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Title of the Thesis

Female management and academic spin-off: role of the financial context and effect on finance and performance

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Index

Abstract of the thesis

The object of the thesis is to study the theme of gender diversity in conjunction with the literature on academic spin-off, deepening the consequences on financial choices and corporate performance as well as examining the moderating role of the institutional context, in terms of local financial development. The issue of equal opportunities, a topic of great importance in today's society that affects many areas ranging from politics to economics, investing also the interest of various media, is producing considerable attention for many scholars who have been conducting for year empirical research concerning the impact on the business caused by the differences between men and women (Croson and Gneezy , 2009; Bertrand 2011; Lyons, Neelakantan and Scherpf, 2008). By invoking the pioneering work of Becker (1964) on the role of human capital, it is possible to argue that the inclusion of women in the management board enables companies to access the full range of intellectual capital available, amplifying the potential response to stress arising in an increasingly complex and hypercompetitive context. Element of originality of the thesis is an examination of the role of gender diversity within a particular category of firms: the research spin-off (RSO). These are companies that are born within Universities with the goal of transferring innovation from laboratories to the market, commercializing the technology developed as a result of the research activity. In these contexts, women can freely express their professionalism without inferiority complexes toward their male colleagues. The first chapter examines the effect of the presence of women in the management of such RSOs on their performance. The result is a positive and statistically significant effect. Such effect appears different than the ones noticed in two control samples built as comparables of RSOs. This is an issue of great interest since this subject is not extensively discussed in literature.. Besides, such work is characterized by a solid database created by crossing information from three sources, with the purpose to identify only a sample of RSOs and not companies that, although recorded as RSOs by a national authority, are just companies that occupy spaces inside the universities dedicated to promoting entrepreneurship, and not without firms actually created from initiatives of University researchers. The second chapter explores the effect of the institutional context, in terms of local financial development, on the performances of the spin-offs (RSOs). While for innovative start-ups the financial context has a positive effect, for RSOs this effect emerges only when they enter the market and it is stronger when they are more independent, i.e. there is no bond with the University of origin. Finally, the last chapter explores the effect of gender diversity on corporate cash holdings; women tend to pursue more conservative financial choices.

Abstract of the thesis In Italian

Il presente lavoro di tesi ha come oggetto di studio il tema della gender diversity in combinazione con la letteratura sugli academic spin-off, approfondendone le conseguenze su scelte finanziarie e performance aziendali oltre che esaminando il ruolo di moderazione del contesto istituzionale, in termini di local financial development. La tematica delle pari opportunità, tema di grande rilevanza nella società attuale che interessa numerosi ambiti che vanno da quello politico a quello economico, investendo inoltre l'interesse dei diversi mezzi di comunicazione, sta generando notevole attenzione da parte di numerosi studiosi che ormai da anni conducono ricerche empiriche riguardanti le conseguenze sull'attività d'impresa derivante da differenze tra uomo e donna (Croson e Gneezy, 2009; Bertrand 2011; Lyons, Neelakantan e Scherpf, 2008). Richiamando il lavoro pioneristico di Becker (1964) sul ruolo del capitale umano, è possibile sostenere che l'inclusione delle donne negli organi societari consente alle imprese di accedere alla gamma completa di capitale intellettuale disponibile, amplificando il potenziale di risposta a sollecitazioni che emergono in un contesto sempre più complesso e ipercompetitivo. Elemento di originalità del lavoro di tesi è l'esame del ruolo della gender diversity all'interno di una particolare categoria di imprese: i research spin-off (RSOs). Si tratta di imprese che nascono nell'alveo della ricerca universitaria con l'obiettivo di trasferire l'innovazione tecnologica dai laboratori di ricerca al mercato dei prodotti, dedicandosi alla commercializzazione della tecnologia sviluppata in conseguenza dell'attività di ricerca. In tali contesti, le donne possono liberamente esprimere la loro professionalità senza complessi di inferiorità verso i loro colleghi maschi. Il primo capitolo esamina l'effetto della presenza di donne nel management di tali RSOs sullo loro stesse performance, rilevando un effetto positivo e statisticamente significativo. Ulteriormente, tale effetto appare ben differente rispetto a quello che emerge in due campioni di controllo costruiti quali comparables degli RSOs. Si tratta del primo lavoro che approfondisce tale legame in letteratura. Inoltre, tale lavoro si caratterizza per un solido database creato incrociando le informazioni da tre fonti, al fine di essere certi di identificare e inserire nel campione RSOs e non imprese che seppur operative all'interno di Università e Centri di Ricerca, ne occupano gli spazi dedicati alla promozione dell'imprenditorialità, senza però essere in realtà nate da iniziative di ricercatori universitari. Il secondo capitolo indaga l'effetto del contesto istituzionale, in termini di local financial development, sulle performance degli spin-off (RSOs). Mentre emerge come per start-ups innovative sin dalla nascita è presente un effetto positivo del contesto finanziario, per i RSOs tale effetto emerge solo nel momento dell'entrata nel mercato dei prodotti e si rafforza quanto più aumenta l'indipendenza, ossia viene meno il legame, con l'Università di origine. Infine, l'ultimo capitolo approfondisce l'effetto della gender diversity sulle scelte di cash holdings aziendale; le donne tendono a perseguire scelte finanziarie più conservative.

