6

Academic Entrepreneurship and Financial Problems: The Capital Structure of the University Spin-Offs

David Rodeiro, Sara Fernández,
Milagros Vivel and María Jesús Rodríguez
University of Santiago de Compostela, Santiago de Compostela
Spain

1. Introduction

The external environment in which universities carry out their activities has changed substantially in the last century. A historical milestone in this change was the publishing of Bush's report in 1945. The fundamental principle of Bush's report was simple: basic research discoveries will be converted via technology transfer to become powerful drivers of economic development and social welfare. Afterward, the mission of universities was no longer limited to teaching; in addition they must research (Valls and Condom, 2003).

More recently, as a consequence of a set of reforms targeted to improve the transfer of research results to industry, a reconceptualization of the universities' role started during the 1980s. In the U.S., Bayh-Dole Act allowed universities to own patents resulting from federal research money. Starting from early 1990s, structural changes in the external environment of European universities pushed them for a more proactive role in technology transfer, too (Baldini et al., 2006). As a result, universities currently have to meet the social and economic needs of society. Therefore, the mission of universities is no longer limited to research and training (Branscomb et al., 1999; Etzkowitz et al., 2000); in addition, they must also contribute to the economic growth of the regions where they are located (the "third" mission). This new phenomenon emerged from the "second revolution" has been labelled "The Entrepreneurial University" (Ertkowitz et al., 2000) or "Academic entrepreneurship".

What is an entrepreneurial University? The term was practically coined with the publication of Clark's work (1998), *Creating entrepreneurial universities organizational pathways of transformation*. In order to define an entrepreneurial university, the author analyse the experience of five European universities which have adopted organizational and functional criteria similar to private companies. Clark (1998) identifies a set of characteristics necessary for the success of the entrepreneurial activities: 1) managers with the authority to make decisions, 2) developed potential partners (industry and government), 3) a diversified financial base to guarantee independence, 4) motivated academics' groups, and 5) an

entrepreneurial culture that demands continual internal renewal in order to adapt to changes in external relations.

According to Etzkowitz (2004), the academic entrepreneurship can be expressed in a set of inter-related propositions: 1) the capitalization of knowledge becomes the basis for economic and social development and, thus, of an enhanced role for the university in society, 2) the interaction with the government and industry, what Etzkowitz et al. (2000) call the "triple helix" model, 3) the university independence, 4) the creation of hybrid organizational formats that incorporate business sector practices (managerialism) and those of "traditional" universities, and 5) the continuing renovation of the university's internal structure as its relationship to the industry and government changes.

On the other hand, several authors have outlined the perils of misunderstanding the university entrepreneurial activity. Industry may excessively intervene in the university activities, leading academics to "academic capitalism" (Slaughter and Leslie, 1997) and "McUniversities" (Hayes and Wynyard, 2002). Society and academics may confuse an entrepreneurial university with a "for-profit university". Zemsky et al. (2005) emphasize the importance of the university's teaching function, encouraging universities to "move learning to the center of the teaching enterprise" (Zemsky et al. 2005, p.9). The excessive industry's intervention may also generate interest conflicts among universities and their members. In addition, the university services created to improve the transfer of research results to industry come at a high cost and require much maintenance.

Despite these perils and the lack of a consensus definition, the academic entrepreneurship adds another mission to the university' traditional list (research and teaching); the economic and social development of the geographic area it is immersed in. There are a very wide range of university-industry interactions which may contribute to carry out this entrepreneurial activity (Agrawal and Henderson, 2002; Cosh et al., 2006; Hughes, 2007; Lester, 2005): informal contacts, recruitment of graduates, use of publications, collaborative research, faculty consulting, attending conferences, patenting and licensing, and new business formation around university science and technology (spin-offs).

Although founding a new company is only one of a number of mechanisms for the transfer of knowledge from universities to industry, this choice has been growing in importance because of its recognition as an instrument for fostering local economic growth. In fact, recent decades have seen an increasing number of companies stemming from university-developed technology. This phenomenon is more evident in the U.S. (Carayannis et al., 1998; Degroof and Roberts, 2004) and in some European countries like the U.K. (Shane, 2004; Locket et al., 2003) or Sweden (Stankiewicz, 1994).

However, several recent studies have suggested that spin-offs are not the most useful of the available pathways for the transfer of knowledge from universities to industry, even in the countries where this phenomenon is more extended. According to Lester (2005), spin-offs are a very small fraction (2-3%) of the total rate of new business starts in the U.S. Hughes (2007) also suggests that there is an overemphasis on spin offs, which may lead decision makers to misunderstand the nature of the technology transfer model.

In addition, a large number of the spin-offs do not succeed in the long term because of their low quality (see Lambert (2003) for the British case). The features which characterise USOs

(small size, recent creation and innovative character) could partially explain these failure rates as they difficult the access to financial resources. Like Di Gregorio and Shane (2003) and Montañez (2006), we consider that several reasons justify an in-depth analysis. Firstly, USOs are a source of technology transfer, demonstrating the important role that universities play in the knowledge economy. Secondly, spin-offs are set up near where the knowledge was developed, thereby, fostering local economic growth. Thirdly, they impel changes in university itself by improving attitudes towards applied research and contact with the business community. And finally, in this way, universities and researchers can obtain long term financial returns.

This paper analyzes the factors that determine the capital structure of the USOs created by the Spanish universities. This study contributes to the literature in several ways. Firstly, our work sheds light on a facet of USO decision-making that has received very little prior academic attention. Secondly, using information from the financial statements of the USOs, we have filled in one of the gaps in the empirical literature and initiated a line for future research. Finally, our results provide quantitative evidence of the importance of firm size, age and guarantees in obtaining long-term debt. With these findings in mind, the policy-makers will be able to design policies which will make it easier for spin-offs to obtain appropriate financing.

This paper is organized as follows. In Section 2 we outline the Spanish university environment. Section 3 describes the theoretical background of the models and outlines the hypotheses to be tested. In section 4, the methodology is explained. In section 5, the empirical results of the study are presented. Finally, we conclude by summarizing the most important findings, introducing the potential limitations of the research and discussing areas for further research and implications for policy-makers.

