

# Academic spinoffs as a value driver for intellectual capital: the case of the University of Pisa

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## Abstract

**Purpose** – The purpose of this paper is to discuss academic spinoffs (ASO) as an expression of the value creation of university technology transfer (TT) investments. More recently, scholars have emphasised intellectual capital's (IC) importance, also for universities in obtaining competitive advantages and by creating value. Such spinoffs are key to regional development, as a primary aspect of universities' IC.

**Design/methodology/approach** – The authors tested the aim through a sample of the University of Pisa's spinoffs. The authors measured the value the university's third mission investment generates on the area by means of entrepreneurship through two different approaches. First, the authors defined a multiplier of the TT investment (university TT multiplier) and then explored the IC components' contributions to the ASOs' enterprise value (EV).

**Findings** – The results show that the University of Pisa's TT investments positively impact the local community through the spinoff system, both in economic terms and in IC. In the long term, these investments can enrich scientific humus and entrepreneurial mindsets.

**Research limitations/implications** – This is an exploratory study of the University of Pisa's impacts on the local economy. The results are limited to the context of Pisa and to the TT policy. Another limitation is the subjectivity of the EV estimation.

**Practical implications** – The results can have some practical implications. The large portfolio of university stakeholders (policymakers, families, students, companies, financiers, etc.) ask for information, especially on long-term results: in a simple way, the multiplier is able to communicate important feedbacks to support their decision-making process.

**Social implications** – With the multiplier, the authors give a tool to measure the social enrichment.

**Originality/value** – In the study, the authors propose a new tool to measure the impact of the investment in TT on the local community.

**Keywords** Universities, Academic entrepreneurship, Intellectual capital, Value creation, University third mission, Spinoffs

**Paper type** Research paper

## 1. Introduction

According to scholars and policymakers, the university has a key role in the local economy and in society. Policymakers are increasingly looking to both innovation and technology transfer (TT) to fuel economic growth. Although they note that universities have two traditional functions, teaching and research, policymakers assert that these institutions have also assumed a third mission, steering towards entrepreneurship, by favouring the commercialisation of science (Slaughter and Leslie, 1997; Nowotny *et al.*, 2003). Via knowledge development and transfer, universities are promoting an entrepreneurial mindset, stimulating new businesses, and creating new jobs. With these strategic aims, since the early 1980s, US universities have increased their entrepreneurial activities along many dimensions, such as patenting and licensing, building science parks, promoting academic spinoffs (ASOs), and by investing equity in startups (Mowery *et al.*, 2004; Siegel, 2006). Over the past 30 years, even European academics that support the third mission and, particularly, TT activities and social engagement, as well as the creation of enterprise value (EV), are developing. In some early studies, some scholars have discussed the factors that could influence TT and its success (Cummings and Teng, 2003; Siegel *et al.*, 2003). After a few years, the focus shifted to TT activities, which planted the



seeds of an entrepreneurial mindset among university researchers (O'Shea *et al.*, 2005; Wright, 2007) that began by promoting ASOs for economic and social enrichment (Chiesa and Piccaluga, 2000; Fontes, 2005; O'Shea *et al.*, 2005). A real impetus to the lively debate in the literature on the third mission of the university was the EU green paper "European indicators and ranking methodology for university third mission" (2012), which defines universities' third mission and emphasises the importance of measuring and monitoring performance (Thursby and Kemp, 2002; Siegel *et al.*, 2003; Chapple *et al.*, 2005; Secundo *et al.*, 2017).

Although there is no general definition of the third mission, its elements are continuing education, innovation promotion, TT, academic entrepreneurship, and social engagement towards local communities. ASOs are a key driver of TT activities. Despite the thriving body of literature on academic entrepreneurship, few studies have investigated the performance of ASOs via fine-grained longitudinal panel data (Rothaermel *et al.*, 2007).

The university must lose its research ivory tower by developing an entrepreneurial university model (Etzkowitz *et al.*, 2000, 2003) with a socio-economic development function.

Thus, when we talk about TT from the university, the two research areas of entrepreneurship and intellectual capital (IC) are strongly interconnected; this goes beyond the university's traditional role as a knowledge factory (Youtie and Shapira, 2008; Aronowitz, 2000).

However, scholars are debating the university's roles in local communities by measuring both their innovation promotion (Etzkowitz, 2003; Shane, 2004; Huggins and Johnston, 2009; Trequattrini *et al.*, 2015) and their wealth creation (Trune and Goslin, 1998; Siegfried *et al.*, 2007; Guerrero *et al.*, 2015; Carlesi *et al.*, 2017). There has only recently been a tendency to assess a university's performance in pursuing its third mission in terms of the creation of IC (Secundo *et al.*, 2017; Mariani, 2017).

As noted by Dumay and Guthrie, in the public sector, IC is an intangible asset that is able to create value and wealth, such as social welfare, progress, and other intangibles. While IC has been explored mainly in the private sector, there is a gap in studies of IC creation in universities (Kong and Prior, 2008). Some early studies dealt with IC in universities in terms of management practices (Hellström and Husted, 2004; Ramirez, 2010; Secundo *et al.*, 2016), measurement, and reporting (Fazlagic, 2005; Leitner, 2004). Nonetheless, IC's contributions to the value creation process in universities have remained widely unaddressed (Guthrie and Dumay, 2015; Secundo *et al.*, 2017).

This debate is so centred on the importance of university entrepreneurship to IC development, and the effects of both entrepreneurship and IC on local development. However, according to Borin and Donato (2015), IC research is now in its fourth stage – the analysis has widened to the extra-organisational level.

This exploratory study aims to highlight ASOs' main contributions to the surrounding area as a value driver of the third stream. We pursued this purpose through a case study at the University of Pisa; our analysis considers the university's value creation process and shows how it can be assessed via IC underpinned by TT activities. To assess university spinoffs' impacts on local economies, after a literature framework, we analysed two elements.

First, we considered ASOs' contributions to the local economy in terms of traditional economic parameters (sales, job creation, and new R&D investments), from 2010, the year the University of Pisa set up its TTO, which marked the beginning of its development programme, to 2014, the latest year for which the relevant data are available. Following, we have defined the university technology transfer multiplier (UTTM) to synthesise the total effects on the local economy with only a number. Thus, we captured therefore the university's innovation investment's overall effects in terms of value creation of ASOs as an expression of IC. Through a statistical analysis, we then explored IC components and their contributions to the spinoffs' EV. The purpose of this last analysis is to show how much of the IC is recognised in ASOs EV and so, on the multiplier. We close with the conclusions, in which we also discuss implications and avenues for future research.

## 2. Background and research questions

### 2.1 *The university's third mission and value creation*

In some reports of 1997, the European Commission already highlighted the importance of fruitful cooperation between universities and industries for Europe's economic growth and job creation. This first document acknowledges the importance of the university in economic development and the need to restructure and reorganise the existing university system by designing a new entrepreneurial university.

Thus, some academics drew attention to the emergence of the "third mission" in an entrepreneurial university (Etzkowitz, 1983). Later and Etzkowitz explored the entrepreneurial models of Stanford University and the Massachusetts Institute of Technology, focussing on the identification, creation, and commercialisation of intellectual property as concrete examples of the third mission. In universities, teaching and research were re-interpreted. While traditional teaching is designed to support companies' modernisation, research began to investigate economic development via various TT activity types. In a knowledge-based system, the university – as a knowledge factory and disseminating organisation – plays a strategic role in industrial innovation.

Now, the university has become implicitly charged with the key task of fostering innovation and technological transformation – with all of the many social implications that technology had led to over the years. European universities are developing a radical shift in governance, exposing the competitive dynamics, and decision logic typical of private companies. This process is the development of the third mission in the principles of accountability and the unifying elements that characterise the modern configuration of the university. It discovers and enhances its relationship with social partners, primarily companies, facing challenging business objectives that for centuries had been considered incompatible with the public nature of produced knowledge.

Universities' third mission covers all the activities through which they contribute to innovation and social change. Several contributions in the literature have identified the third mission activities (Geiger, 2006; Rothaermel *et al.*, 2007; Geiger and Sa, 2009; Laredo, 2007; Hsu *et al.*, 2015). The green paper "Fostering and measuring third mission in higher educational institution" (2012) identifies a third mission for universities as activities relating to research (TT and innovation, etc.), to education (lifelong learning/continuing education, training, etc.), and to social engagement – a variety of activities that involve many constituent parts of universities. The third mission is designed to encourage the direct application and use of knowledge to contribute to the social, cultural, and economic development of the society.

In this direction, the university has four activities to realise TT and innovation:

- (1) formation of an entrepreneurial culture for students and researchers;
- (2) the protection of intellectual property and the commercial exploitation of patents;
- (3) support for ASOs; and
- (4) collaborations with companies via agreements and projects.

In pointing to this new mission, scholars and policymakers began to refer to an entrepreneurial university model (Etzkowitz, 2003). One key effect is the ability to convert knowledge that has been created via research into business ideas by creating industry-university collaborations or spinoffs (Etzkowitz and Klofsten, 2005). Universities are becoming charged with socio-economic development, with benefits for the local area (Huggins and Johnston, 2009; Trequattrini *et al.*, 2015).

