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The Role of Human Capital of Management Team on Performance in Iranian Academic Spin-Offs

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Abstract. Academic spin-offs are recognized as the main means of technology transfer, contribute to the commercialization of the results of academic research, leading to society wealth creation. Academic spin-offs start with some major disadvantages related to their liability of newness, smallness and their university origination. It is been argued that academic spin-off need to strengthen their team management human capital to reach to sustainable return.

This paper follows resource-based view and entrepreneurship literature to investigate the role of human capital of management team in terms of experience and in terms of as entrepreneurial behavior on the performance of Iranian academic spin-offs. The effect of human capital on the performance of academic spin-offs is studied using data derived from a survey of 79 firms operating in different sectors; agriculture, industry and services sectors. It is found that entrepreneurial experience leads to financial performance while entrepreneurial orientation leads to innovative

performance in Iranian academic spin-offs. The paper has some managerial implications and suggestions for future research.

Keywords: Human Capital, Academic Spin-Offs, Entrepreneurial Experience, Entrepreneurial Orientation, Resource-Based Theory.

1. Introduction

Academic spin-offs are important means of commercializing technologies and represent a mechanism of wealth creation (Roberts, 1991). These spin-offs are business ventures that transfer a core technology from the parent organization (Steffensen et al., 2000) or within a university (Pirnay et al., 2003). Academic spin-offs start with some major disadvantages related to their liability of newness, smallness and their university origination which provide problems for their later growth (Lockett et al., 2005). The success of such new ventures depend on their human capital (Vohora et al., 2004) which resides in the management team to learn new skills and develop new capabilities(Zahra et al., 2009).

Human capital theory, explains firm survival and performance in terms of the firm's human capital (Shrader and Siegel, 2007). It is specifically mentioned that a firm's human capital in terms of managerial team is an important component of the theory as it is considered to be a resource with the potential of generating competitive advantage through the identification and exploitation of an opportunity (Caldeira and Ward, 2003).This will particularly apply in the case of academic spin-offs since the management team play critical role the in bundling resources effectively in order to build capabilities (Wright et al., 2007, Sirmon et al., 2007).

In addition to management team's experience, the eagerness of management team members to start a spin off, that is entrepreneurial behavior, may be further separated into their entrepreneurial orientation (Walter et al., 2006).

However, despite its importance there are few recent studies that have looked at the entrepreneurial characteristics of Iranian entrepreneurs in relation to their management team to successfully run the academic spin-offs.

The present paper adopted the resource-based theory on the role of human resources with suggestions from the human capital theory (Colombo and Grilli, 2005), and entrepreneurship literature (Walter et al., 2006), using evidence derived from a sample of 79 academic spin-offs in Iran. The present study proposes that management team need to have different experience as research experience (Clarysse and Moray, 2004, Zahra and George, 2002) and entrepreneurial experience, (Shane and Venkataraman, 2000, Shane, 2000), and entrepreneurial behavior (entrepreneurial orientation) (Walter et al., 2006)in order to successfully run their academic spin-offs.

The paper is structured as follows: Section 2 presents the relative theory and summarizes the existing literature and highlights the main research hypotheses. Section 3 briefly describes the dataset and the variables used and the methodology adopted and Section 4 presents the results of the empirical analysis. Section 5 discusses the results and conclusions and section 6 examines the study's practical implications and finally section 7 discusses the study limitation and future study.

2. Background and Hypothesis

Resource-Based View of the firm, posits that firm can only achieve a sustainable competitive advantage if they possess valuable, rare, inimitable and non-substitutable resources (Barney, 2000). According to the resource-based theory, human capital resources are considered to be a source of competitive advantage as they are believed to be valuable, heterogeneous and immobile (Zhuang and Lederer, 2006).Usually, human resources are measured as: size of the founding team, background of the founders, professional management experience, and organizational size (Mustar et al., 2006).

Founders' human capital seems to have a considerable influence on academic spin-off development (Vohora et al., 2004).Academic spin-offs are better able, using human capital, to adapt continuously to changing circumstances in the external environment, to perceive new opportunities and threats, and to gain competitive advantages.

As academic spin-offs move from an academic into a business environment, they increasingly interact with different partners and sector which makes their area complex, particularly for the founders who are used to the academic environment. In such a complex area the human capital characteristics of the members of management team play a key role for the development and growth of the new start-up (Wright et al., 2007).