2. Entrepreneurship trends in Spanish universities

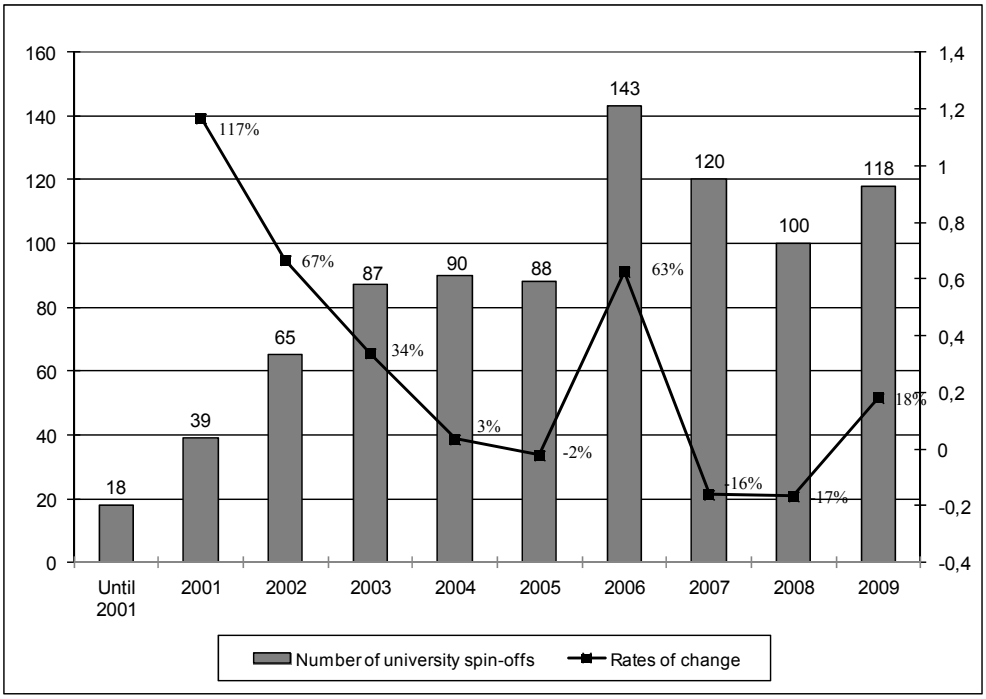
In Spain, the university system has traditionally been an example of a fully and highly centralized governance structure. After the restoration of democracy, the major change was introduced by the *University Reform Act* (1983). This increased the universities' administrative autonomy and transferred the responsibility for universities to the seventeen regional governments, which have had to take care of them in financial and organizational matters.

Despite these legal changes, Spanish universities have been characterized by a short tradition of ties with industry. In 1986, the *Law of Promotion & General Coordination of Scientific & Technical Research (Law of Science)* designed a new scientific and technological policy in order to face certain deficiencies of the national research system. Later, in 1988, the Government established the universities' Technology Transfer Offices (TTOs) to support and promote the dissemination of scientific knowledge and technology transfer activities.

Twenty years later, Spanish universities have substantially improved their contribution to the national research system by increasing the activities related to the commercial exploitation of knowledge. For instance, the research contracts have increased considerably in recent years, growing from 100 million Euros in 1996 to 428 million Euros in 2006. The

requests of patents made in the Spanish University System have growth from the 282 requests in 2000 to 572 in 2006. The TTOs have also played an important role in this process by managing about the 98% of the knowledge protection in the Spanish universities (Office of Technology Transfer, 2007).

Regards to the USOs, in the Spanish University System only 18 new companies had been created until December 2000. From that year, the number of companies created in the universities has increased significantly until 2003. As shown in Figure 1, from the 39 companies created in 2001 the number of spin-offs up to 118 in 2009 (TTOs, 2010). When we analyzed the rates of change in the number of spin-offs created, we found that there is a very significant increase in percentages above 100% at the beginning of the century. These rates decreased in the following years and stabilized in recent periods analyzed.



Graphic 1. Number of university spin-offs (2001 – 2009)

In fact, the creation of USOs increased its importance in the Spanish University System because the policies and activities to promote these companies also grew. However, this phenomenon is not as important as in other countries, eg, U.S.A., and its impact on the economy is relatively low (Callan, 2001). The Spanish case is consistent with the conclusions of the work *Fostering Entrepreneurship* (OECD, 1998). This work found that the number of these companies does not reach the hundreds in many OECD countries. Also it found that most of these companies are born in a little group of universities that have a high level of excellence in research. Usually, these universities match up with those that spend a great deal of financial resources to create structures to support these technology transfer activities.

3. Theoretical framework and hypotheses

Ever since Modigliani and Miller (1958) put forward their theory as to the irrelevance of financing decisions in the value of a company, numerous studies have attempted to demonstrate the existence of an optimum capital structure. Most of them focus on large and SMEs, however we have not found any work which analyses the factors which lie behind their capital structure of the USOs, although many empirical works highlight the funding difficulties they face.

Therefore, we have decided to review the empirical works which analyzes the capital structure determinants at enterprises of similar characteristics to USOs, in particular: those of a small scale (SMEs) and those belonging to high-technology industries (technology-based firms, or TBFs). In general, these works focus on three major lines of research: the trade-off theory, the agency theory and the pecking order theory. Drawing on these studies, our research presents a series of hypotheses connecting the aspects highlighted by the above theories with the capital structure of the Spanish USOs. Even though we contrast the applicability of the three research paradigms, the pecking order theory would seem to be the most appropriate for the case of small size and high-technology firms.

Table 1 summarizes the hypotheses regarding the expected relationship between the characteristics of USOs and their capital structure.

Theoretical rationales		Dependent variables	Pecking order theory	Agency theory	Trade-off theory
H1	Growth opportunities	Total debt/ Long-term debt	-	-	-
		Short-term debt	+	+	+
H2	Firm size	Total debt/ Long-term debt	+	+	+
		Short-term debt	-	-	-
H3	Profitability	Total debt/ Long-term debt	-	+	+
		Short-term debt	+	-	-
H4	Firm age	Total debt/ Long-term debt	+ / -	+	-
		Short-term debt	-	-	+
H5	Guarantees	Total debt/ Long-term debt	+	+	-
		Short-term debt	-	-	+
H6	Effective tax rate	Total debt/ Long-term debt			+
		Short-term debt			
H7	Non-debt tax shields	Total debt/ Long-term debt			-
		Short-term debt			

Notes: (+ / -) Positive / negative influence on the debt level or external finance

Table 1. Hypotheses: firm characteristics

Growth opportunities

Companies with greater growth opportunities generally have a higher level of uncertainty as to their ultimate development, and are subjected to a greater information asymmetry. From the perspective of the pecking order theory, this raises the cost of external funding, and impedes access to finance. Consequently, those enterprises with the greatest growth opportunities give priority to internally generated resources over debt (Diamond, 1991).