Numerous studies have investigated the external factors that influence the success of university entrepreneurship, such as the social context, laws and policies, and local determinants (Mowery *et al.*, 2001; Henrekson and Rosenberg, 2001; Etzkowitz, 2003;

Friedman and Silberman, 2003; Jacob *et al.*, 2003; Gulbrandsen and Smeby, 2005). Other scholars have studied the factors that affect TT activities' efficiency (Bercovitz *et al.*, 2001; Feldman *et al.*, 2002; Markman *et al.*, 2005).

Of more interest are the university's impacts on local innovation (Gibb and Hammon, 2006; Wright, 2007) and how TT contributes to socio-economic development, especially via startups or spinoffs (Mowery *et al.*, 2001). In the UK, as elsewhere in Europe, the growth of ASOs has steadily increased in response to pressure in the commercialisation of the science base or develops knowledge-based services for larger firms that subcontract R&D activities such as experimental testing.

Most studies of the third mission have explored the performance measures of university entrepreneurship, such as the new company creation rate and their economic results (Chiesa and Piccaluga, 2000; Di Gregorio and Shane, 2003; Clarysse *et al.*, 2005; Leitch and Harrison, 2005; Link and Scott, 2005; O'Shea *et al.*, 2005). Other research has progressively made clearer other aspects relating to the creation, growth, and weaknesses of spinoffs, such as financial literacy gaps, and the lack of skills on the part of the founders and team members (Clarysse *et al.*, 2005; Carlesi *et al.*, 2017), scarcity of resources, and managerial cultural problems (Rappert *et al.*, 1999).

As for private companies value creation is a business' foundation, for public investment, the need to estimate the impacts a public investment could produce is now well-established. Contributions in the value creation a public project or activity produces on regional development have its early roots in studies by Kahn and Keynes.

Since the 1980s, the constant reduction of public funding has made it necessary to verify the achievement of social and economic policies and greater transparency and accountability, also in the public sector. Universities' contributions to economic development and their social engagement, referred to as third mission activities, have become politically relevant (Rasmussen and Borch, 2010). Specifically, the attention is on evaluating universities' contributions to the economic development and social engagement, referred to as TT activities (Siegfried *et al.*, 2007; Rasmussen and Borch, 2010). Given this lively debate, our first research question is:

*RQ1.* How do we measure the UTTM's impacts on a local community?

## 2.2 IC in universities' third mission

It has become common knowledge that IC represents a key source for competitive advantage for any enterprises (Quinn *et al.*, 1996; Bartlett and Ghoshal, 2002; Jardon and Susana Martos, 2012).

Several studies have pointed out IC's impacts concerning EV, and not only on profitability. Other scholars have empirically assessed these impacts, along the MERITUM (measuring intangibles to understand and improve management) guidelines (2001) for managing and reporting on intangibles (Lengnick-Hall *et al.*, 2004; Pulic, 2004; Marr *et al.*, 2004; Chen *et al.*, 2005; Tseng and James Goo, 2005; Chen, 2008; and Kong and Prior, 2008, for not-for-profit ventures). While IC in the private sector has been widely explored, it was only in the last decade that scholars begin to study IC in public and non-profit organisations, with a special focus on higher education and research institutes (Mouritsen *et al.*, 2004; Kong, 2007; Kong and Prior, 2008; Secundo *et al.*, 2017). In recent years in particular, some scholars have discussed IC's importance as the value driver of universities' third mission (Secundo *et al.*, 2017). However, IC's studies on the value creation process in the public sector have remained widely under-researched (Guthrie and Dumay, 2015; Secundo *et al.*, 2017).

While Stewart defines IC as "the intellectual material – knowledge, information, intellectual property, experience – that can be put to use to create wealth" (Stewart and Capital, 1997),

for Dumay and Guthrie as well as Secundo *et al.* (2017), in the public sector, IC is an asset for value creation and wealth, such as social welfare, progress, and other intangibles. Other studies have defined IC components also in terms of social contributions (Petty and Guthrie, 2000; Boedker *et al.*, 2008; Ricceri, 2008; Dumay, 2014; Ferenhof *et al.*, 2015).

The most common breakdown of IC identifies three components: human capital, structural (organisational) capital, and relational (or social) capital (Nahapiet and Ghoshal, 1998; Guthrie *et al.*, 2006; Boedker *et al.*, 2008). Concerning IC in universities, human capital refers to the people (e.g. researchers, professors, technical staff, administrative staff, and students) and their skills (e.g. expertise, knowledge, and experience). Structural or organisational capital comprises databases, intellectual property, research projects, routines, and all the intangible resources that exist in an organisation. Relational or social capital refers to the system of relationships between public and private partners that enable them to create value (Secundo *et al.*, 2017).

IC studies have defined four stages of evolution (Petty and Guthrie, 2000; Guthrie *et al.*, 2012). Stage 1 focusses on the increasing awareness and understanding of IC and how it contributes to the creation of sustainable competitive advantages in private organisations (Petty and Guthrie, 2000). Stage 2 focusses on the strategic management of IC, and on the methods used to measure its contribution to value creation (Sveiby, 2010). Guthrie *et al.* (2012) introduced a third stage, in which the focus is on studying how organisations understand and apply IC as a management technology. More recent studies have focused on bridging the knowledge created inside and outside an organisation (Borin and Donato, 2015). In this last stage, the analysis of IC has extended outside the organisation to the local, regional, or national level. In this direction, universities interpret their third mission as promoting types of social innovation and entrepreneurship that contribute to the local economy.

In line with Stage 4 of research on IC, we analyse the link between the knowledge produced inside the organisation (university) and the knowledge it transmits outside via ASOs. Especially, we explore whether, among human capital, structural capital, and relational capital, it is possible to locate connectivity (Vagnoni and Oppi, 2015) as a fourth dimension (Secundo *et al.*, 2017), or if the components play different musical scores in the value creation process. Given this discussion, our second research question is:

*RQ2.* How do the components of IC contribute to the EV of universities' spinoffs?

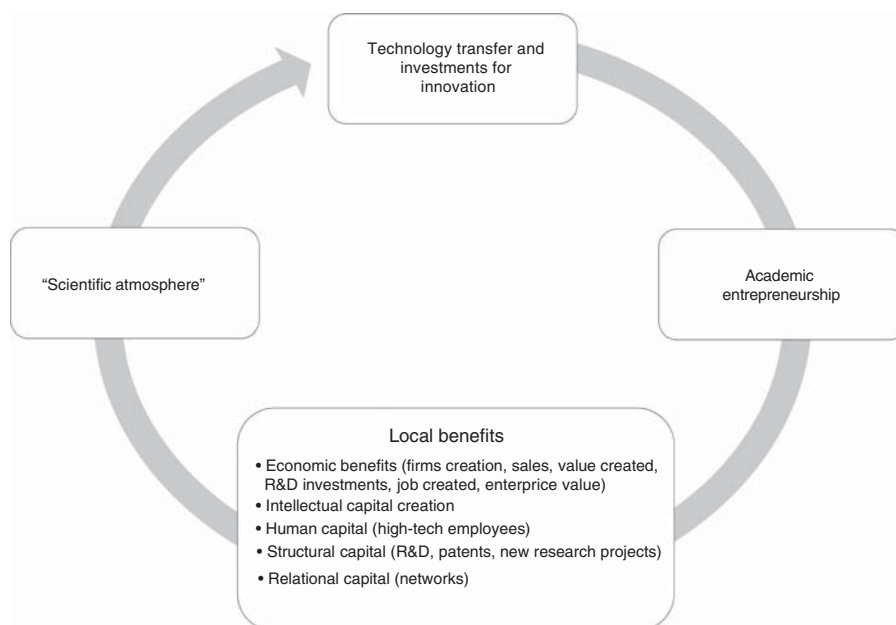
### 3. Methodology and data

According to Goldstein and Drucker (2006), the university may be the biggest driver of economic progress, especially in small regions far from large metropolitan areas. Thus, there is an interest in measuring the amount of wealth a university can produce on an area by calculating the socio-economic impacts "that especially the activities of the third mission can produce" (Broad *et al.*, 2007; Gunasekara, 2004).

As depicted in Figure 1, the main assumption is that, through TT and innovation investments, (in terms of the establishment of an entrepreneurial culture for students and researchers and by supporting spinoffs), universities start new academic businesses. Thus, ASOs become a university's operating arm in the local economy by realising economic benefits and creating IC. In turn, these benefits stimulate a scientific atmosphere that feeds this loop and leads to new innovative ideas, research, and businesses.

To answer *RQ1*, we first studied the University of Pisa system, so the ASOs on which our study revolves around.

In addition to companies' financial statements and business plans, we gathered the data for this study also through a questionnaire (Appendix 1) that was structured to gain quantitative and qualitative information to measure ASOs' EV, especially because these



**Figure 1.** Value creation of technology transfer investments

kinds of companies usually present their balances sheet in summary form. The interviews were essential to also the IC components, for *RQ2*.