Introduction to the thesis

The present works consists of three chapters, each of which is a publishable paper, and aims to deepen both the role of women in the corporate financial choices and the impact of local financial development on the research spinoffs (RSO hereinafter) accounting-based performance. In the first chapter I investigate the role of women with executive role within RSO on firm's performance. The role of gender differences on firm's activities is a hot topic within the business community, drawing researchers' attention under different points of view (Burgess and Tharenou 2002, Hillman et al. 2002, Erhardt et al. 2003, Van der Walt and Ingley 2003, Lyons et al. 2008, Croson and Gneezy 2009, Terjesen et al. 2009, Bertrand 2011). Although either the role of female manager or the spinoff's performance have been topics extensively discussed in literature, the novelty of the present work is that these two arguments have been put in relationship. Moreover, the uniqueness offered by the first chapter is that, although many papers in literature conduct econometric analysis on research spinoffs, just a few of them use a comparable sample of firms as robustness. I used a sample of more than one thousand Italian RSO and two consistent samples of comparable firms to corroborate my analysis, then I focused on the impact of the presence of women within the board of managers on firm's performance. In the second chapter I focused on the role of local financial development on RSO performance. As Manzocchi et al. (2014) suggest, the characteristics of the local environment in which firms operate is at the core of the potential success of a firm, and specifically, among the variety of features related to the environments the role of the financial system is noteworthy in affecting the competitiveness of a firm. The financial system can be defined as the set of instruments, institutions and mechanisms that ensure the transfer of financial resources from surplus to deficit subjects (financial resources allocation function). Therefore the degree of local financial development is of fundamental importance for the success of firms. Well-developed financial systems have a positive effect on entrepreneurship, growth and, as a result, company's performance. Although Guiso et al. (2004) highlight that local financial development increase entrepreneurship rate, there are still just a few papers investigating how local financial development affect business activities of new firms. For example, Deloof, La Rocca and Vanacker (2016) study the financial decisions of start-ups shaped by local financial development. In this case the novelty of the work consists in the fact that none previous papers focused on these two arguments at the same time. I use for my analysis the same RSO sample of the previous chapter and, considering that RSOs face a long period of incubation (during which further research activity is usually

carried out) within the Universities in which they are born before enter the market and become completely independent, I focused on the role played by the local financial development on RSOs' performance. Moreover I went in depth in this argument finding out that research spinoffs, as long as they survive inside the universities they are born in, cannot be considered just like other firms in terms of sensitivity to the local financial system. This happens because often public contributions created to foster these firms, prevent that a normal relationship of financing can be established between the research spinoff and the financial system. As long as other revenues outnumber the firm sales, spinoffs can be considered still incubated. This is a uniqueness offered by the present work. The third chapter focuses on gender diversity and its managerial implications, analyzing the impact of these differences on financial policies adopted by firms, with particular attention to cash holdings. The mainstream literature about management diversity considers women less risk prone than men toward financial choices. A factor that well explains the difference in preferences, behaviors and decisions of women compared to men is the different interpretation of risky situations, according to which women are more nervous and more afraid of men in view of negative outcomes. While men consider stimulants risky situations, women are skeptical and prefer to avoid, as far as possible, situations of risk; risky decisions are considered as threats to them. Therefore, when it comes to corporate financial decision, women who play executive roles within firms tend to accumulate buffer of cash for precautionary reasons. The aim is to investigate whether and how the presence of women, with an executive role within the firm, may affect corporate cash holding choices, in line with the idea that they tend to safeguard financial flexibility. In this case I found evidence that the presence of women increases the availability of cash within firms. The uniqueness of this chapter consists in the size of the sample used: 12466 firm-year observations that refer to eighteen European countries.