SMEs, and in particular USOs, are mainly subjected to conflicts of interest between shareholders and creditors, as the managers and owners are practically the same. According to Myers (1977), the under-investment problem increases at those companies with the greatest growth opportunities, meaning that creditors tend to reduce the funding made available. However, given that firms could recourse to short-term debt in order to mitigate the under-investment problem, some authors, such as Michaelas et al. (1999) and Sogorb-Mira (2002) suggest a positive relationship between levels of short-term debt and growth opportunities.

Those companies with the greatest growth opportunities generally have a high level of intangible assets, including in particular R&D expenditures and intellectual property. Since R&D expenditures are deductible, spin-offs with a major volume of R&D expenditures could be less interested in taking advantage of the tax benefits derived from the payment of interest on debts over the long term, and instead choose to take on a greater volume of short-term debt (Casasola, 2003). Similarly, a high level of intangible assets is generally associated with a greater probability of bankruptcy (Azofra and Fernández, 1999). For both reasons, from the perspective of the trade-off theory, an inverse relationship can be expected between growth opportunities and debt level.

Size

The pecking order theory states that external finance will be more expensive for smaller companies as they are subjected to greater information asymmetries, leading them to prefer internal finance and to reduce the repayment period of their debt in order to benefit from renegotiation. Meanwhile, larger companies present more detailed information to outsiders (Petit and Singer, 1985) and have credit ratings for bonds, reducing their information asymmetry and allowing them to increase their debt.

According to the agency theory, the larger the company, the greater the conflicts of interest between managers and shareholders because of the greater separation between ownership and control. An increase in the volume of debt could reduce the agency problems.

Meanwhile, larger companies are generally more diversified, and become bankrupt less often, meaning that size is generally seen as a proxy variable for bankruptcy probability (Warner, 1977; Smith and Warner, 1979; Ang et al., 1982). Moreover, the relative effect of the financial distress costs weighs more heavily on smaller companies. Then, from the perspective of the trade-off theory one would expect a positive relationship between size and debt level.

Profitability

According to the pecking order theory, the most profitable companies use internal finance to a greater extent, and reduce the role of external finance (Myers, 1984; Myers and Majluf, 1984).

At small firms, the managers are generally the owners and prefer to avoid any source of funding which involves the entry of new shareholders. Drawing on this agency argument, the most profitable spin-offs prefer to use internally generated resources and, if external finance is required, they will choose finance which does not limit their management capacity (generally short-term debt which comes with fewer covenants than long-term debt).

The trade-off theory considers the balance between the interest tax shield and the costs of possible financial distress that increasing debt would cause. It predicts that the most profitable spin-offs borrow less.

Age

The pecking order theory predicts that those firms which have been in business longer will have lower levels of information asymmetry, and will therefore draw on external financing to a greater extent (Petersen and Rajan, 1994). Some authors, such as Berger and Udell (1995) and Degryse and Van Cayseele (2000), hold that the age of the company reflects the reputation which it openly communicates to the market. Thus, the study by Hyytinen and Pajarinen (2005) focusing on small Finnish TBFs produced similar results to those predicted by the pecking order theory.

However, age may also have a negative impact on the debt level, as longer-established companies generally build up a greater volume of internal resources, thereby reducing their need to draw on outside sources of funding. Thus, Hogan and Hutson (2005) demonstrates that at TBFs which have been in existence for more than ten years, funding through the retention of profits takes on a greater role, replacing external finance.

More mature companies are more likely to have a greater separation between ownership and control, thereby increasing the conflict between shareholders and managers. Meanwhile, one would expect the conflicts between shareholders and creditors to be reduced as a result of the common interest in maintaining the company's prestige achieved in the previous years of operation. Taking into account these agency conflicts, one would expect that more mature companies would have a higher debt level, and that their repayment terms would be longer.

More mature companies have other tax deduction mechanisms apart from interest tax shields, meaning that according to the trade-off theory one would expect them to have less of an interest in increasing their debt for fiscal reasons, and that they would seek to shorten the repayment periods on their debt.

Guarantees

According to the pecking order theory, tangible assets reduce information asymmetries, as a clearer picture is available of the investments made by the company, meaning that their assets are not undervalued.

The conflicts of interest between shareholders and bondholders, such as the moral hazard problem, would decrease proportionately to the amount of committed investments already in place (De Miguel and Pindado, 2001). The tangible assets provide a greater guarantee for creditors, thereby giving easier access to external finance.

Tax Aspects

Finally, from a purely tax-based perspective, we have included two hypotheses in order to establish whether the tax system has any influence on the financing decisions made at spin-offs. Modigliani and Miller (1963) conclude that firms will prefer debt to other financing resources due to the tax deductibility of interest payments. Thus, one would expect a positive relationship between the effective rate at which USOs are taxed and their debt level.

According to De Angelo and Masulis (1980), if the firm has other alternative tax shields such as depreciation that could substitute the tax advantages of additional debt, they will be less inclined to use debt for such purposes. Consequently, an inverse relationship could be expected between the non-debt tax shields and the debt level.

4. Methodology

4.1 The sample and data

In our econometric analysis, we have used panel data from the Spanish USOs. The population of Spanish USOs was identified using the annual report of the University Network of Technology Transfer Offices (2005). At the end of 2005 there were 387 USOs in Spain. We first used a survey in order to compile qualitative data through direct contact with spin-offs. The survey was administered by mail and addressed to named CEOs or Managing Directors using a web-based questionnaire. Completed questionnaires were received during January and June 2006. The number of valid returns was 72, giving a response rate of just under 19% (Table 2).

Universe	Spanish university spin-offs *
Sphere	Spain
Sampling procedure	Computer assisted survey by means of web-based form
Rate of response	18.6%
Sample size	72 spin-offs
Sample error	±10.43%
Level of confidence	95%
Fieldwork	January 2005 - June 2006

Notes: * University Network of Technology Transfer Offices (2005).