We organised our methodology in three steps. First, to obtain the information needed for our analysis, we submitted a semi-structured questionnaire to the CEOs of the University of Pisa's spinoffs. Then we collected ASOs' financial statements and calculated EV for each ASOs of the sample. Finally, we introduced a multiplier (UTTM) to measure the impact of the university's TT investments and ASOs' R&D expenditure on ASO EVs, which we used as a proxy for the value created by the university for its local economy. To find the relationships between IC elements and EV, we performed a non-parametric statistical test.

Regarding Step 1, we tested a preliminary draft of the questionnaire with two entrepreneurs, to realise the final version (Appendix 1). The questionnaire had two sections. In Section 1, we asked for general information about the company in order to get a general profile (e.g. age, number of employees, industry, number of shareholders, and R&D expenses). In Section 2, we sought to map ASOs' IC components. The main information obtained on these firms' IC shows the number of patents and awards, the number of research projects, the place in which they made physical investments, the number of partnerships and/or the participation in associations, the presence of managerially skilled staff in the firms, etc. We completed the questionnaires in face-to-face meetings with entrepreneurs (average duration: 45 minutes). This step occurred during the first three months of the study.

The University of Pisa's spinoff population was 30 units in 2014. To assess EV, we selected only those that presented at least one balance sheet and a three-year business plan. Thus, we had to exclude nine ASOs; the final sample consisted of 21 companies whose characteristics are representative of the population, although they differed regarding age, industry, and activity types (Table I). To preserve anonymity, we omitted the spinoffs' names.

Also, as Table II underlines, the sample is fully representative of the University of Pisa's ASO system.

ID	Year of birth	Industry	No. of owners	Sales	No. of employees
A	2007	Engineering	6	392,446	5
B	2008	Engineering	2	476,459	10
C	2013	Life	7	28,150	0
D	2010	Life	7	36,365	0
E	2012	Life	6	27,930	1
F	2014	ICT	7	37,750	1
G	2014	Life	2	7,867	0
H	2013	ICT	2	0	0
I	2011	ICT	21	400,171	3
J	2011	Engineering	3	100,738	1
K	2003	Advanced instruments	7	103,544	7
L	2006	ICT	8	736,647	7
M	2011	New materials	6	106,740	1
N	2012	Life	2	43,000	0
O	2011	Advanced instruments	6	102,508	nd
P	2011	Engineering	8	83,896	0
Q	2009	Engineering	3	16,639	1
R	2011	Advanced instruments	11	576,918	11
S	2009	New materials	10	143,678	1
T	1997	Advanced instruments	10	3,965,353	50
U	2009	Energy and environment	6	200,728	2

**Table I.**  
Descriptive data  
of the sample

**Source:** Own elaboration on questionnaire data

	Population	Sample	% of population
<i>Industry</i>			
Engineering	5	5	100.0
Life	6	5	83.3
New materials	2	2	100.0
Advanced instruments	6	4	66.7
Energy and environment	2	1	50.0
ICT	7	4	57.1
Innovation services	1	0	0.0
Total	30	21	70
<i>Sales revenue</i>			
Less than €100,000	14	9	64.3
€100,000-300,000	8	6	75.0
€300,000-500,000	4	3	75.0
€500,000 and above	4	3	75.0
Total	30	21	70
<i>Number of employees</i>			
< 4	20	15	75.0
4-8	5	3	60.0
8-11	2	2	100.0
12 and above	3	1	33.3
Total	30	21	70

**Table II.**  
Profile of the sample  
in comparison  
with population of  
University of  
Pisa ASOs

**Source:** Our elaboration of questionnaire data

With the aim of contextualising the spinoffs, Table III also compares the spinoffs and some features of Pisa's local economy.

The most salient characteristics of the sample firms are: they are among the most innovative firms in Pisa; their relative importance in terms of R&D among other (university) departments; and their human resources have a strong academic background (Table III). Among these firms, 70 per cent were micro-enterprises with fewer than four employees and with a lower percentage of tangible assets; half had revenues of less than €100,000 per year. Another relevant feature is that the ASOs are entirely composed and managed by scientists who are actively involved but are not always on the firm's payroll. The employees and administrators have scientific backgrounds; only in few cases did they have some entrepreneurial training while employed, such as MBA or other managerial training. These employees are key figures in their company: they deal with both scientific research and company management.

As anticipated above, in answer to our first question, we had to evaluate the University of Pisa's contributions to economic development and social engagement, referred to TT activities. We adopted a micro-approach to analyse the entrepreneurial performance of the University of Pisa's ASOs and the benefits generated for the local area. This is consistent with the social engagement of universities' third mission in the local environment, especially via TT policies. To measure the impact of the University of Pisa's TT investment in the local community area, we applied economic impact studies, with a multiplier analysis well known in literature (Caffrey and Isaacs, 1971; Selgas *et al.*, 1973; Salley and Prather, 1976; Salley, 1978; Elliott and Meisel, 1987; Elliott *et al.*, 1988; Siegfried *et al.*, 2007). Many economic impact studies conducted by colleges and universities apply a regional multiplier to all expenditures by an institution. The economic meaning of universities' multiplier role is evident. According to Siegfried *et al.* (2007), local economic impact is obtained by adding up the college community's expenditures (students, faculty, staff, and visitors) generated by a university's presence and by applying a multiplier model to account for the interdependence of economic activity in a regional economy under a demand-side perspective (Segarra I Blasco, 2003).

Since our perspective is on effects on knowledge, to evaluate third mission activities' impacts, we adopted an index that shows the effects a university's investments in innovation produce in terms of EV, UTTM, which shows the University of Pisa's value creation as a result of its investments in TT and expenditures in R&D activities promoted by ASOs. The formula is as follows:

$$UTTM = \frac{\text{ASOs' enterprise value}}{\text{TTI} + \text{ASOs' R\&D expenditures}} \quad (1)$$

The denominator is composed of University of Pisa TT investments (TTI) and R&D activity expenditures: investments in innovation. TTI considers the cost of the research enhancement unit (REU) and the expenses for patenting between 2010 and 2014.

	Years				
	2010	2011	2012	2013	2014
Number of high-tech firms in Pisa	201	240	201	232	241
Number of spinoffs in the sample	9	15	17	19	21
Per cent of ASOs on total high-tech firms in Pisa	4.48	6.25	8.46	8.19	8.71
Number of employees in high-tech firms in Pisa	2,586	4,469	3,780	4,655	5,301
Number of employees in the spinoffs in the sample	44	56	72	81	101
Per cent of employees in the spinoffs on total high-tech firms' employees	1.70	1.25	1.90	1.74	1.91

Source: Own elaboration

**Table III.** Comparison between the sample and Pisa's local economy



R&D expenditure represents the sample ASOs' research activities between 2010 and 2014, which are often carried out in the university structure with university employees.

In the numerator, we used ASOs' EV as expression of the effect created by innovation investments (the following equation):

$$\text{ASOs' enterprise value} = \sum_{x=A}^U \frac{\text{EVMM}_x + \text{EVWM}_x}{2} \quad (2)$$

where: A–U = ASOs in the sample,  $\text{EVMM}_x$ , mathematical mean of the four methodologies estimated for company X (Equation (3)).  $\text{EVWM}_x$ , weighted average of the four methodologies estimated for company X (Equation (4)).

Since the business evaluation seems to capture every value driver, it is necessary to integrate several methodologies. Normally, practitioners adopt at least two methodologies. To consider a spinoff's entire value, and these new businesses are operating in an industry with high uncertainty, we adopted four methodologies that address all value drivers: discounted cash flow (DCF), the income method[1] from an accounting perspective, the multiples method, and the venture capital approach to get companies' market value. The venture capital approach is one of the most recommended evaluation methods for startups (Damodaran, 2007, 2011).

The DCF method is the main means to assess EV; it works well with company cash flows. According to Damodaran (2007), DCF reduces expressiveness for young small firms, because they have no information about existing assets cash flows, expected growth, discount rates, and the assessment of when the firm will reach equilibrium (to estimate the terminal value). To address these valuation challenges, we selected only companies with the available financial information needed to develop the DCF technique at a good reliability level. While the income method works well when assessing a company's ability to generate income, the drawback is that it is not suitable for firms whose operating earnings are negative (Damodaran, 2009); however, we did not have a company with operating earnings in the minus sign. Finally, the multiplier method and the venture capital approach focus on a company's market value. With the four values, it is possible to know the value for both the market and for investors or venture capitalists.