Chapter 1

Do female managers affect spin offs' performance? The case of Italian Research Spin-Offs (RSOs)

Abstract

This paper investigates whether female in management team can shape Research Spin-Offs (RSOs) performance, boosting success in a new science-based business. Despite the growing participation of female in research and commercial science's contexts, and also the growing relevance of female in top management position, there is still a lack of consensus whether the involvement of females in top executive teams improves firm performance. Nevertheless, the relationship has not been still tested in RSOs, directly coming from scientific context. Moreover, the paper intends to measure the effect of female representation in management team on RSOs' performance, in comparison to what results from a sample of innovative technology start-ups as well as a sample of high-tech comparables, having similar features of the RSOs but whose business ideas and competences do not come from academia. The results of the empirical analysis show a positive relation between the presence of top manager females in RSOs and their financial performance, mainly related to the specific research context and to the personal attributes of female working in such environment. The positive role of female is far beyond what resulted in the other two comparable samples.

Key words: Gender diversity, female in management team, research spin-off, university spin-off, firm performance.

1. Introduction

Policy makers, especially in the aftermath of the crisis, place at the top of their agenda policies and reforms to sustain the creation of new firms, by considering the potential benefits that entrepreneurship exerts on the economy as a whole (Klapper and Love, 2010)[1]. In particular, considering the role that innovation plays in boosting the economic growth, much

[1]Jean Claude Juncker (2014), the president of European Commission, stated in the European parliament that *"Jobs, growth and investment will only return to Europe if we create the right regulatory environment and promote a climate of entrepreneurship and job creation.".* Similar views from policy makers with regards to the importance of entrepreneurship are also apparent in the US and the emerging and developing economies.

attention has been placed on the way to foster new technologies transfer and diffusion from the research centers where they are created to the market through business activities. Moreover, knowledge and technologies' exploitation from Universities to firms is since the new millennium a "hot" topic among researchers and experts (Bozeman 2000, Chesbrough 2006, Bozeman et. al 2015).

Although patents and research contracts have traditionally been considered the most frequently used ways to transfer the knowledge created within universities to society, recent studies (O'Shea et al. 2008, Visintin and Pittino 2014) highlight that research-based spin-offs (hereinafter RSOs) are the most successful business alternative for promoting a commercial perspective to university research. A RSO is a new company, incorporated within Universities or research institutions, whose founders are faculty members (assistant, associate and full professors but also lecturers and researchers as well as PhD, graduate and undergraduate students), and whose target is the commercialization of the results of scientific activities. RSOs are a mechanism of exploitation and transfer of scientific knowledge produced in research institutions, and are receiving a growing attention for their positive spillover effects on the overall economy. In fact RSOs are companies incorporated within research institutions as a result of scientific research, with a high innovation rate content. Moreover, through the involvement of young researchers, they also have a positive effect on new jobs creation and economic wealth (Clarysse et al. 2001, Clarysse and Moray 2004).

Despite the high technological profile of most of these university start-ups, many of them have not been very successful in terms of financial performance. Prior research, in fact, has shown that RSOs usually demonstrate lower levels of performance compared to non-academic spin-offs (Ensley and Hmieleski 2005, Mustar et al. 2008). Consequently, in this field of literature, the identification of the element that encourage the development and the success of RSOs is a relevant issue among academic entrepreneurs, as well as experts and policy makers.

Moreover, the literature about RSOs recognizes that top management teams' composition can play an important role in the successful development of RSOs themselves (Heirman and Clarysse 2004, Muller 2006, Mustar et al. 2008, Muller 2009). This is a part of the so called management's talent, that in economics is supposed to be not-observable but very valuables in affecting business activities. Investigating the role of management team's characteristics is a way to indirectly measure the role of management heterogeneity, as assumed to be a main driver of corporate performance. Therefore, the relevance of analyzing the management team's characteristics in science-based context (Lanza and Passarelli, 2014) is even more

relevant considering its effect on spin-off performance. In particular, with regard to heterogeneity in management's talent I focused on the increasing attention on the *gender issue* concerning the role of female executives in firms.