Table 2. Technical research sheet

Secondly, we used SABI database taking into account the annual accounts deposited by companies in business registry offices throughout Spain. Therefore, we have constructed an unbalanced panel comprising 72 USOs for which the information is available between 1999 and 2005.

4.2. Definition of variables

As no market values are available for privately held USOs, all the variables are book values. Table 3 shows the variables employed in the analysis.

Our dependent variable is book leverage (*book_lev*). It is measured as the ratio of book value of total debt to the book value of the sum of total debt and equity. Total debt covers both

long-term debt and current liabilities, the latter including those which do not have an explicit cost, as the balance sheets of most spin-offs within the sample did not allow such data to be distinguished.

Nonetheless, an analysis of capital structure based only on total liabilities may screen the important differences between long – term and short – term debt (Barclay and Smith, 1999; Sogorb-Mira, 2002). In order to provide a more complete view of the capital structure of the Spanish USOs, we also consider as dependent variables the following measures of leverage: long-term debt ratio (*lt_lev*) and short-term debt ratio (*st_lev*).

GROUP	VARIABLE	DEFINITION
Dependent Variables	Book leverate (book_lev)	Total debt /Total debt and equity
	Long-term debt ratio(lt_lev)	Long-term debt / Total debt
	Short-term debt ratio (st_lev)	Short-term debt / Total debt
Independent variables	Growth opportunities (%int_assets)	Intangible assets / Total assets
	Firm size (l_totalassets)	Natural log of total assets
	Profitability (ROA)	Earnings before interest and taxes / Net total assets
	Firm age (more_2)	1 for spin-offs aged more than 2 years, and 0 otherwise
	Guarantees (%tang_assets)	Tangible assets / Total assets
	Effective tax rate (effec_tax)	Taxes / (Earnings after interest and before taxes + depreciation)
	Non-debt tax shields (ndebt_taxshields)	Depreciation / Total assets
Control Variables	Sector (booklev_cont, ltlev_cont, stlev_cont)	Deviation in terms of the debt (total/long-term/short-term) of each spin-off from the annual median for the sector

Table 3. Variables

The independent variables are the following:

In order to measure growth opportunities, the proportion of intangible assets was used (*%int_assets*).

The proxy variable employed for the size of the spin-off was the natural logarithm of its total assets (*l_totalassets*).

In order to evaluate the profitability, the ratio of EBIT to total assets was used (*ROA*).

The firm age was defined as a dummy variable, with a value of 1 for spin-offs aged more than 2 years, and 0 otherwise (*more_2*).

In order to measure guarantees, the proportion of fixed tangible assets was used *(%tang_assets)*.

Following Sogorb-Mira (2002), the effective tax rate was calculated as the ratio of tax to the total pre-tax profit plus depreciation (*effec_tax*).

The non-debt tax shields were calculated as the ratio of depreciation to the total assets (*ndebt_taxshields*).

Finally, the control variable was the deviation in terms of the debt (total/long-term/short-term) of each spin-off from the annual median for the sector. The aim of this approach is to control industry effects.

5. Empirical analysis

5.1 Univariate analysis

Table 4 provides summary statistics of the variables used in the estimation.

	Obs.	Min.	Max.	Mean	Median	S. D.
book_lev	206	0	0,9988	0,5961	0,6070	0,2724
st_lev	206	0	0,9794	0,4440	0,4171	0,2767
lt_lev	206	0	0,8583	0,1521	0,0061	0,2213
%int_assets	206	0	0,9306	0,1430	0,0512	0,2052
l_totalassets	206	7,79	16,05	11,63	11,61	1,65
ROA	206	-0,9720	0,7381	-0,0112	-0,0008	0,2509
%tang_assets	206	0	0,9477	0,2097	0,1518	0,2172
effec_tax	203	0	0,9821	0,0751	0	0,1339
ndebt_taxshields	204	0	0,3515	0,0536	0,0334	0,0640
stlev_cont	206	-0,3463	0,6387	0,0023	-0,0025	0,1552
ltlev_cont	206	-0,8453	7862000	201503	1306	733557
booklev_cont	206	-0,6588	0,2823	-0,0259	0,0048	0,1535

Table 4. Summary statistics

Total liabilities on average amount to about 59.6% of total assets value. If we split total liabilities into long-term debt and current liabilities, the figures 15.2% and 44.6% respectively, show that debt financing for USOs in our sample corresponds mainly to a short term nature, exactly 74%. We find that intangible and tangible assets represent over 14% and 20% of total assets value, respectively. The average ROA over the period of study of the USOs in the sample is negative (-1.1%). Finally, the variables which measure the effective tax rate and non-tax debt shields have mean values of 7.5% and 5.3% respectively.

Table 5 shows the correlation matrix. As could be expected, most of the variables that are theoretically related to leverage are correlated and present the predicted sign. To determine the extent to which multicollinearity was a problem, we calculate the variance inflation factor (VIFs) scores. It was found that the VIFs scores did not exceed 2 for all the variables, which is not close to the rule of thumb "threshold" value of 10 (Hair et al., 1998). Therefore, multicollinearity was not a major problem in the analysis.

	book_lev	st_lev	lt_lev	%int_assets	l_totalassets	ROA	%tang_assets	effec_tax	ndebt_taxshields	booklev_cont	ltlev_cont	stlev_cont	VIF
book_lev	1												
st_lev	0.675***	1											
lt_lev	0.386***	-0.419***	1										
%int_assets	-0.27***	-0.326***	0.075	1									1.36
l_totalassets	0.145**	-0.136*	0.349***	0.324***	1								1.29
ROA	0.063	0.142**	-0.099	-0.255***	-0.055	1							1.45
%tang_assets	0.399***	-0.041	0.543***	-0.235***	0.117*	-0.012	1						1.13
effec_tax	0.008	0.127*	-0.149**	-0.191***	-0.043	0.507***	-0.049	1					1.37
ndebt_taxshields	0.058	-0.061	0.150**	0.172**	0.141**	-0.149**	0.047	-0.134**	1				1.08
booklev_cont	0.476***	0.300***	0.209***	-0.002	0.221***	-0.137**	0.109	-0.104	0.141**	1			1.69
ltlev_cont	-0.095	-0.050	-0.054	-0.036	-0.184***	0.184***	-0.109	0.131*	0.038	-0.138**	1		1.10
stlev_cont	0.361***	0.398***	-0.053	0.051	0.234***	-0.074	0.071	-0.056	0.094	0.614***	-0.12*	1	1.64

Notes: ***,**,* denotes significance at the 1%, 5% and 10% levels, respectively.