We tested our data using the above four methods and ended up with four values for each spinoff in the sample. We used these four values to obtain two averages: the mathematical mean (EVMM) and the weighted mean (EVWM), which have come to represent a maximum and a minimum value for each firm. EVWM enjoys strong acceptance among Italian accounting practitioners; as an index it is made up of 35 per cent DCF, 35 per cent income method, 15 per cent multiples method, and 15 per cent venture capital approach (as shown in the following formulas).

$$\text{EVMM} = \frac{\text{EV}_{\text{DCF}} + \text{EV}_{\text{INCOME}} + \text{EV}_{\text{MULTIPLIER}} + \text{EV}_{\text{VC METHOD}}}{4} \quad (3)$$

$$\text{EVWM} = \text{EV}_{\text{DCF}} \times (0,35) + \text{EV}_{\text{INCOME}} \times (0,35) + \text{EV}_{\text{MULTIPLIER}} \times (0,15) + \text{EV}_{\text{VC METHOD}} \times (0,15) \quad (4)$$

We took all the data required for the calculation of the cost of capital (to use the discount flows) from the open database of Damodaran's website[2]. Following the practice of business evaluation, we adjusted the data to take into account the firms' specific characteristics. By using the four abovementioned methodologies, we were able to assess the firms' more tangible assets (cash flow, income, etc.), and their intangible ones (industry performance,

R&D investments, number of patents, etc.). The spinoffs' EV can be seen an indicator of the value created by the institutions (university) in both tangible and intangible terms.

In our study, we construed it as follows: for every euro of TT and innovation investments, the University of Pisa generates €X in additional ASO EV. The effect in terms of job creation adds value to this impact (Figure 3).

In particular, as noted, since ASOs are an effect of TT activities, they can be considered as an intangible asset of the university, the impacts in terms of IC produced by third stream investments. In fact, ASOs' EV represents the synthesis of the effects of all investments held within the company that express the value of the ASO researcher-entrepreneurs (human capital), the research projects, patents, etc. (structural capital), the international research networks, venture capital relationships, and reputation (relational capital). In turn, IC value growth feeds the scientific atmosphere. Some authors have recently highlighted that the research must study how IC helps to create value for a university's local economy rather than focus on the single components' performance (Secundo *et al.*, 2017).

To determine IC's influence on EV in spinoffs, we performed two statistical analyses (*RQ2*). The first is a correlation matrix between variables and EV (Table V); the second is a means analysis via the non-parametric Wilcoxon rank sum test. To choose a good statistical test, consistent with the purpose of the analysis, we first performed a Shapiro-Wilk test; the results showed that the normality of the sample was not verified and, this led to the use of a non-parametric test.

We performed the above statistical analysis using the software GRETL with two variable types: economic variables and IC parameters. The economic variables were return on assets (ROA), number of employees (EN), and financial independence ratio (FIR); the IC variables were research and development expenses (R&D), completed research projects (RPW), number of patents (NP), conference participation (CP), and number of participations in business associations (AP).

In our analysis, R&D investment volume is one of the proxies used to assess the spinoffs' impacts. Also, according to Secundo *et al.* (2017), we used other variables, such as the number of publications, participation in business associations, and the number of research projects. These variables also provide a measure of the spinoffs' contributions (and indirectly, that of the university's third mission policies) to the locally generated scientific knowledge, new ideas, and new scientific proposals for industry. Finally, we compared the different techniques' results.

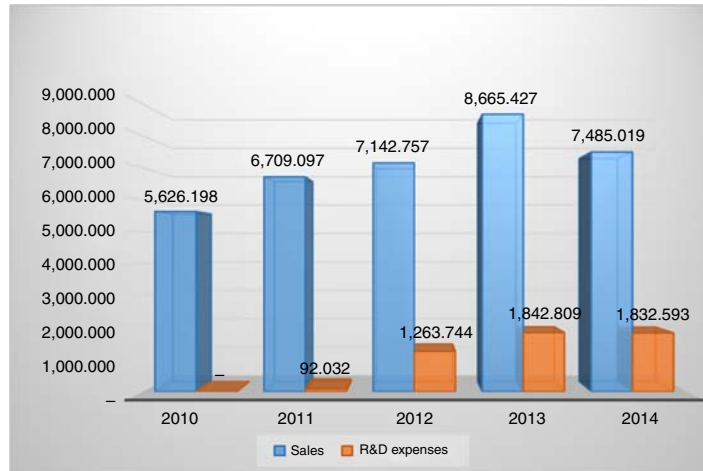
#### 4. Findings

In relation to *RQ1*, the study purpose was to assess the impact of the University of Pisa's investment in innovation, between 2010 and 2014, via the ASOs. First, we highlighted that ASOs bring local economic benefits in terms of traditional economic parameters, such as the growth of sales in the local area, which reached €7,485.019 over the period. The R&D investments amounted to about €1.8 million (Figure 2). In 2014, ASOs gave work to 101 employees, with 57 new high-tech jobs created over the last four years (Figure 3). The number of newly established companies grew from 9 to 21 over the period. Overall, the University of Pisa's ASOs constitute a medium-sized company by helping to develop a scientific environment.

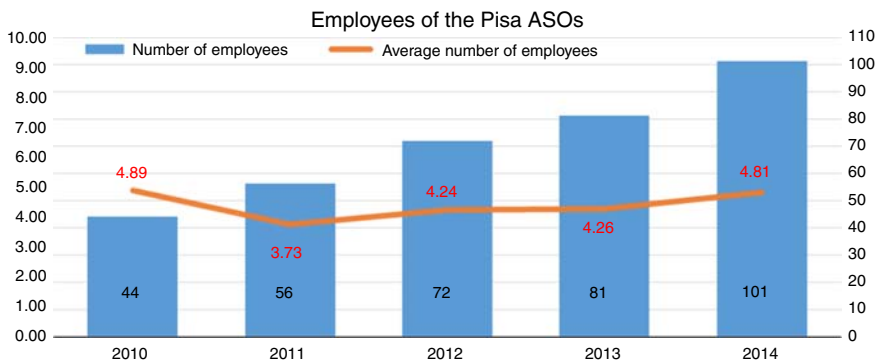
We can highlight that the revenues and the R&D expenses increased not only in aggregate terms (owing to the increase in the number of spinoffs) but also in terms of company value. This last datum shows the spinoffs' growth during the period. As shown in Figure 1, the value created and the IC growth is among the local benefits of university spinoffs.

The UMMT value of 2.74 expresses a synthesis of the multiplier effect of the investments in innovation and in ASOs' R&D on value creation (Table IV).

**Figure 2.**  
Total sales and R&D expenses of the sample firms



**Figure 3.**  
Total and average employees of the spinoffs in the sample



**Table IV.**  
Multiplier elements

Variable	Description	Value
ASOs enterprise value (EV)	Sum of the averages EV for each spinoff in the sample	€18,856,493
Invested capital in TT (TTI)	Sum of the capital invested by University since 2010 to 2014 in TTs. It includes the cost of the REU and the capital invested for patenting	€1,840,000
Spinoffs R&D expenditures (R&D)	Sum of the R&D expenditures made by ASOs between 2010 and 2014	€5,031,178
Multiplier	Represents the effect of €1 invested in TT generates in terms of EV (EV/(TTI + R&D))	2.74

With the multiplier effect, it is possible to appreciate that €1 invested in innovation and ASOs' R&D activities generated about three euros on the local community, in terms of spinoffs' EV, which, as anticipated above, include both tangible and intangible drivers of value.

Some studies have highlighted a regional multiplier with a magnitude around 2, essentially in a demand-side perspective, with more variables (Siegfried *et al.*, 2007).

Regarding the intangible elements of IC performance, we found that the University of Pisa's ASOs developed 23 research projects and 26 awards. These results are from both the university's innovation processes and its investments in R&D (Figure 4). All these elements are strongly connected to the entrepreneurial team's academic backgrounds and add value to the UMMT.

To highlight the contributions of the IC elements of spinoffs (e.g. intangible drivers) on EV, and to answer to RQ2, we used a statistical approach. The correlation matrix (Table V) shows that the number of employees and the R&D investment levels (which are typical IC elements) are strongly correlated to the EV.

An interesting aspect that emerged from the correlation matrix and that was confirmed by the statistical test performed (Table VI) is the negative weak correlation between number of patents and EV (Wilcoxon test  $p$ -value = 0.078). One possible explanation is that the University of Pisa's ASOs, which focus on R&D activities, neglect the commercial aspects of their inventions. The latter is also confirmed by several studies that have shown a lack of financial and managerial culture in R&D-oriented spinoffs (Colombo and Piva, 2008; Carlesi *et al.*, 2017). In contrast, this test highlighted meaningful relationships between some IC variables (R&D investments and number of employees) and EV.