While some women demonstrated to be a great leader in society, either in the past (i.e., Cleopatra or Elisabeth 1) or more recently or even nowadays (i.e., Margharet Thacther and Angela Merkel), it is common belief that these are rare exceptions, while in practice the number of women in leadership positions is still very low, especially in Europe[2]. The world of business is not free from commonplaces concerning women, and the conventional wisdom sees women mostly working as secretaries. Letting aside the common sense, we instead observe female managers earning more and more consideration, getting position of CEO in important companies such Sony, HP, IBM, PepsiCo, General Motors, Yahoo, Oracles and many others. In the highly-competitive and changing environments that firms have to face nowadays, women can provide a relevant and valuable contribution in order to help firms themselves to be successful. The female way of thinking and behaving, can provide different points of view in problem solving, representing for firms a reservoir of strategic options to be used to face the competition. Even the capital market can appreciate firms having female in charge, considering valuable their sense of duty and assuming them to be more socially responsible. Female demonstrated the potential to be successful in mature companies but also in start-ups and spin-offs. For instance, Linda Aversani, the 40 year old founder and CEO of Diamante in Italy who developed diagnostic kits, and Elizabeth Holmes, the 32 year old founder and CEO of Theranos Inc. in Palo Alto (USA) who developed a blood-testing device (although facing many difficulties and negative contingencies), are just two of several examples of successful women in business.

By considering the participation of females in research and commercial science's contexts, Murray and Graham (2007) emphasize that it has been particularly highly stratified by gender. Different studies, in fact, show the evidence of a gender gap in commercial science (Valian 1999, Etzkowitz et al. 2000, Whittington and Smith-Doerr 2005, Thursby and Thursby 2005, Corley and Gaughan 2005, Ding et al. 2006, Burke and Mattis, 2007, Stewart et al. 2007). However, recent studies (i.e. Yu Meng, 2016) suggest that the presence of women have increased steadily during the last decades.

[2] The last available Catalyst report (2014) shows that European women held few academic and business leadership positions. Specifically, in the European Union, women held 15.5% of Vice Chancellor positions, while, only 8.2% of women seats on companies' top management positions.

In terms of research concerning the effect of female participation in top management teams of firms, generally considered, on their performance, the evidences are controversial. Although the main literature testing direct associations, through correlations or linear regression, reveal a positive effect of women on financial performance (Krishnan and Park 2005, Belghiti-Mahut and Lafont 2010, Ren and Wang 2011, Mahadeo et al. 2012, Lückerath-Rovers 2013), there are also studies reporting a negative (e.g. Inmyxai and Takahashi 2012, Pathan and Faff 2013), or non significant relationship (e.g. Dezsö and Ross 2012, Jia and Zhang 2013, Zhang et al. 2013). It therefore follows that there is still not a consensus whether the involvement of females in top executive teams improves or not firm performance.

Instead in technology transfer literature the research of this phenomenon is still poor. Most of the studies focus on the role of female in founders team (Clarysse and Moray, 2004), but very few studies focus on the role of female in the research spin-offs' management, with a significant lack of research devoted to analyze whether the specific composition of RSO management teams in terms of female percentage is a relevant issue for firms' performance. Moreover, understanding the participation of women in commercial science remains an important challenge for those studying the academic-commercial boundaries, including policy makers who try to increase the rates of technology transfer. As a main purpose of the paper, I attempt to investigate whether on average female involved in management team can shape RSOs' performance. Moreover, to appreciate the role of female in RSO I intend to scrutinize my main relationship in comparison with what resulted from two control samples. The first one consists of innovative technology start-ups[3], whose business ideas and competences do not come from academia, while the second one consists of firms comparables in terms of size and sectors found through the "propensity score approach". There is not empirical research directly comparing groups of high-technology university-based start-ups with high-technology independent start-ups, in order to draw definitive conclusions on the impact that female in management team have on the financial performance. To the best of my knowledge, the present work is among very few studies on this topic (Miranda et al., 2017; McGuinness et al., 2017), also considering the context of Italian spin-offs. The present work contributes to the existing literature being one of the few studies on female management in RSOs, and the

[3] Technology startups, new technology ventures (NTVs), or new technology-based firms (NTBFs) are small and usually young companies involved in innovation activities. In contrast to university spin-offs, technology startups develop their own technology. In the majority of these cases, the startup is even founded with the intention of developing technologies. The key characteristics of startups (young age and small in size) may imply that they are not very experienced in the potential market they might enter with their technology (Gans and Stern 2003).New technology-based companies can be founded independently, meaning without any direct link to universities or research institutes

first one in comparing RSO's results with what reported for samples of innovative technology start-ups and comparable firms. The results of the empirical analysis show a positive relation between the presence of top manager female in RSOs and firm performance, mainly related to the specific research context and to the personal attributes of female working in such environment. The paper is organized as follows: the first section focuses on the theoretical framework and hypotheses development. Then the paper focuses on the research methodology and the main econometric results. The conclusions and the implications are reported in the last section.

