealed that differences between the four motivation dimensions were significant (Table 3).

Table 3: Means of factor variables (based on a scale of 1-7).

Motivation	Mean
Necessity	5.38
Research	4.59
Independence	4.19
Achievement	3.77

Note: All differences are statistically significant at the 99% level of confidence, except for the difference between Research and Independence, which is significant at the 95% level of confidence.

After indentifying spin-off motivations the relationship between motivations and success was assessed. Correlation coefficients show that except for Necessity all studied motivations have a significant and positive relationship with subjective success (Table 4). In addition, research-related benefits have a relatively strong (but still moderate) connection to two of the objective success indicators as well: spin-off owners with stronger research and development motives have higher revenues and growth rates than those with weaker research-related motivation. Motivations on the other hand have not been found to be related with the number of employees and firm age.

Table 4: The relationship between entrepreneurial motivations and success

Motivation	*Spearman's rho*				*Pearson's r*	
	SUBJECTIVE SUCCESS		OBJECTIVE SUCCESS			
	Entrepreneurial success	**Technology transfer success**	**Revenue**	**Revenue change**	**Number of employees**	**Firm age**
Necessity	0.029	0.078	-0.093	-0.073	-0.050	0.183
Research	0.398**	0.421**	0.363**	0.312**	0.152	-0.030
Independence	0.422**	0.222*	0.249*	0.175	0.055	0.095
Achievement	0.462**	0.353**	0.222*	0.216	0.138	0.049

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

5. Conclusion

This paper studied the relationship between the motivations and success of 80 Hungarian academic entrepreneurs. The entrepreneurial motivations evaluated included the prospect of higher income, the need for achievement, the need for independence and research-related benefits. Success was measured by objective business performance indicators and also subjectively, spin-off owners were asked to evaluate themselves as academic entrepreneurs and also to rate the level to which their research results has been transferred to the market.

The results show that Necessity (dissatisfaction with university remuneration) is the strongest motivation in starting a firm, while the need for achievement is the weakest one of the four. Motivations, except for Necessity, are significantly associated with subjective success. Their relationship with objective success however is weaker or non significant. Research-related benefits are exceptions as they have a relatively strong positive relationship with the amount of spin-off revenue and also with revenue growth.
In sum, the prospects of higher income play an important role in spinning out a company, but it is not the possibility of getting rich (pull), but rather the necessity to complement university salary and to achieve and maintain an acceptable quality of life (push). The results also highlighted the importance of research-related motives, which have a relatively strong role in firm creation, and are also related to both objective and subjective success. The need for achievement and the desire for independence are not particularly important when starting a firm, their relationship with the subjective entrepreneurial success is stronger than that of other motives.

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