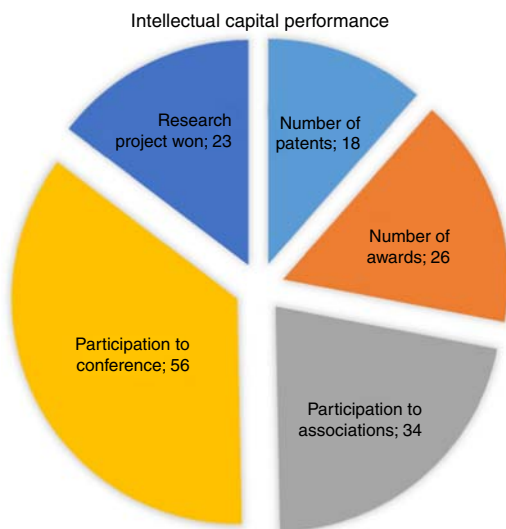


Figure 4. IC performance of the spinoffs in the sample

EV	R&D	RPW	PN	CP	AP	ROA	EN	FIR	
1.0000	0.9362**	0.2389	-0.2720	-0.2851	0.0413	0.1740	0.8737**	0.0330	EV
	1.0000	0.2076	-0.3814	-0.3200	-0.1229	0.1314	0.8450	0.0894	R&D
		1.0000	0.0063	0.0064	0.4063	0.1644	0.0241	0.0320	RPW
			1.0000	0.6438	0.1531	-0.0196	-0.2752	-0.2335	PN
				1.0000	0.1066	-0.1016	-0.3004	-0.2356	CP
					1.0000	0.3091	-0.2127	0.1920	AP
						1.0000	-0.0583	0.3708	ROA
							1.0000	0.0813	EN
								1.0000	FIR

Notes: Correlation coefficients, using observations 1-21 (missing values were omitted); critical value at 5 per cent (for the two tails) = 0.4329 for  $n = 21$ . \*\*Indicates correlation is significant at the 0.05 level (two-tailed)

Table V. Correlation matrix

Since these results could be weak owing to the small sample size, we also compared the means. From this last analysis, it emerged that the ASOs with a higher R&D investment level also have an EV that is significantly higher than the other firms in the sample (Table VI). Table VI shows the results of the means difference analysis, using a non-parametric test (Wilcoxon rank sum test).

From our analysis, it is possible to observe that the R&D investments, patents, and number of employees correlated with EV, which thus can also be used as a proxy for IC creation. Moreover, although a statistical significance does not emerge, it is still possible to appreciate the positive contribution of participation in associations (AP) and in new research projects (RPW) on ASOs' EV (Table VI). Another aspect that deserves to be deepened is the negative relationship between CP and EV. A possible explanation is that the largest number of conferences are only scientific and academic, without effects in economic terms and on EV in a short time. However, this network could lead to new knowledge by contributing to the university's social engagement. According to the third stream, spinoffs' activities generate economic benefits, social benefits, and IC creation. This all contributes to the creation of new ideas and the development of a scientific atmosphere.

## 5. Discussion and conclusion

Secundo *et al.* (2015), note that the management, measurement, and reporting of IC in the university present still larger challenges to explore. This study sought to propose a way to measure the value created by investment in TTs in terms of both economic benefits and IC creation.

To measure the value created by TT activities, we implemented a multiplier, relating investment volume in innovation and in ASOs' R&S and the spinoff's EV. UTTM could be a proxy of the investment output and expression of IC creation.

Notably, the denominator of our multiplier does not include all the university investments that take place in relation to the third mission, only those in TT. The same applies to the numerator, which does not consider all of the third mission's possible output, only those that can be expressed by the value of the spinoffs that accrue to the specific relevant factors (i.e. innovation, value creation, and jobs created, etc. as a result of investments in TT). In line with the academic literature (Trune and Goslin, 1998; Siegfried *et al.*, 2007; Huggins and Johnston, 2009; Trequattrini *et al.*, 2015; Carlesi *et al.*, 2017), this study also found a positive impact of the entrepreneurial university on the local area.

**Table VI.**

Results from the means analysis (dependent variable: enterprise value) *t*-test between the means (dependent variable: enterprise value)

	Under the mean	Over the mean	Enterprise value Difference between the means	Wilcoxon rank sum test	Statistical significance
<i>IC</i>					
R&D**	329,002	1,656,500	1,327,498	0.001	***
RPW	868,806	1,021,700	152,894	0.356	
PN	1,278,550	479,246	-799,304	0.078	*
CP	1,076,070	660,406	-415,664	0.102	
AP	842,172	972,270	130,098	1.000	
EN	479,933	1,942,920	1,462,987	0.043	**
<i>Economic variable</i>					
ROA	1,023,650	847,639	-176,011	0.136	
FIR	641,463	1,131,080	489,617	0.672	

**Notes:** \*, \*\*, \*\*\*Indicates correlation is significant at the 0.10, 0.05 and 0.01 levels, respectively

The result of a multiplier of 2.74, which has been achieved through careful study, presents a key aspect of a topic that calls for further development. In the EV estimation used here, we have sought to capture all the possible intangible value drivers of the University of Pisa's spinoffs, especially owing to their characteristics as R&D-oriented firms. Intangible value is undoubtedly these companies' main asset.

We compensated for the difficulty in estimating a direct evaluation of the intangible components of these unlisted companies, with budgets in summary form, a brief company history, and a poor managerial culture, by trying to determine the extracted value from IC. The assumption that IC could play a key role in EV, especially in these types of businesses, is also confirmed in the statistical analysis, which detects a strong correlation between R&D investments and EV, demonstrating some ability to transform research into a business.

The empirical analysis also drew attention to the fact that there is still another side to the entrepreneurial mindset coin, because our spinoffs are still struggling to industrialise patents with a strong relevance from an academic perspective but that are remaining under-utilised from a business perspective. A negative correlation emerges between number of patents and EV, in contrast with what has been stated in previous works on large listed firms (Griliches, 1981; Hirschey *et al.*, 2001; Bloom and Van Reenen, 2002). New and micro companies are still unable to turn research into value. Furthermore, they do not realise the strategical role of an informative symmetry for enterprise market value. Even with all the necessary described cautions, particularly the UTTM results seem to confirm scholars and policymakers' strong interest on universities' third mission. Investments in the third mission can create value and wealth, especially owing to universities' ability to fertilise a scientific atmosphere by capitalising on IC.

We have presented several implications for research and practice. From an academic perspective, this study contributes to the literature on IC in universities by showing empirical evidence of the effects that IC has for the local economy. However, the study conclusions are limited to the Pisa local economy, but could also be further investigated in other contexts.

Also the use of ASOs' EV as a proxy of the value created from IC represents an innovative element in literature that opens the debate on measuring IC in higher education institutions following the corporate logic of value creation.

The practical implications are primarily for policymakers who seek to know and communicate their policies' results. The approach through multipliers allows one to synthesise all TT policies' effectiveness, in a single number. This last point is one of the EU's primary goals on the topic, as indicated in the green paper (2012).

Another practical implication of this study is directed at universities since they are subject to stringent spending constraints and are not used to thinking in terms of value creation in the economic sense of the term. Via IC creation, a university can capitalise on its investments and can aggregate knowledge. IC becomes a key driver on which universities and businesses meet. Stimulating a university to think in terms of value creation allows it to give tangible form to IC, which is a strategical intangible asset.

By adopting the business logic of value creation in the economic sense, a university begins to speak the language of businesses, reinterpreting the concept of scientific research.

The historical interest in measuring a university's economic impact on its surrounding regions is driven by the need to guide strategic management of third stream activities and policymaker investment decisions. The large university stakeholder portfolio (legislator, families, students, companies, financiers, visitors, etc.) ask for information, especially on long-term results: they want to know the capability of their funds (public and private funds) to create value. In a time when universities can no longer assume that they will be funded, entrepreneurship and new ways to engage are required at every level to bring in the necessary resources (financial, collaborations, access to facilities, etc.) from different sources. This study highlights a difficulty by ASOs to commercialise their research. This underscores low

managerial skills on the part of ASO managers who, as highlighted above, are the same scientists who created the company. A key goal for universities and policymakers could be to encourage management training in academic enterprises and the commercialisation of scientific research with the aim of creating value. This would align universities and industry better; since the ability to create value is key information for any investor, this also would increase industry support for universities, reducing their dependence on public funding. From an academic point of view, our findings could contribute to an active discussion on the IC's role in the creation value process in the universities.

## 6. Limitations

This is an exploratory study of the University of Pisa's contributions to the local community. Thus, the results cannot be generalised but are limited to the context of Pisa. The considerations that emerged in this research have uncovered more in-depth insights that this research group is now investigating. First, we created a benchmark to compare our results with other universities; second, our search may be refined by developing models that enable us to estimate EV and to capture the intangible elements of this value, including IC. A limitation of this research is the small sample size, which has its limits from a statistical perspective, even though it represents 70 per cent of the population. Another limitation is in the subjectivity of the EV estimation which, even if it represents the spinoffs' value, is still the result of an assessment of which assumptions depend on the appraiser. Further, in relation to IC creation, we neglected some variables in literature and considered others that have been unexplored.

It would also be useful to extend this analysis to include other elements of IC, to attempt a direct evaluation. This would provide a more complete picture of these factors' impacts on spinoffs' EV and therefore on the multiplier.