2. Theoretical Framework and Hypothesis Development

2.1 Research contexts' characteristics and personal attributes of female manager in RSOs

In order to understand my hypotheses, at first I give a description of the characteristics of the research context in which RSOs operate. A branch of the literature argues that a research context typically shows a higher degree of gender parity, which means that women, compared to men, have a more equal access to resources and opportunities in terms of education, employment, and political empowerment (Hausmann et al. 2012).

Such contexts enable what most researchers call "gender inclusion"[4]. The concept of inclusiveness is related to the idea of respect for different cultures and personal conditions and enhancement for all people. The Ferris State University provide the following definition of an inclusive University, that can be broadened to each inclusive context: "*An inclusive University promotes and sustains a sense of belonging; it values and practices respect for the talents, beliefs, backgrounds, and ways of living of its members*". Thus, the gender inclusion can be defined like the attitude of a context to create the conditions for which there are no inequalities between women and men, and research contexts, i.e. universities, better suit this definition. Baltimoria et al. (2008) state that inclusive contexts are characterized by the following elements: work structures and cultural norms that support positive relations

[4] The United States Agency for International Development gives the following definition of Gender : "*Gender refers to identities or roles assigned to men and women through early socialization, and how they affect relationships, rights, responsibilities, resources, and rewards. These roles cut across public and private spheres, as well as ethnic, caste, and class identities. They change over time, and vary by culture and context. Gender equity recognizes that in order to achieve equality a "leveling of the playing field" must be done in order to compensate for gender gaps and the legacy of discrimination. This usually involves a focus on women, because women are almost always in a subordinate position within society*".

between men and women; freedom from stereotyping about women's and men's roles and occupations; work conditions (e.g., job titles, work schedules, policies, and physical environment) that include and value both men and women; opportunities for reward and advancement based on qualifications, performance and talent, not gender; work policies and structures that support work-life integration According to Florida (2004), research contexts typically possess "the three 'T's": talent (a highly talented/educated/skilled population), tolerance (a diverse community, which has a 'live and let live' ethos), and technology (the technological infrastructure necessary to fuel an entrepreneurial culture). Specifically, tolerance or, broadly speaking openness to diversity (in terms of age, race, gender), provides an additional source of economic advantage that works alongside technology and talent.

Research environments call also for a lot of social interactions, since competition is in an increasingly global market place (Kent and Moss, 1994). By considering female managers' attributes in RSOs, it is possible to notice that the human capital is very high, in fact, most of them are doctoral-level female scientists (Fox 2001). Even though research contexts are male-dominated fields, female in such context are considered having equal skills and capabilities. Research contexts are competitive environments; in such contexts, females at top management positions are not randomly chosen. They instead arrive at their positions facing a tough process of selection starting from the academic career. Thus, because of this strong selection, RSOs female managers are not different from males in terms of skills.

Women working in such competitive environments experiment also at least some degree of assimilation in order to have full access to the opportunity of promotion (Saenz and Morales, 2005). Assimilation of female begins at the point of hire and is completed when the female managers become full contributors to the top management team and are no longer considered outsiders in the team. Geiler and Renneboog (2015) put forward the point that even if leadership seem to be more associated with masculine traits, female leadership is often interpreted as not being congruent with females' gender role. This concept is called "romance of leadership". When assimilation is completed, a female executive has become a "male" manager. Therefore, according to assimilation theory, the effect of female executives on firm performance has no difference with that of male executives.

In context with greater gender parity and tolerance, they are more likely to possess the types of human capital appropriate for top management (Wright et al. 1995). The management in these organization may be more likely to share either the knowledge or the experience, and to

value female directors[5]. Stoermer et al. (2016) show that employees who work in inclusive climates are more likely to feel empowered and thus, develop stronger self-confidence and self-efficacy beliefs which can enhance their creativity and participation in decision-making processes. Adams and Funk (2012) show that female directors are more open to change and less conservation-oriented than both their population counterparts and male directors. Then, the nature of female human capital would provide more innovative insights and ideas for running a firm. Women, in fact, are also strong in the areas of idea generation and innovation, and are generally more satisfied with their jobs than men (Rosener 1995). Moreover, the multiple roles that women perform in their personal life provide psychological benefits that enrich interpersonal and leadership abilities (Ruderman et al. 2002) such as their networking capabilities. With a greater degree of gender diversity, it is more likely that these abilities will facilitate the enhancement of managerial capabilities and generate a work atmosphere that ease the communication among people, the proposal of ideas, and the employee participation, to both product and process innovations. In fact, gender diversity in the top management team increases the possibility of connecting with each member of the organization and generates an open work environment (Nielsen and Huse, 2010). Mensi and Klarbach (2014), argue that also the effect of female in top manager teams on the firms' performance depends on context's peculiarities and on top management team features itself.