Table 5. Correlation matrix

5.2 Multivariate analysis

As we explained in Section 2 and bearing in mind that the estimations were carried out with panel data, the basic regression that we run can be expressed as:

$$\left.\begin{array}{c} Book\_\,lev_{it} \\ Lt\_\,lev_{it} \\ St\_lev_{it} \end{array}\right\} = \mu + \%int\_assets_{it} + l\_totalassets_{it} + ROA_{it} + more\_2_{it} + \%tang\_assets_{it} + effec\_tax_{it} + ndebt\_taxshields_{it} + (booklev\_con_{it} / ltlev\_cont_{it} / stlev\_cont_{it}) + \alpha_i + \lambda_t + \varepsilon_{it} \quad (1)$$

where λ_t is a time-specific effect, α_i denotes the unobservable individual specific effect that is time – invariant, and ε_{it} is a white noise disturbance. According to Baltagi (2001), the panel data methodology presents clear advantages over cross-sectional or time series studies. For instance, it can control for firm heterogeneity, and reduce collinearity among the variables that are contemplated (Arellano and Bover, 1995).

A critical question in cross-section models is to identify whether the unobservable individual effects are correlated with the independent variable of the model (fixed effects) or not correlated (random effects). In order to contrast the correlation between the individual effects and the independent variables, both the Hausman test (Hausman, 1978) and the Breusch-Pagan test (Breusch and Pagan, 1980) can be used.

	Total debt			Long-term debt			Short-term debt		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	R.E.	F.E.	I.V.	R.E.	F.E.	I.V.	R.E.	F.E.	I.V.
%int_assets	-0.2457*** (-2.97)	-0.2082** (-2.07)	0.1499 (0.96)	0.0645 (0.9)	0.0368 (0.4)	0.5010*** (2.84)	-0.3434*** (-3.75)	-0.2884** (-2.48)	-0.2324 (-1.16)
l_totalassets	0.01736 (1.51)	0.0186 (1.29)	0.0261 (0.95)	0.0400*** (4.09)	0.0474*** (3.81)	0.0771** (2.26)	-0.0226* (-1.81)	-0.0134 (-0.85)	-0.0766** (-2.16)
ROA	0.0595 (1.01)	0.0347 (0.54)	-0.1933 (-0.8)	-0.0095 (-0.17)	0.0013 (0.02)	-0.5942** (-2.14)	0.0342 (0.52)	0.0306 (0.41)	0.0737 (0.22)
more_2	0.0462 (1.58)	0.0411 (1.29)		0.0159 (0.6)	0.0487* (1.67)		0.0648** (1.97)	0.0165 (0.45)	
%tang_assets	0.2322*** (3.12)	0.0771 (0.8)	0.1749 (0.78)	0.4731*** (7.39)	0.2536*** (2.93)	0.1692 (0.51)	-0.0974 (-1.19)	0.0631 (0.57)	-0.1397 (-0.47)
effec_tax	-0.0734 (-0.67)	-0.1167 (-0.99)	-0.3346 (-1.09)	-0.0616 (-0.61)	0.0454 (0.42)	0.7399** (2.26)	-0.0003 (0)	-0.1128 (-0.83)	-0.9839*** (-2.71)
ndebt_taxshi elds	-0.1476 (-0.69)	-0.2118 (-0.91)	0.1567 (0.58)	0.1441 (0.75)	0.0833 (0.39)	0.0313 (0.1)	-0.2652 (-1.1)	-0.2497 (-0.93)	-0.0384 (-0.11)
Booklev_cont /ltlev_cont/ stlev_cont	0.7087 (8.41)	0.7195*** (8)	0.1236 (0.79)	0.0000 (1.08)	0.0000 (0.55)	-0.0000* (-1.67)	0.8481*** (9.69)	0.8533*** (9.44)	0.4979*** (3.96)
constant	0.3941*** (3.13)	0.4072** (2.5)	-0.0136 (-0.61)	-0.4274*** (-4.06)	-0.4960 (-3.62)	-0.0003 (-0.01)	0.7570*** (5.63)	0.6393*** (3.67)	-0.0032 (-0.12)
Obs.	203	203	40	203	203	40	203	203	40
Breusch–Pagan T1	49.75 (0.000)			12.36 (0.000)			23.44 (0.000)		
Hausman T.2		15.86 (0.0445)			92.06 (0.000)			18.60 (0.0172)	
Hausman T.3			(0.99)			(0.99)			(0.99)
Regresión-based T4			2.25 (0.1378)			1 (0.3208)			0.05 (0.8273)

Notes: ***,**,* denotes significance at the 1%, 5% and 10% levels, respectively. t – statistics in parentheses. RE Random effects model, FE Fixed effects model, IV Instrumental variables (first differences)

1. The Breush-Pagan Lagrange multiplier test in the random effects model for the null hypothesis that there are no individual specific effects.
2. $\chi 2$ statistic and p-value for the Hausman test for the null hypothesis that explanatory variables and individual effects are uncorrelated.
3. P-value of the Hausman test comparing IV and OLS estimates. If we accept the null hypothesis, then there is no endogeneity.
4. F statistics and p-value of the regresión-based test proposed by Wooldridge (2002) If we accept the null hypothesis, then there is no endogeneity.

Table 6. Determinants of debt level

In addition, the profitability variable could lead to problems of endogeneity, which would invalidate the consistency of the estimator for fixed effects as a result of the repercussion which debt levels could have on this variable. In order to contrast this fact, we corrected the proposed models by using instrumental variables and by applying the first difference estimator. The most frequent means of instrumenting the variables where problems of

endogeneity exist involve replacing exogenous regressors with themselves, and the endogenous variable, in this case profitability, with its lags (Hsiao, 2003). We subsequently contrast the similarity of the coefficients of the models estimated by instrumental variables and by ordinary minimal squares, once again applying the test of Hausman (1978) in addition to the test proposed by Wooldridge (2002).

The results of fixed effects models, random effects models and instrumental variables estimators are reported in Table 6.