## Notes

1. Income method is the most commonly used method in Italy, and is based on discounting the net operating profit minus the adjustment for taxes (NOPLAT).
2. <http://pages.stern.nyu.edu/~adamodar/>

## References

- Aronowitz, S. (2000), *The Knowledge Factory: Dismantling the Corporate University and Creating True Higher Learning*, Beacon Press, Boston, MA.
- Bartlett, C.A. and Ghoshal, S. (2002), "Building competitive advantage through people", *MIT Sloan Management Review*, Vol. 43 No. 2, pp. 34.
- Bercovitz, J., Feldman, M., Feller, I. and Burton, R. (2001), "Organizational structure as a determinant of academic patent and licensing behavior: an exploratory study of Duke, Johns Hopkins, and Pennsylvania state universities", *The Journal of Technology Transfer*, Vol. 26 Nos 1/2, pp. 21-35.
- Bloom, N. and Van Reenen, J. (2002), "Patents, real options and firm performance", *The Economic Journal*, Vol. 112 No. 478, pp. C97-C116.
- Boedker, C., Mouritsen, J. and Guthrie, J. (2008), "Enhanced business reporting: international trends and possible policy directions", *Journal of Human Resource Costing and Accounting*, Vol. 12 No. 1, pp. 14-25.
- Borin, E. and Donato, F. (2015), "Unlocking the potential of IC in Italian cultural ecosystems", *Journal of Intellectual Capital*, Vol. 16 No. 2, pp. 285-304.
- Broad, M., Goddard, A. and Von Albetri, L. (2007), "Performance, strategy and accounting in local government and higher education in the UK", *Public Money and Management*, Vol. 27 No. 2, pp. 119-126.

- Caffrey, J. and Isaacs, H. H. (1971), *Estimating the Impact of a College or University on the Local Economy*, American Council on Education, Washington, DC.
- Carlesi, A., Mariani, G. and Scarfó, A.A. (2017), "Academic spin-offs for the local economy growth", *Corporate Ownership and Control*, Vol. 14 No. 2.
- Chapple, W., Lockett, A., Siegel, D. and Wright, M. (2005), "Assessing the relative performance of UK university technology transfer offices: parametric and non-parametric evidence", *Research Policy*, Vol. 34 No. 3, pp. 369-384.
- Chen, Y.S. (2008), "The positive effect of green intellectual capital on competitive advantages of firms", *Journal of Business Ethics*, Vol. 77 No. 3, pp. 271-286.
- Chen, M., Cheng, S. and Hwang, Y. (2005), "An empirical investigation of the relationship between intellectual capital and firms' market value and financial performance", *Journal of Intellectual Capital*, Vol. 6 No. 2, pp. 159-176.
- Chiesa, V. and Piccaluga, A. (2000), "Exploitation and diffusion of public research: the case of academic spin-off companies in Italy", *R&D Management*, Vol. 30 No. 4, pp. 329-340.
- Clarysse, B., Wright, M., Lockett, A., Van de Velde, E. and Vohora, A. (2005), "Spinning out new ventures: a typology of incubation strategies from European research institutions", *Journal of Business Venturing*, Vol. 20 No. 2, pp. 183-216.
- Colombo, M.G. and Piva, E. (2008), "Strengths and weaknesses of academic startups: a conceptual model", *IEEE Transactions on Engineering Management*, Vol. 55 No. 1, pp. 37-49.
- Cummings, J.L. and Teng, B.S. (2003), "Transferring R&D knowledge: the key factors affecting knowledge transfer success", *Journal of Engineering and Technology Management*, Vol. 20 No. 1, pp. 39-68.
- Damodaran, A. (2007), *The Dark Side of Valuation*, Pearson Education.
- Damodaran, A. (2009), "Valuing young, start-up and growth companies: estimation issues and valuation challenges", *Stern School of Business*, New York University, New York, NY.
- Damodaran, A. (2011), *The Little Book of Valuation: How to Value a Company, Pick a Stock and Profit*, John Wiley & Sons.
- Di Gregorio, D. and Shane, S. (2003), "Why do some universities generate more start-ups than others?", *Research Policy*, Vol. 32 No. 2, pp. 209-227.
- Dumay, J. (2014), "15 years of the journal of intellectual capital and counting: a manifesto for transformational IC research", *Journal of Intellectual Capital*, Vol. 15 No. 1, pp. 2-37.
- Elliott, D.S. and Meisel, J.B. (1987), *The Economic Impact Study of Southern Illinois University at Edwardsville on the St. Louis Metro Area: 1986*, Department of Economics, Southern Illinois University, Carbondale, IL.
- Elliott, D.S., Levin, S.L. and Meisel, J.B. (1988), "Measuring the economic impact of institutions of higher education", *Research in Higher Education*, Vol. 28 No. 1, pp. 17-33.
- Etzkowitz, H. (1983), "Entrepreneurial scientists and entrepreneurial universities in American academic science", *Minerva*, Vol. 21 Nos 2/3, pp. 198-233.
- Etzkowitz, H. (2003), "Innovation in innovation: the triple helix of university-industry-government relations", *Social Science Information*, Vol. 42 No. 3, pp. 293-337.
- Etzkowitz, H. and Klofsten, M. (2005), "The innovating region: toward a theory of knowledge-based regional development", *R&D Management*, Vol. 35 No. 3, pp. 243-255.
- Etzkowitz, H., Webster, A., Gebhardt, C. and Terra, B.R.C. (2000), "The future of the university and the university of the future: evolution of ivory tower to entrepreneurial paradigm", *Research Policy*, Vol. 29 No. 2, pp. 313-330.
- Fazlagic, A. (2005), "Measuring the intellectual capital of a university", *Trabajo presentado en Trends in the Management of Human Resources in Higher Education*, Paris.
- Feldman, M., Feller, I., Bercovitz, J. and Burton, R. (2002), "Equity and the technology transfer strategies of American research universities", *Management Science*, Vol. 48 No. 1, pp. 105-121.



- Ferenhof, H.A., Durst, S., Zaniboni, B. and Selig, P.M. (2015), "Intellectual capital dimensions: state of the art in 2014", *Journal of Intellectual Capital*, Vol. 16 No. 1, pp. 58-100.
- Fontes, M. (2005), "The process of transformation of scientific and technological knowledge into economic value conducted by biotechnology spin-offs", *Technovation*, Vol. 25 No. 4, pp. 339-347.
- Friedman, J. and Silberman, J. (2003), "University technology transfer: do incentives, management, and location matter?", *The Journal of Technology Transfer*, Vol. 28 No. 1, pp. 17-30.
- Geiger, R. L. (2006), "The quest for 'economic relevance by US research universities'", *Higher Education Policy*, Vol. 19 No. 4, pp. 411-431.
- Geiger, R. and Sa, C.M. (2009), "Technology transfer offices and the commercialization of university research in the United States", in Clancy, P. and Dill, D. (Eds), *The Research Mission of the University: Reforms and Response*, Sense Publishers, Rotterdam, Boston and Taipei, pp. 177-196.
- Gibb, A. and Hammon, P. (2006), "Towards the entrepreneurial university", *International Journal of Entrepreneurship Education*, Vol. 4 No. 1, pp. 73-110.
- Goldstein, H. and Drucker, J. (2006), "The economic development impacts of universities on regions: do size and distance matter?", *Economic Development Quarterly*, Vol. 20 No. 1, pp. 22-43.
- Griliches, Z. (1981), "Market value, R&D, and patents", *Economics Letters*, Vol. 7 No. 2, pp. 183-187.
- Guerrero, M., Cunningham, J.A. and Urbano, D. (2015), "Economic impact of entrepreneurial universities' activities: an exploratory study of the United Kingdom", *Research Policy*, Vol. 44 No. 3, pp. 748-764.
- Gulbrandsen, M. and Smeby, J.C. (2005), "Industry funding and university professors' research performance", *Research Policy*, Vol. 34 No. 6, pp. 932-950.
- Gunasekara, C. (2004), "The third role of Australian universities in human capital formation", *Journal of Higher Education Policy and Management*, Vol. 26 No. 3, pp. 329-343.
- Guthrie, J. and Dumay, J. (2015), "New frontiers in the use of intellectual capital in the public sector", *Journal of Intellectual Capital*, Vol. 16 No. 2, pp. 258-266.
- Guthrie, J., Petty, R. and Ricceri, F. (2006), "The voluntary reporting of intellectual capital: comparing evidence from Hong Kong and Australia", *Journal of Intellectual Capital*, Vol. 7 No. 2, pp. 254-271.
- Guthrie, J., Ricceri, F. and Dumay, J. (2012), "Reflections and projections: a decade of intellectual capital accounting research", *The British Accounting Review*, Vol. 44 No. 2, pp. 68-82.
- Hellström, T. and Husted, K. (2004), "Mapping knowledge and intellectual capital in academic environments: a focus group study", *Journal of Intellectual Capital*, Vol. 5 No. 1, pp. 165-180.
- Henrekson, M. and Rosenberg, N. (2001), "Designing efficient institutions for science-based entrepreneurship: lesson from the US and Sweden", *The Journal of Technology Transfer*, Vol. 26 No. 3, pp. 207-231.
- Hirschey, M., Richardson, V.J. and Scholz, S. (2001), "Value relevance of nonfinancial information: the case of patent data", *Review of Quantitative Finance and Accounting*, Vol. 17 No. 3, pp. 223-235.
- Hsu, D.W., Shen, Y.C., Yuan, B.J. and Chou, C.J. (2015), "Toward successful commercialization of university technology: performance drivers of university technology transfer in Taiwan", *Technological Forecasting and Social Change*, Vol. 92, March, pp. 25-39.
- Huggins, R. and Johnston, A. (2009), "The economic and innovation contribution of universities: a regional perspective", *Environment and Planning C: Government and Policy*, Vol. 27 No. 6, pp. 1088-1106.
- Jacob, M., Lundqvist, M. and Hellsmark, H. (2003), "Entrepreneurial transformations in the Swedish university system: the case of Chalmers University of Technology", *Research Policy*, Vol. 32 No. 9, pp. 1555-1568.
- Jardon, C.M. and Susana Martos, M. (2012), "Intellectual capital as competitive advantage in emerging clusters in Latin America", *Journal of Intellectual Capital*, Vol. 13 No. 4, pp. 462-481.
- Kong, E. (2007), "The strategic importance of intellectual capital in the non-profit sector", *Journal of Intellectual Capital*, Vol. 8 No. 4, pp. 721-731.