2.2 Percentage of women in top management of RSO and performance

In studies concerning the direct impact of top managers on firm performance (Hambrick and Mason 1984) the role of female is under scrutinized (Smith et al. 2006). While in the past women have been underutilized in management positions (Katzenbach et al. 1995, Rosener 1995), over the last two decades the percentage of women in all management positions has increased (Oakley 2000, Terjesen et al. 2009). Stoermer et al. (2016) demonstrate that the relationship between diversity, management inclusion, and climate inclusion is stronger in egalitarian context than in masculine and/or high power distance cultures. Hoobler et al. (2016), by testing the direct impact of female representation in organizational leadership (i.e., women as CEOs; top management team, members; and board members) on different measures of financial performance (e.g., return on investment, ROI; sales performance),

[5] Women managers are likely to have superior performance in several areas including conflict resolution, adapting to change, producing high-quality work, developing one's capabilities, and motivating and inspiring others.

suggest that female leaders are more likely to positively affect their organization's performance in inclusive contexts, since these maintain more progressive attitudes toward women. Post and Byron (2015) highlight that female top management representation will be more positively related to firm performance in contexts with greater gender parity. Moreover, Krishnan and Park (2005) suggest that women are more likely than men to be perceived as leaders by group members in environments that call for a lot of social interactions, which is particularly applicable to today's technology market, since it compels people to compete in an increasingly global market place (Kent and Moss 1994).

Apart from the role exerted by the context, according to Hoobler et al. (2016)'s approach, it is similarly relevant the micro level of analysis, concerning the effect of personal attributes on the relation between top management team and firm performance. Rosener (1995) suggests that women are good at seeing the big picture issues and can have a strong impact as top managers on productivity, morale, and profits. Kalleberg and Leicht (1991) found that small firms led by women were more oriented toward quality strategies and are as successful as those led by males. Adams and Funk (2012) and Adams et al. (2011) found evidence that female directors are more stakeholder-oriented than male. Women, in addition, are more likely to possess a "feeling" cognitive style, namely a behavior that emphasizes harmony, compared to their male counterparts. This style is likely to enable women to inspire confidence among peers and subordinates, to share information and power, to bring people together, and to respond to challenges (Hurst et al., 1989).

Also the multiple roles that women play in their personal lives, including marital, parental, or filial, provides them psychological benefits that sharpen their multitasking abilities, and enrich their interpersonal and leadership skills (Ruderman et al. 2002). These skills increase comprehensiveness in decision-making and enhance organizational performance. These attributes are stronger in universities and research centers environments, where females must possess the skills to satisfy different and heterogeneous activities such as teaching, researching and those related to technology transfer. The literature (Evans and Diekman 2009) suggests also that the positive effect of female human capital on performance is amplified when and where females are assigned to career paths that are considered less confirming their stereotypical traits. Smith et al (2006) show that the positive effects of females in top management strongly depend on the qualifications of females. Female managers with high education degree seems to have a notable and positive influence on performance (Smith et al. 2006). Thus, it is possible to argue that, while general firms with large percentages of women in management are able to take better advantage of the total pool of managerial resources, this

effect is even stronger considering Universities and Research Center's competences whose the management of RSOs belongs to (Blackburn et al. 1994, Rosener 1995); in research contexts, in fact, although numerically male-dominated field, the levels of education, inclusiveness and tolerance are very high by allowing female to better exploit their own feature with effects on RSOs' performance. Consequently:

Hypothesis 1a: *The relationship between the percentage of female top management representation and RSO's performance is positive.*

Hypothesis 1b: *A higher percentage of female top management representation has a stronger positive effect on RSO's performance compared to its effect on performance of high-tech no-science-based start-ups.*

2.3 Dominance of women in top management of RSO and performance

Flabbi *et al* (2015) suggest that it is not just the mere presence of women that matters, but gender sizes within a team. The more is the number of women in the top management team, the higher is the "collegial support" and all the attributes and capabilities are amplified. Moreover, since managers must build relationships and secure cooperation of different units in the firm, they prefer to interact with those people who share their background and life experiences; building such alliances reduces the chances of miscommunication. Huffman (2016), in fact, found women's presence in managerial positions to be positively related to gender integration also at non-managerial levels of organizations: "*establishments with higher proportions of female managers [were] markedly less gender segregated*" (2016: 267). In research contexts whose RSOs belong, management may be also more likely to share knowledge, experience and values. Moreover, since women may suffer from a lack of "collegial support" in executing their ideas and their projects (Foss el al., 2013), gender proportion matters.