The Breusch-Pagan test rejects the null hypothesis that there are no individual specific effects, something which generally occurs in practice (Wooldridge, 2002; Verbeek, 2004). The outcome of the Hausman test also enables us to reject the hypothesis of no correlation between the individual unobserved characteristics and some explanatory variables and, thereby, the choice should be the fixed effects model.

However, as mentioned above, the profitability variable could present problems of endogeneity which would invalidate the consistency of the fixed effects estimator. Therefore, given the existence of correlation between the non-observable heterogeneity and the explanatory variables (first problem of endogeneity), we corrected the model using instrumental variables (IV). We took the second lag as the instrument for the profitability variable.

Then we contrasted the similarity between OLS and IV estimates by means of two tests. The regression-based test proposed by Wooldridge (2002) provides low F (1.77) statistics, allowing us to accept the null hypothesis that the coefficient of the residuals is equal to 0, and hence the exogeneity of the variables. These results are ratified by the Hausman test (1978). Since no evidence was found for the existence of problems of endogeneity, we concluded that the fixed effect estimation was consistent. The results of the empirical analysis ratify some of the outlined hypotheses (Table 7).

In the analysis of total debt, only the proxy variable for growth opportunities is statistically significant. The negative coefficient of the percentage of intangible assets *(%int_assets*) confirms the expected inverse relationship between total debt and growth opportunities. Companies with greater growth opportunities are subjected to a higher level of uncertainty (pecking order theory), greater under-investment problems (agency theory) and a greater probability of financial distress (trade-off theory). These circumstances would explain a limit on funding by external investors.

Although the remaining variables present the signs predicted by the pecking order theory, except for profitability and effective tax rate, we did not find a statistically significant relationship between these and the book leverage.

The proposed hypotheses present a closer fit in explaining the levels of long-term debt of the spin-offs. In addition, in this case all the significant factors present the expected sign according to the pecking order and agency theories.

We find a positive and statistically significant relationship between the size of the USOs and their level of long-term debt. This result supports the hypothesis of the pecking order theory, according to which larger companies are subjected to lower information asymmetries, giving them easier access to external finance. It also confirms the ideas based

on the trade-off theory, according to which the costs of bankruptcy have a relatively smaller impact on larger-sized companies, and they are therefore less concerned about taking on a greater level of debt. In addition, at larger-sized companies a high level of debt can help reduce conflicts between managers and shareholders.

	Pecking order theory	Agency theory	Trade-off theory	Results
book_lev				
Growth opportunities	-	-	-	-
Firm size	+	+	+	Ns
Profitability	-	+	+	Ns
Firm age	+	+	-	Ns
Guarantees	+	+	-	Ns
Effective tax rate			+	Ns
Non-debt tax shields			-	Ns
lt_lev				
Growth opportunities	-	-	-	Ns
Firm size	+	+	+	+
Profitability	-	+	+	Ns
Firm age	+	+	-	+
Guarantees	+	+	-	+
Effective tax rate			+	Ns
Non-debt tax shields			-	Ns
st_lev				
Growth opportunities	+	+	+	-
Firm size	-	-	-	Ns
Profitability	+	-	-	Ns
Firm age	-	-	+	Ns
Guarantees	-	-	+	Ns
Effective tax rate				Ns
Non-debt tax shields				Ns

Note: (+ / -) Positive / negative influence on the debt level. (Ns) No evidence of a relationship was found

Table 7. Hypotheses and results

There is also a statistically significant relationship between the firm age and the long-term debt ratio; spin-offs aged more than 2 years generally have a higher level of long-term debt. This result supports the hypothesis of the pecking order theory, according to which companies which have been in operation for a longer time are subjected to less information asymmetry. Our results partially coincide with those of Hogan and Hutson (2005), who indicate that TBFs aged less than two years generally use internal sources.

Finally, the positive coefficient of the percentage of tangible assets (*%tang_assets*) confirms the expected relationship between long-term debt ratio and guarantees. This result corroborates that the tangible assets can act as collateral, reducing agency conflicts between creditors and shareholders, and reduce information asymmetries regarding the value of the company's investments, as they are easier to value than intangible assets.

In the analysis of short-term debt, only the proxy variable for growth opportunities is statistically significant (*%int_assets*). However, the negative sign was contrary to the relationship predicted by the financial theories. Normally, the circumstances explaining lower debt levels lead SMEs to have recourse to short-term debt as a possible solution for funding limits, but the results do not support this hypothesis. In our opinion, the considerable weighting which short-term debt has at total debt (74%) lead short-term creditors to mistrustful of spin-offs with high proportion of intangible assets, and restrict the funding which they make available to them.

Finally, although the size and profitability variables present the signs predicted by the pecking order theory, we do not find a statistically significant relationship between both variables and the short-term debt ratio.

The above results lead us to conclude that both the pecking order theory and the agency theory are more appropriate than the trade-off theory in explaining the long-term debt ratio of the USOs. We cannot say the same either for book leverage or for short-term debt ratio. The fact that aforementioned theories refer to the debt with explicit cost, which was not possible to split up from the rest of debt, could explain the lack of significance in the estimated coefficients both for total debt and for short-term debt ratios.

The tax variables are not significant in any model. This result corroborates the opinion of some authors according to whom tax aspects do not help explain the capital structure of SMEs, and in our case of the spin-offs.

6. Conclusions

Society claims University must be a force for fostering regional economic and social development. The University's response has been an increase in the dissemination of scientific knowledge and technology transfer activities among other ways by creating academic spin-offs. But, recent studies have suggested that spin-offs are not the most useful of the available pathways for the transfer of knowledge from universities to industry due to slow growth of these firms in various countries. USOs tend to remain relatively small and fail to grow; this suggests that large numbers of companies remain struggling with different obstacles. These barriers could be related to the market, finance and management,

accommodation, regulatory issues, etc. But one of the most important obstacles is the access to financial resources, especially after a few years of existence of a spin- off when (small) series production facilities are needed or when additional R&D investment is necessary.

For these reasons, in this paper, we have analyzed the factors that determine the capital structure of the spin-offs created by Spanish universities. We have constructed an unbalanced panel comprising 72 USOs from 1999 to 2005. We have estimated a variety of models that included the main explanatory variables mentioned in theoretical framework and earlier empirical studies.

In our model, growth opportunities are negatively related to debt level. Due to the characteristics of the proxy constructed for these growth opportunities, the interpretation is that as investors perceive that there is a greater probability of bankruptcy and a greater information asymmetry, they demand a higher premium from the USO which discourages the use of debt.