- Kong, E. and Prior, D. (2008), "An intellectual capital perspective of competitive advantage in nonprofit organizations", *International Journal of Nonprofit and Voluntary Sector Marketing*, Vol. 13 No. 2, pp. 119-128.
- Laredo, P. (2007), "Revisiting the third mission of universities: toward a renewed categorization of university activities?", *Higher Education Policy*, Vol. 20 No. 4, pp. 441-456.
- Leitner, K.H. (2004), "Intellectual capital reporting for universities: conceptual background and application for Austrian universities", *Research Evaluation*, Vol. 13 No. 2, pp. 129-140.
- Leitch, C.M. and Harrison, R.T. (2005), "Maximising the potential of university spin-outs: the development of second-order commercialization activities", *R&D Management*, Vol. 35 No. 3, pp. 257-272.
- Lengnick-Hall, C.A., Lengnick-Hall, M.L. and Abdinnour-Helm, S. (2004), "The role of social and intellectual capital in achieving competitive advantage through enterprise resource planning (ERP) systems", *Journal of Engineering and Technology Management*, Vol. 21 No. 4, pp. 307-330.
- Link, A.N. and Scott, J.T. (2005), "Opening the ivory tower's door: an analysis of the determinants of the formation of US university spin-off companies", *Research Policy*, Vol. 34 No. 7, pp. 1106-1112.
- Mariani, G. (2017), "Il contributo delle spin-off accademiche allo sviluppo dell'area locale", in Carlesi, A. and Marchi, L. (Eds), *Il Capitale Relazionale Delle Università*, Pisa University Press, Pisa, pp. 156-173.
- Markman, G.D., Phan, P.H., Balkin, D.B. and Gianiodis, P.T. (2005), "Entrepreneurship and university-based technology transfer", *Journal of Business Venturing*, Vol. 20 No. 2, pp. 241-263.
- Marr, B., Schiuma, G. and Neely, A. (2004), "The dynamics of value creation: mapping your intellectual performance drivers", *Journal of Intellectual Capital*, Vol. 5 No. 2, pp. 312-325.
- Mouritsen, J., Nikolaj, B. P. and Marr, B. (2004), "Reporting on intellectual capital: why, what and how?", *Measuring Business Excellence*, Vol. 8 No. 1, pp. 46-54.
- Mowery, D.C., Nelson, R.R., Sampat, B.N. and Ziedonis, A.A. (2001), "The growth of patenting and licensing by US universities: an assessment of the effects of the Bayh-Dole Act of 1980", *Research Policy*, Vol. 30 No. 1, pp. 99-119.
- Mowery, D.C., Nelson, R.R., Sampat, B.N. and Ziedonis, A.A. (2004), *Ivory Tower and Industrial Innovation: University-Industry Technology Before and After the Bayh-Dole Act in the United States*, Stanford University Press, CA.
- Nahapiet, J. and Ghoshal, S. (1998), "Social capital, intellectual capital, and the organizational advantage", *Academy of Management Review*, Vol. 23 No. 2, pp. 242-266.
- Nowotny, H., Scott, P. and Gibbons, M. (2003), "Introduction: mode 2 revisited: the new production of knowledge", *Minerva*, Vol. 41 No. 3, pp. 179-194.
- O'shea, R.P., Allen, T.J., Chevalier, A. and Roche, F. (2005), "Entrepreneurial orientation, technology transfer and spinoff performance of US universities", *Research Policy*, Vol. 34 No. 7, pp. 994-1009.
- Petty, R. and Guthrie, J. (2000), "Intellectual capital literature review: measurement, reporting and management", *Journal of Intellectual Capital*, Vol. 1 No. 2, pp. 155-176.
- Pulic, A. (2004), "Intellectual capital – does it create or destroy value?", *Measuring Business Excellence*, Vol. 8 No. 1, pp. 62-68.
- Quinn, J.B., Anderson, P. and Finkelstein, S. (1996), "Leveraging intellect", *The Academy of Management Executive*, Vol. 10 No. 3, pp. 7-27.
- Ramírez, Y. (2010), "Intellectual capital models in Spanish public sector", *Journal of Intellectual Capital*, Vol. 11 No. 2, pp. 248-264.
- Rappert, B., Webster, A. and Charles, D. (1999), "Making sense of diversity and reluctance: academic-industrial relations and intellectual property", *Research Policy*, Vol. 28 No. 8, pp. 873-890.

- Rasmussen, E. and Borch, O. J. (2010), "University capabilities in facilitating entrepreneurship: a longitudinal study of spin-off ventures at mid-range universities", *Research Policy*, Vol. 39 No. 5, pp. 602-612.
- Ricceri, F. (2008), *Intellectual Capital and Knowledge Management: Strategic Management of Knowledge Resources*, Routledge, Milton Park.
- Rothaermel, F.T., Agung, S.D. and Jiang, L. (2007), "University entrepreneurship: a taxonomy of the literature", *Industrial and Corporate Change*, Vol. 16 No. 4, pp. 691-791.
- Salley, C.D. (1978), "Calculating the economic multiplier for local university spending", *Research and Planning for Higher Education*, Association for Institutional Research, Tallahassee, FL, pp. 49-54.
- Salley, C.D., Prather, J.E. and Williams, J.E. (1976), "A review of economic multipliers for postsecondary institutions with selected models applied to Georgia State University", Report No. 77-5, Georgia State University Office of Institutional Planning, Atlanta, September, available at: <http://files.eric.ed.gov/fulltext/ED135320.pdf>
- Secundo, G., Dumay, J., Schiuma, G. and Passiante, G. (2016), "Managing intellectual capital through a collective intelligence approach: an integrated framework for universities", *Journal of Intellectual Capital*, Vol. 17 No. 2, pp. 298-319.
- Secundo, G., Passiante, G., Matos, F. and Do Rosário, C.M. (2015), "Intellectual capital in academic entrepreneurship: moving beyond measurement", presented at European Conference on Knowledge Management, p. 684.
- Secundo, G., Perez, S.E., Martinaitis, Ž. and Leitner, K.H. (2017), "An intellectual capital framework to measure universities' third mission activities", *Technological Forecasting and Social Change*, Vol. 123, October, pp. 229-239, available at: <http://dx.doi.org/10.1016/j.techfore.2016.12.013>
- Segarra i Blasco, A. (2003), "La universitat com a instrument de dinamització econòmica del territori", *Coneixement i Societat: Revista d'Universitats, Recerca i Societat de la Informació*, Vol. 3 No. 2003, pp. 78-101.
- Selgas, J.W., Saussy, John, C. and Blocker, C.E. (1973), "The impact of the college on the local economy", Research Report No. 11. Harrisburg Area Community College, Harrisburg, PA.
- Shane, S.A. (2004), *Academic Entrepreneurship: University Spinoffs and Wealth Creation*, Edward Elgar Publishing, Cheltenham.
- Siegel, D.S. (2006), *Technology Entrepreneurship: Institutions and Agents Involved in University Technology Transfer*, Vol. 1, Edgar Elgar, London.
- Siegel, D.S., Waldman, D. and Link, A. (2003), "Assessing the impact of organizational practices on the relative productivity of university technology transfer offices: an exploratory study", *Research Policy*, Vol. 32 No. 1, pp. 27-48.
- Siegfried, J.J., Sanderson, A.R. and McHenry, P. (2007), "The economic impact of colleges and universities", *Economics of Education Review*, Vol. 26 No. 5, pp. 546-558.
- Slaughter, S. and Leslie, L.L. (1997), *Academic Capitalism: Politics, Policies, and the Entrepreneurial University*, The Johns Hopkins University Press, Baltimore, MD.
- Stewart, T. and Capital, I. (1997), *The New Wealth of Organizations*, Nicholas Brealey, London.
- Sveiby, K.E. (2010), "Methods for measuring intangible assets", 27 April, available at: [www.sveiby.com/articles/IntangibleMethods.htm](http://www.sveiby.com/articles/IntangibleMethods.htm) (accessed 22 August 2010).
- Thursby, J.G. and Kemp, S. (2002), "Growth and productive efficiency of university intellectual property licensing", *Research Policy*, Vol. 31 No. 1, pp. 109-124.
- Trequattrini, R., Lombardi, R., Lardo, A. and Cuozzo, B. (2015), "The impact of entrepreneurial universities on regional growth: a local intellectual capital perspective", *Journal of the Knowledge Economy*, pp. 1-13.
- Trune, D.R. and Goslin, L.N. (1998), "University technology transfer programs: a profit/loss analysis", *Technological Forecasting and Social Change*, Vol. 57 No. 3, pp. 197-204.