The more women have moved into decision-making positions in organizations, the more issues related to gender differences in the ability to manage conflicts has become an important concern (Powell, 1988). Conflict management skills are an integral part of leadership effectiveness and "*perceptions of how females handle crisis and conflict often are cited as blocks to the female manager's ascent to the executive suite*" (Shockley-Zalabak, 1981, p. 289). The literature shows that gender differences in conflict management style, if they exist at all, tend to disappear once gender differences on other factors, such age, education, or managerial experience, are controlled (Korabik and Ayman, 1987). Thus, men and women

managers who are similar to one another, especially in spin-offs, are not different in conflict management style. Brewer et al. (2002) examined the relationship among biological sex, gender role, organizational status, and conflict management behavior of males and females in three similar organizations; they showed that masculine individuals were highest on the dominating conflict style. In the competitive context of spin-off, the assimilation of female to male is full in top management team and female managers seem to be more associated with masculine traits; so, even if the number of female is dominant, none conflict effect can be registered. Moreover, some recent studies (Stroebe et al, 2016) show that women in powerful roles, may possess qualities that make them particularly suitable for dealing with conflict, such as unique leadership qualities: women may be more oriented towards maintaining relationships and avoiding escalation of conflict (Eagly & Karau, 1991).

Moreover, in context where there is not disparity between man and women and the gender inclusion is high, women in top management positions are more likely to exploit their own human capital (Wright, Baxter and Birkelund, 1995).

According to all these considerations, it is possible to assume that the effect of the dominance of female in top management, on performance is amplified then in other non-research based startups. Thus I can formulate the two hypotheses as follows:

> ***Hypothesis 2a:*** *The relationship between the dominance of female top management representation and RSO's performance is positive.*

> ***Hypothesis 2b:*** *A higher level of dominance of female top management representation has a stronger positive effect on RSO's performance compared to its effect on performance of high-tech no-science-based start-ups*

2.4 Women in top management of RSO and performance of young research spin-off

According to Clarysse and Moray (2004) RSOs have development paths similar to the ones suggested by Galbraith (1982) for new high-tech firms[6]. Vohora et al. (2004) identify the following phases of development: research phase, opportunity framing phase, pre-organization, re-orientation, sustainable returns. Van Geenhuizen and Soetanto (2009) highlight that RSOs in the first stages of their life cycle (young RSOs) have to deal with specific critical juncture. They also observe, by studying the RSOs of the Delft University of

[6] Galbraith (1982) suggests that new high-technology ventures passes through five identifiable development stages: proof of principle prototype, model shop, startup volume production, natural growth, and strategic maneuvering.

Technology, that the rate of survival of RSOs in their dataset after six years of existence was 90%. Also Mustar et al. (2008) found that the average rate of survival for EU RSOs within the same timeframe of six years was 75%. Young spin-offs are characterized by complexity and dynamism. In particular, complexity is conceptualized as the heterogeneity and the range of an organization's activities (Child, 1972), while dynamism is defined as the relative instability in an environment arising from the interconnectedness among its various elements (Aldrich, 1979). Young RSOs deal with complex environments and they are also riskier than other business ventures since they include technological and market uncertainty (Veryzer, 1998).

Hambrick et al. (1996) found that in turbulent industries, management heterogeneity (measured as heterogeneity in functional backgrounds, education, and tenure) has a positive impact on organizational performance. Different studies (Eagly and Johnson, 1990; Brett and Stroh, 1999; Weber and Zulehner 2010) suggest also that start-ups with female first hires display a higher likelihood of survival. Women are generally considered cut out for alleviating stress among subordinates and improving their productivity.