Many scholars have pointed to the importance of experience for the growth of new ventures. We propose that the management team needs to contain two kinds of experience, research experience and entrepreneurial experience. Research experience is related to a number of year members of the management team conducted research in a specific field. While entrepreneurial experience is the experience of management team in starting a new company.

Literature suggests that academic entrepreneurs are more productive researchers before they started a firm than their other peers(Lowe and Gonzalez-Brambila, 2007). The work of Shane (2000) illustrates how previous research experience of the entrepreneurs may influence selection which market opportunities to pursue on university invention(Shane, 2000). Also, Zucker et al., (1998) argue that early biotechnology start-ups are often collocated near ''star scientists'' to access the scientists' tacit knowledge. Therefore, it is assumed that the best scientists enjoy access to scientific knowledge, leading to a comparatively stronger capacity to identify high-value entrepreneurial opportunities that might effect on academic spin-off performance. Based on the discussion our first proposition is:

H1: *Research experience of members of the management team will be positively associated with academic spin-offs performance.*

It can be derived from entrepreneurship literature that entrepreneurial experience increases the probability of entrepreneurial opportunities since it helps to develop the mindset and skills necessary to use and exploit these opportunities (Shane and Venkataraman, 2000, Shane, 2000). Scholten et al, (2006) found that management team members with start-up experience benefited academic spin-offs growth.

Entrepreneurs with entrepreneurial experience evaluate more market opportunities (Gruber et al., 2008) and plan the growth of their start-up better if they had considerable start-up experience. Chandler (1996) found evidence that start-up pre-ownership was positively related to venture performance, if the new business was connected to the experiences gained from an entrepreneur's previous firm(Chandler, 1996).Based on the discussion the proposition is:

H2: *Entrepreneurial experience of members of the management team will be positively associated with academic spin-offs performance.*

A second stream of research has focused on entrepreneurial behavior as indicators of entrepreneurial success (Baum and Silverman, 2004). The main focus is on entrepreneurial behavior that captures" all actions taken by a firm's members that relate to the discovery, evaluation, and exploitation of entrepreneurial opportunities" (Kuratko, 2005, Shane and Venkataraman, 2000).Entrepreneurial behavior outlined by Schumpeter (1934) as creative destruction is believed to stimulate growth and economic performance.

Many firms attribute their success to entrepreneurial orientation (McGrath and MacMillan, 2000).

Firms with high entrepreneurial orientation are more likely to embrace the creation and pursuit of new entries (Miller, 2011). Regarding academic spin-offs, it has been proved that entrepreneurial orientation has a highly significant direct effect on their realization of competitive advantages in academic spin-offs (Walter et al., 2006). This leads to our first hypothesis:

H3: *Entrepreneurial orientation of members of the management team will be positively associated with academic spin-offs performance.*

3. Method

We tested our hypotheses on a sample of 79 academic spin-offs in Iran. We target all 85 companies and we arrived to 79 spin-offs with response rate of (%93). The academic spin-offs are selected based upon the

following criteria: (i) commercializing knowledge created at the university or academic institution; and (ii) the firms not older than 10 years. The average number of employees is9. The average age of the spin-offs was about 4 years. Interestingly, 64% of spin-offs had entrepreneurial experience. With regard to sectors and technology, the spin-offs were mainly involved in Industry (55%), Service (22%) and Agribusiness and food (23%). Data were collected using a semi-structured questionnaire addressed to the principal entrepreneur of the spin-off firm by conducting in depth face-to-face interviews. Although the data being collected are self-reported, previous studies show that founder-reported measures can be considered reliable (Brush and Vanderwerf, 1992) while asking information about the start-up team members since they work very close to each other. We measured the constructs of the present study using multi-item scales that we adapted from existing literature and the reliability and validity was assessed through various analyses. The present study collected both financial performance and innovative performance. To capture performance, we adapted a scale for perceptual performance developed by prior work (Jaworski and Kohli, 1993). The entrepreneurs were asked to indicate how profitable they are compared to their competitors in terms of "revenue" "sale" and "current profitability." This type of Likert scale has been used often (Powell, 1996) and has proved historically to be highly correlated to accounting measures of performance (Baker and Sinkula, 1999, Dess and Robinson, 1984). Factor analysis revealed that the construct exhibited a one-dimensional factor structure. The items were considered satisfactory because their loadings ranged from 0.93 to 0.87, with the values for alpha chronbach of 0.89.