The empirical evidence obtained from the estimation of the models shows that the critical factors in setting the long-term debt ratio of a USO are firm size, age and guarantees. The positive coefficients for these variables suggest that both the pecking order theory and the agency theory are more appropriate than the trade-off theory in explaining the long-term debt level of the USOs.

Finally, growth opportunities are also negatively related to short-term debt level. From our point of view, the high weighting which short-term debt has at total debt impedes USOs to have recourse to short-term debt as a possible solution for funding restrictions.

Our findings show a picture where spin-offs has a problematic situation in gaining resources. A way for obtaining finance resources, especially long-term debt, is increasing size, age and guarantees.

The results of this paper have implications for the design of public policies that aim at supporting USOs. First, our descriptive results of the financial situation of the USOs suggest the need to balance the short-term and long-term debt levels. The specific characteristics of USOs (technology-intensive small businesses) lead them to rely excessively on short-term resources. In this contest, when those companies with the greatest growth have to look for funds to finance investment projects, could find themselves strangled by an excess of unwanted short-term debt, and are "stifled by their own success".

Second, the USOs have a high proportion of intangible assets if compared with other SMEs, while tangible assets provide collateral for barely one fifth of their liabilities. As a result, USOs are often forced to provide additional guarantees due to the high perception of risk on the part of creditors. In this contest, public authorities, in partnership with universities, need to promote instruments to help USOs guarantee the repayment of the debt.

Finally, firm size and age have a positive relationship with the level of long-term debt. These results suggest the need to create instruments to help USOs not only at the point of foundation, but also during the early years of a business's life cycle. USOs very often do not have an ended product or technology which can directly be launched onto the market, or simply lack the necessary business skills and experience. In this regard, universities can play a major role, as they are familiar with the main weaknesses of spin-offs in the period

immediately after foundation, although there would be a need for the involvement of other types of outside agents with greater experience of the business world (innovation centres and technology parks).

Finally, this paper presents some limitations which could partly explain the lack of significance in some variables and open the way for further research. Firstly, the lack of significance in some variables may be associated to the sample size. In order to correct this problem, financial data could be collected from those USOs which did not respond to our survey by extending the sample. Secondly, although we placed the emphasis on the firm characteristics highlighted by financial theories, the social and human capital of the entrepreneur and the host university have also to be considered in order to explain the capital structure of the USOs. Thirdly, due to the size of the USOs in the sample, it was not possible to distinguish the debt with explicit cost. These aspects must therefore be taken into consideration when interpreting the results.

7. Acknowledgment

This research builds upon "Polos, subpolos y condicionantes del emprendimiento en la Euroregión Galicia-Norte de Portugal: potencialidades de la macroregión" project financed by the Galician Government (10SEC201032PR). We would like to thank this financial aid.

8. References

Agrawal, A.; Henderson, R. (2002): "Putting patents in context: exploring knowledge transfer from MIT", *Management Science,* 48 (1), pp. 44–60.

Ang, J. S., Chua, J. H., & Mcconnell, J. J. (1982). The administrative costs of corporate bankruptcy: A note. *Journal of Finance*, 37, 337-348.

Arellano, M., & Bover, O. (1995). Another look at the instrumental variable estimation of error-components models. *Journal of Econometrics*, 68, 29 -51.

Azofra, V., & Fernández A. I. (1999). Las finanzas empresariales 40 años después de las proposiciones de MM. Teorías y realidades. *Papeles de Economía Española*, 78-79, 122-144.

Baldini, N., Grimaldi, R., & Sobrero, M. (2006). Institutional changes and the commercialization of academic knowledge: A study of Italian universities' patenting activities between 1965 and 2002. *Research Policy,* 35, 518–532

Baltagi, B. H. (2001). *Econometric Analysis of Panel Data*. New York. John Wiley and Sons.

Barclay, M. J., & Smith, C. W. (1999). The capital structure puzzle: Another look at the evidence. *Journal of Applied Corporate Finance*, 12(1), 8-20.

Berger, A., & Udell, G. (1995). Relationship Lending and Lines of Credit in Small Firm Finance. *Journal of Business*, 68(3), 351-81.

Branscomb, L., Kodama, F., & Florida, R. (1999). Industrializing Knowledge. University-Industry Linkages in Japan and the United States. Cambridge: The MIT Press.

Breusch, T., & Pagan, A. (1980). Testing for autocorrelation in dynamic linear models. *Australian Economic Papers*, 17, 334-355.

Callan, B. (2001): "Generating spin-offs: evidence from the OECD", *Science Technology Industry Review. Special issue on fostering high tech spin-offs: a public strategy for innovation,* 26, pp. 13-56.

Carayannis, E.; Rogers, E.; Kurihara, K. y Allbritton, M.; (1998): "High Technology Spin-offs from Government R&D Laboratories and Research Universities", *Technovation* 18(1), 1–11.

Clark, B. R. (1998). *Creating entrepreneurial universities organizational pathways of transformation*. New York: IAU Press.

Cosh, A.; Hughes, A.; Lester, R. (2005): *UK PLC Just How Innovative Are We?*. Cambridge MIT Institute.

De Angelo, H., & Masulis, R. W. (1980). Optimal capital structure under corporate and personal taxation. *Journal of Financial Economics*, 8, 3-29.

Degroof, J.J.; Roberts, E.B. (2004): "Overcoming Weak Entrepreneurial Infrastructures for Academic Spin-Off Ventures", *Journal of Technology Transfer*, 29, pp. 327-352.

Degryse, H., & Van Cayseele, (2000). Relationship lending within a bank-based system: evidence from European small business data. *Journal of Financial Intermediation*, 9, 90-109.

Di Gregorio, D., & Shane, S. (2003). Why do some universities generate more start-ups than others?. *Research Policy*, 32, 209-227.

Etzkowitz, H. (2004). The evolution of the entrepreneurial university. *International Journal Technology and Globalisation*, 1(1), 64-77.

Etzkowitz, H., Andrew; W., Christiane, G. & Cantisano; B. (2000). The Future of the University and the University of the Future: Evolution of Ivory Tower to Entrepreneurial Paradigm. *Research Policy*, 29 (2), 313–330.

Hausman, J. (1978). Specification tests in econometrics. *Econometrica*, 46, 1251-1271.