- Tseng, C.Y. and James Goo, Y.J. (2005), "Intellectual capital and corporate value in an emerging economy: empirical study of Taiwanese manufacturers", *R&D Management*, Vol. 35 No. 2, pp. 187-201.
- Vagnoni, E. and Oppi, C. (2015), "Investigating factors of intellectual capital to enhance achievement of strategic goals in a university hospital setting", *Journal of Intellectual Capital*, Vol. 16 No. 2, pp. 331-363.
- Wright, M. (2007), *Academic Entrepreneurship in Europe*, Edward Elgar Publishing.
- Youtie, J and Shapira, P. (2008), "Building an innovation hub: a case study of the transformation of university roles in regional technological and economic development", *Research Policy*, Vol. 37 No. 8, pp. 1188-1204.

### Further reading

- Bezhan, I. (2010), "Intellectual capital reporting at UK universities", *Journal of Intellectual Capital*, Vol. 11 No. 2, pp. 179-207.
- Carlesi, A. and Mariani, G. (2017), "L'impatto economico degli atenei sul territorio. La valutazione del capitale relazionale in termini economici", in Carlesi, A. and Marchi, L. (Eds), *Il capitale relazionale delle università*, Pisa University Press, Pisa, pp. 133-173.
- Damodaran, A. (1999), "The dark side of valuation: firms with no earnings, no history and no comparables", available at: <http://people.stern.nyu.edu/adamodar/pdfiles/papers/HighGrow.pdf> (accessed March 2000).
- Dumay, J., Guthrie, J. and Puntillo, P. (2015), "IC and public sector: a structured literature review", *Journal of Intellectual Capital*, Vol. 16 No. 2, pp. 267-284.
- E3M (2010), "Needs and Constraints Analysis of the Three Dimensions of Third Mission Activities", available at: [www.e3mproject.eu/docs/Three-dim-third-mission-act.pdf](http://www.e3mproject.eu/docs/Three-dim-third-mission-act.pdf)
- E3M Project (2012), *Green Paper Fostering and Measuring "Third Mission" in Higher Education Institutions*, Brussels, available at: [www.e3mproject.eu/docs/Green%20paper-p.pdf](http://www.e3mproject.eu/docs/Green%20paper-p.pdf)
- Etzkowitz, H. and Leydesdorff, L. (2000), "The dynamics of innovation: from national systems and 'mode 2' to a triple helix of university-industry-government relations", *Research Policy*, Vol. 29 No. 2, pp. 109-123.
- Garrido-Yserte, R. and Gallo-Rivera, M. T. (2010), "The impact of the university upon local economy: three methods to estimate demand-side effects", *The Annals of Regional Science*, Vol. 44 No. 1, pp. 39-67.
- Hofer, A.R., Potter, J., Fayolle, A. and Organisation for Economic Co-operation and Development (OECD) (2010), "From strategy to practice in university entrepreneurship support: strengthening entrepreneurship and local economic development in eastern Germany: youth, entrepreneurship and innovation", Working Papers No. 2010/09, OECD Local Economic and Employment Development (LEED), Paris.
- Iacobucci, D. and Micozzi, A. (2015), "How to evaluate the impact of academic spin-offs on local development: an empirical analysis of the Italian case", *The Journal of Technology Transfer*, Vol. 40 No. 3, pp. 434-452.
- Johansson, M., Jacob, M. and Hellström, T. (2005), "The strength of strong ties: university spin-offs and the significance of historical relations", *The Journal of Technology Transfer*, Vol. 30 No. 3, pp. 271-286.
- Kahn, R.F. (1931), "The relation of home investment to unemployment", *The Economic Journal*, Vol. 41 No. 162, pp. 173-198.
- Keynes, J.M. (1937), "The general theory of employment", *The Quarterly Journal of Economics*, Vol. 51 No. 2, pp. 209-223.
- María Diez, J., Lizet, O.M., Begona, P. and Santidrián, A. (2010), "Intellectual capital and value creation in Spanish firms", *Journal of Intellectual Capital*, Vol. 11 No. 3, pp. 348-367.

- Molas-Gallart, J., Salter, A., Patel, P., Scott, A. and Duran, X. (2002), "Measuring third stream activities. Final report to the Russell Group of Universities", available at: [www.researchgate.net/profile/Jordi\\_Molas/publication/246796517\\_Measuring\\_Third\\_Stream\\_Activities/links/54e11476cf2966637916ab3.pdf](http://www.researchgate.net/profile/Jordi_Molas/publication/246796517_Measuring_Third_Stream_Activities/links/54e11476cf2966637916ab3.pdf) (accessed April 2002).
- Paloma Sánchez, M., Elena, S. and Castrillo, R. (2009), "Intellectual capital dynamics in universities: a reporting model", *Journal of Intellectual Capital*, Vol. 10 No. 2, pp. 307-324.
- Pöyhönen, A. and Smedlund, A. (2004), "Assessing intellectual capital creation in regional clusters", *Journal of Intellectual Capital*, Vol. 5 No. 3, pp. 351-365.
- Ramírez, C.Y., Santos, P. and Tejada, P. (2011), "Intellectual capital in Spanish public universities: stakeholders' information needs", *Journal of Intellectual Capital*, Vol. 12 No. 3, pp. 356-376.
- Sánchez-Barrioluengo, M. (2014), "Articulating the 'three-missions' in Spanish universities", *Research Policy*, Vol. 43 No. 10, pp. 1760-1773.

Questionnaire 1

Interviewee

Date

Interviewer

General information about the company

1. Kind of business

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2. Year of birth \_\_\_\_\_

3. ATECO code \_\_\_\_\_

4. Shareholders:

Name and surname	Percentage of shares (%)	Role within company	Education

5. Corporate changes from the year of constitution

- Yes
- No

6. If yes, complete the following table:

Year	Type of change

7. Information about the company

Year	Sales	R&D expenses	No. of employees	Employees gross salary	Employees net salary	Country	No. of employees in R&D	R&D employees' gross salary

### Questionnaire 2

Interviewee \_\_\_\_\_

Date \_\_\_\_\_

Interviewer \_\_\_\_\_

#### Detailed information about companies

1. In the past two years, your research unit has committed (indicate the change compared to the previous year):

	Unit	Variation	Salary	Variation	Country	Collaboration type
Professor						
Researcher						
PhD						
Research fellows						
Technical staff						
Foreign staff						
Other staff						

2. Did you complete research project during the period 2010 to 2014?

- Yes  
 No

3. Describe it:

Project type	Role in the project	Organisation	Year	Country	Obtained loan for the project	Achieved results

4. With the research projects completed, did you have the opportunity to buy tools?

For research    For the trials    For teaching    For other uses

- |                   |                          |                          |                          |                          |
|-------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| €1,000 or under   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| €1,001 to €3,000  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| €3,001 to €5,000  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| €5,001 to €7,000  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| €7,001 to €10,000 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| > €10,000         | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

5. The above purchases were made using suppliers located in the region (indicate the city)

Yes  No  City \_\_\_\_\_

6. If yes, for what percentage of the total amount? \_\_\_\_\_

7. Partnerships with other organisations:

Organisation	Country	Year	Collaboration type	Results obtained	Profit (€)

8. Patents and awards

Award	Patent	Year of filing of the patent	Patent's book value

9. Are you developing new projects?

Period	Project type	In collaboration with	Country	Aim	Project value	Project result(s)

10. Have you done:

- 1 New products Yes  No
- 2 Scientific publications Yes  No
- 3 Other (describe) \_\_\_\_\_

11. If you have not realised new patents, this is due to:

- 1 Lack of innovations subjected to patent
- 2 Technical difficulties
- 3 Bureaucratic difficulties
- 4 Other (specify) \_\_\_\_\_

12. Have you funded:

Kind	Period	Collaboration type	Department	Aim	Finance (amount)
Scholarships					
PhD scholarships					
Research grants					
Contracts					
Instrumentation					
Training					
Other (specify)					

13. Have you done staff training?

- Yes  No
- If yes, what kind?  Managerial training  Technical training  Language training



14. The company participates in associations?

Yes  No

If yes, specify the number of associations in which the company participates:

\_\_\_\_\_

15. Paper presentation and participation in conferences over the past two years:

Year	Conference type	Country	Effects on the company

16. In the company, are there persons with managerial skills?

Yes  No

If yes, describe:

Role	Education type	Experience (years)	Salary

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