For measuring innovation, we followed a scale used in many prior studies (Song et al., 2006). It comprises the following three items: "The overall performance of our new product development program has met our objectives," "From an overall profitability standpoint, our new product development program has been successful," and "Compared with our major competitors, our overall new product development program is far more successful." Factor analysis revealed that the construct exhibited a one-dimensional factor structure. The items were considered satisfactory because their loadings were 0.85, 0.88 and 0.89, with the values for alpha

chronbach of 0.88. We rely on the scale from previous study of Walter et al., (2006), five items belong to entrepreneurial orientation of academic spin-offs, which is a reflective measure. The scale contains items that refer to the key features of a firm's entrepreneurial orientation: proactiveness, innovation, risk taking, and assertiveness in business development (Miller et al., 1997). Items are," entrepreneurial behavior is a central principle", "we are very dynamic", "innovation is emphasized above all", "we are willing to take risks", " willingness to continuous progress is the joint foundation" and "we are eager at being always first to market". The mean score, calculated as the average of the five items, assesses a spin-off's intensity of entrepreneurial orientation. As with the other construct in the study, we tested the construct's dimensional structure using exploratory factor analysis. Factor analysis revealed that the construct exhibited a one-dimensional factor structure. The items were considered satisfactory because their loadings ranged from 0.68 to 0.87, with the values for alpha chronbach of 0.82. Research experience is measured as the average number of years of research experience among the team members at the time of start-up and entrepreneurial experience is measured as a dummy variable of having previously start-up experience (Shane, 2002, Scholten, 2006, Westhead et al., 2001, Florin et al., 2003).To obtain normally distributed variables, we used square root transformation form management team years of doing research.

Five sets of control variables were included; start-up team size, start-up team age, spin-off age, size and sectors. In line with previous studies (e.g.,Mihalache, 2012) we control for team size and age and spin-off size and age, since age and abilities might be correlated (Hambrick and Mason, 1984, Kor, 2003).To obtain normally distributed variables, we used log transformation for firm size and age and team size and age.We examined spin-offs from: industry, service and agriculture (used as the base group). For each sector, we included a dummy (1, "pertaining to this sector"; 0, "not pertaining to this sector").

Table 1.

	Mean	S.D	1	2	3	4	5	6	7	8	9	10	11	12
1. Financial performance	4.42	1.38	1.000											
2. Innovative performance	5.11	1.21	0.412**	1.000										
3. Entrepreneurial orientation	5.64	1.14	0.087	0.375**	1.000									
4. Research experience	0.65	0.48	-0.042	.201	0.214	1.000								
5. Entrepreneurial experience	2.74	4.02	0.232*	0.105	0.039	0.141	1.000							
6. Academic spin-off age	3.82	4.95	0.141	0.188	0.244*	0.265*	0.158	1.000						
7. Academic spin-off size	9.56	13.36	0.164	0.254*	0.126	0.277*	0.263*	0.581**	1.000					
8. Management team size	2.64	1.56	0.031	0.106	-0.155	0.378**	0.012	0.271*	0.353**	1.000				
9. Management team age	30.66	5.19	0.066	-0.085	-0.126	0.143	0.107	0.131	0.320**	0.458**	1.000			
10. Agriculture	0.22	0.41	-0.207	-0.065	-0.080	0.045	-0.138	-0.012	0.135	-0.064	-0.112	1.000		
11. Industry	0.55	0.50	0.003	0.012	0.108	-0.054	0.156	0.097	0.008	-0.132	-0.020	-0.599**	1.000	
12. Service	0.22	0.415	0.170	0.018	-0.091	0.001	-0.008	-0.133	-0.140	0.214	0.154	-0.283*	-0.585**	1.000