Hayes, D., & Wynyard, R. (Eds.). (2002). *The McDonaldization of higher education*. Westport, CT: Bergin and Garvey.

Hogan, T., & Hutson, E. (2005). Information asymmetry and capital structure in SMEs: new technology-based firms in the Irish software sector. *Financial Management Association Annual Meeting,* Chicago, Illinois, 12-15.

Hsiao, C. (2003). *Analysis of Panel Data*. Cambridge: Cambridge University Press.

Hughes, A. (2007): University-Industry Linkages and UK Science and Innovation Policy. *ITEC Working Paper Series*, pp. 07-24.

Hyytinen, A., & Pajarinen, M. (2005). Financing of technology-intensive small businesses: some evidence on the uniqueness of the ICT sector. *Information Economics and Policy*, 17(1), 115-132.

Lambert, R. (2003): *Lambert Review of Business-University Collaboration (2003): Final Report*, HM Treasur.

Lester, R. (2005): Universities, Innovation, and the Competitiveness of Local Economies. *Summary report from the local innovation project - Phase I. Industrial Performance Center Working Paper Series. Cambridge*, MA, MIT. Industrial Performance Center.

Lockett, A.; Wright, M.; Franklin, S. (2003): "Technology transfer and universities, spin-out strategies", *Small Business Economics,* 20 (2), pp. 185-200.

Louis, K., Blumenthal, D., Gluck, M., & Stoto, M. (1989). Entrepreneurs in academe: an exploration of behaviors among life scientists. *Administrative Science Quaterly*, 34, 110-131.

Michaelas, N., Chittenden, F., & Poutziouris, P. (1999). Financial policy and capital structure choice in UK SMEs: empirical evidence from company panel data. *Small Business Economics*, 12, 113-130.

Modigliani, F., & Miller, M. H. (1963). Taxes and the cost of capital: A correction. *American Economic Review*, 53, 433-443.

Montañez, B. Y. (2006). Factores condicionantes de la creación de spin-off universitarias: un estudio exploratorio. *III Jornada de Pre-comunicaciones a Congresos de Economía y Administración de Empresas*, Barcelona.

Myers, S. (1977). Determinants of corporate borrowing. *Journal of Financial Economics*, 5, 147-175.

Myers, S. (1984). The capital structure puzzle. *Journal of Finance*, 34, 575-592.

Myers, S. C., & Majluf, N. (1984). Corporate Finance and Investment Decisions When Firms Haves Information that investors don´t have. *Journal of Financial Economics*, 13, 187-221.

OECD (1998). *Fostering Entrepreneurship*, Paris: OECD.

Petersen, M., & R. Rajan (1994). The Benefits of Lending Relationships: Evidence from Small Business Data, *Journal of Finance*, 49 (1), 3-37.

RED OTRI DE UNIVERSIDADES, (2010); "Informe Red OTRI de Universidades, 2010", *Conferencia de Rectores de las Universidades Españolas, CRUE, Madrid.*

Shane, S. (2004): *Academic Entrepreneurship: University Spinoffs and Wealth Creation*, Edward Elgar.

Slaughter, S., & Leslie, L. (1997). *Academic capitalism: Politics, policies, and the entrepreneurial university*. Baltimore: Johns Hopkins University Press.

Smith, C., & Warner, J. (1979). On financial contracting: an analysis of bond covenants. *Journal of Financial Economics*, 7(2), 117-161.

Sogorb-Mira, F. (2002). *On capital structure in the small and medium enterprises: the Spanish case*. Instituto de Estudios Europeos, 2.

Stankiewicz, R.; (1994); 'Spin-off Companies from Universities', *Science and Public Policy* 21(2), 99–107.

Valls, J., & Condom, P. (2003). La nueva universidad: la universidad emprendedora, *Iniciativa emprendedora*, 41: 5-11.

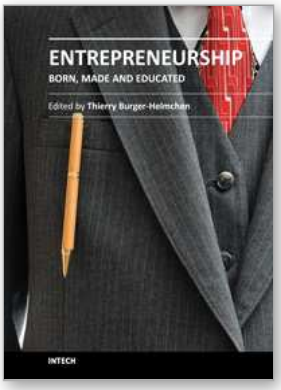
Vannevar Bush (1945): *Science The Endless Frontier, A Report to the President by Vannevar Bush*, Director of the Office of Scientific Research and Development, United States Government Printing Office, Washington: July 1945.

Verbeek, M. (2004). *A Guide to Modern Econometrics*. John Wiley & Sons, Ltd.

Warner, J. B. (1977). Bankruptcy costs: some evidence, *The Journal of Finance*, 32(2), 337-347.

Wooldridge, J. (2002). *Econometric Analysis of Cross Section and Panel Data*. Cambridge: The MIT Press.

Zemsky, R., Wegner, G. R., & Massy, W. F. (2005). *Remaking the American University: Market-Smart and Mission Centered*. New Brunswick, NJ & London: Rutgers University Press.



Entrepreneurship - Born, Made and Educated
Edited by Prof. Thierry Burger-Helmchen

ISBN 978-953-51-0210-6
Hard cover, 336 pages
Publisher InTech
Published online 14, March, 2012
Published in print edition March, 2012

Entrepreneurship has a tremendous impact on the economic development of a country. As can be expected, many public policies foster the development of self- entrepreneurship in times of unemployment, praise the creation of firms and con- sider the willingness to start new ventures as a sign of good fortune. Are those behaviours inherent to a human being, to his genetic code, his psychology or can students, younger children or even adults be taught to become entrepreneurs? What should be the position of universities, of policy makers and how much does it matter for a country? This book presents several articles, following different research approaches to answer those difficult questions. The researchers explore in particular the psychology of entrepreneurship, the role of academia and the macroeconomic impact of entrepreneurship.

INTECH
open science | open minds

InTech Europe
University Campus STeP Ri
Slavka Krautzeka 83/A
51000 Rijeka, Croatia
Phone: +385 (51) 770 447
Fax: +385 (51) 686 166
www.intechopen.com

InTech China
Unit 405, Office Block, Hotel Equatorial Shanghai
No.65, Yan An Road (West), Shanghai, 200040, China
中国上海市延安西路65号上海国际贵都大饭店办公楼405单元
Phone: +86-21-62489820
Fax: +86-21-62489821