4. Findings

Table 1 provides descriptive statistics and zero order correlations among the variables used in the regression analyses. The type of analysis used, is multiple hierarchal regression with performance in terms of financial and innovativeness as the dependent variables and experience and entrepreneurial behavior as independent variables, and team size and age, spin-off size and age and sector and as control variables (See Table 2). To examine multicollinearity between the predictors, the VIF factors and tolerance statistics were calculated. All VIF values in models were below the value of 10 (Field, 2009). The tolerance statistics are all above 0.2, indicating no multicollinearity problems (Field, 2009). The results of the hierarchical multiple regression analyses are reported in Table 2. To distinguish between the relative effects of team experience and entrepreneurial orientation, we determined the relative importance of each set, performing F-tests involving both the full and restricted models (Kotha and Nair, 1995).In Model 1, we only include control variables in which service and spin-offs size were found to be positive and significant in a rather weak model (an adjusted R square of 0.03). In Model 2, experiences were added; this gave one more coefficient that was significant. In Model 3, entrepreneurial orientation were added causing a considerable improvement in model fitness. Hypothesis1 received no support, since research experience negatively affect performance (ß = -0.329, $p < 0.05$) in model 2 and (ß = -0.380, $p < 0.01$) in model 3. Entrepreneurial experience showed significant positive relationship with performance, therefore hypothesis 2 was significantly supported in model 2 (ß = 0.256, $p < 0.05$) and in model 3 (ß = 0.246, $p < 0.05$). In the full model, entrepreneurial orientation intend to effect on financial

performance, but not significantly. Regarding to innovative performance, only entrepreneurial orientation had a statistically significant, positive relationship with performance (ß = 0.362, $p < 0.001$), supporting hypothesis 3 (table 2). Regarding to the control variable, spin-off size affect both on financial and innovative performance and spin-offs operating in service sectors seems to have better performance.

Table 2. Results of Multiple Regression on academic spin-offs

	Financial performance			Innovative performance		
	Model**1**	Model**2**	Model**3**	Mode**1**	Model**2**	Model**3**
Constant						
Spin-off size (Ln)	0.322*	0.333*	0.306*	0.434*	0.415*	0.334*
Spin-off age (Ln)	-0.042	-0.068	-0.071	-0.082	-0.097	-0.090
The team size (Ln)	-0.158	0.008	0.070	-0.053	-0.039	0.123
The team age (Ln)	-0.006	-0.012	-0.003	-0.174	-0.177	-0.154
Service	0.316*	0.249*	0.224*	0.149	0.132	0.065
Industry	0.183	0.093	0.071	0.088	0.066	0.014
Team experience						
Entrepreneurial experience		0.256*	0.246*		0.091	0.070
Research experience(SQRT)		-0.329*	-0.380**		0.010	-0.130
Team entrepreneurial behavior						
Entrepreneurial orientation			0.139			0.362**
N	79	79	79	79	79	79
F	1.33	2.26*	2. 14*	1..50	1.15*	1.97*
R2	0.117	0.253	0.258	0.131	0.14	0.24
Adjusted R2	0.03	0.133	0.135	0.043	0.045	0.12

5. Conclusion

The present study shows that management team human capital has significantly effect on spin-offs performance. Our finding shows that performance has positively affected the entrepreneurial experience. This is in line with other researchers' findings (e.g. (Chandler, 1996, Scholten, 2006). Interestingly, the research experience had negative impact on performance, which is in line with the arguments that have emerged for a 'dark side' of human capital (Ucbasaran et al., 2008, Koellinger, 2008) which can be a 'double-edged' sword (Koellinger, 2008). Ucbasaran et al. (2008), for example, suggested that entrepreneurs with very high levels of general education and experience may not be able to turn their high levels of general human capital into superior performance. The next theoretical implication is that the manifestation of entrepreneurial orientation as an important means through which spin-offs can increase the innovative performance. This is in line with the notion of an entrepreneurial orientation is that firms are more likely to embrace the

creation and pursuit of new entries (Lumpkin and Dess, 1996, Miller, 2011). The present study offers several practical implications. Academic spin-off management team can enhance their financial performance by equipping their management team by members with number of start-up experience called serial entrepreneurs(Franklin et al., 2001). Besides, they can reach to new entries and innovative product by having team with high entrepreneurial orientation.

Although the study provides some interesting findings, several limitations should be noted. Our study used a single key informant approach, which is a common practice in entrepreneurial research in start-up teams. Kumar et al. (1993) have suggested that choosing the appropriate key informant could alleviate some of the potential problems(Kumar et al., 1993). We have chosen the academic founders of spin-offs as key informants, people we assume are well informed about their start-up team members. However, the debate on whether multiple responses from other members are necessary to ensure the validity of results continues.

Future research can strengthen the result by conducting the survey on all team members in management team of academic spin-offs.

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