Women are also more likely to adopt a "learning" approach with their networking strategies: they are more likely to seek ties not only with others people inside the organization but they are also likely to seek extra-organizational relationships with other women so that they are better equipped to overcome gender-related obstacles by learning from other people's experiences (Gersick et al., 2000 and Ibarra, 1997). Learning from others gives women the opportunity to act in a more comprehensive way, a process that utilizes an extensive decision process when dealing with immediate opportunities and threats, and thereby generates higher-quality decisions (Miller et al., 1998). Women managers coming from research contexts have attributes that are even more critical in dealing with unstable environments. Moreover, in the first stage of spin-offs' life cycle, also networking capabilities are vital, because, spin-off deal with technology uncertainty (that needs continuous improvement), uncertainty of market exploration and financial funds.

Extending the findings of previous research to *gender* diversity, it is possible to argue that in complex environments, as the ones that characterize RSOs in their first stage of life, greater representation of women in management is advantageous for firm's organization. Because of the tough selection process of female already discussed in previous sections, in fact, the tenacity, the interpersonal abilities and the pragmatism of such female managers coming from a research context, is even more helpful to deal with turbulence, riskiness and uncertainty.

Consequently:

Hypothesis 3a: *The relationship between the percentage of female top management representation and the young RSO's performance is stronger positive compared to the performance of mature RSOs*

Hypothesis 3b: *A higher percentage of female top management representation has a stronger positive effect on young RSO's performance compared to its effect on performance of young high-tech no-science-based start-ups.*

3. Research Methodology

3.1 Sample and data collection

To create my dataset I collected at first all Italian RSO names and VAT numbers from the website www.netval.it, which is a non-profit association whose partners are public and private Italian universities and research institutes. Netval main target is the promotion and enhancement of academic research; for this purpose, it provides a wide variety of services, supporting the exploitation of research results through the organization of specific courses (e.g. summer schools) and networking with institutions, the world of business and finance. Netval website states that in Italy there are about one thousand two hundred active RSOs. Unfortunately, in trying to confirm the validity of this database I did not found an exact match with such figure. In fact, at first I conducted a search on Bureau Van Dijk (Bvd) by using the Vat numbers. Bvd is a database that provides financial information (i.e. financial statements, ratios, activities, and information on managers and ownership structure) about both types of listed and unlisted companies in Europe. Since the total number of active firms found was far below the one indicated by Netval, I went on depth on this search by using the company names. As a result, I found that, in several cases, the firms indicated in Netval were not indeed RSOs. To sort out this problem I contacted, either by email or telephone, each Italian University (public and private) and public research institute listed in the Ministry of Education website to obtain a list of RSOs from each of them (when not available directly on their websites). This part of the study covered the period from October 2015 to February 2016 (because of the slowness with which many universities replied to my email, unless I urged them to answer periodically) . Finally, I obtained an exhaustive and trustworthy sample of one thousand seventy-four active RSOs, either from universities or public research institutes, updated at February 2016. Such difference in number is due, in my opinion, mainly to three reasons. First of all, many universities rent out their spaces to high-tech new firms that, however, are not RSOs. Often there are no researchers or professors inside the ownership or

management structure of these entities. In such cases there could be a misunderstanding in the communication of the list that each university provides to Netval[7]. Moreover, a RSO, from its incorporation onwards, can change its legal form because of the merger regulation or simply because of the unanimous agreement of its shareholders. As a consequence, either the name or the VAT number can change. Often database like Netval are not updated periodically, so they take a while to show the correct figures. The third reason is to attribute to the recent incorporation of many of such firms: the legal expiring date to send both the income statement and the balance sheet to the taxation office is around the month of June, which is why many firms whose constitution is to refer to the previous year are not included in the database until they send all the legal documents regarding their activity. For comparison, in my analysis I created two control samples. The first sample is called in this study "innovative-startups" and includes firms that benefit of tax advantages laid down by Italian law for those small firms that operate in high tech industries. Italian government aimed to develop those firms whose business objective is the developing and the production of innovative high-tech products or services. To benefit from this advantages companies have to meet many requirements: being new or have been operational for less than 5 years; having their headquarters in Italy or in another EU country, but with at least a production site branch in Italy; having a yearly turnover lower than 5 million Euros; do not distribute profits; producing, developing and commercializing innovative goods or services of high technological value; not being the result of a merger, split-up or selling-off of a company or branch; being of innovative character, which can be identified by at least one of the following criteria: 1. at least 15% of the company's expenses can be attributed to R&D activities; 2. at least 1/3 of the total workforce are PhD students, holders of a PhD or researchers; alternatively, 2/3 of the total workforce must hold a Master's degree; 3. the enterprise is the holder, depositary or licensee of a registered patent (industrial property) or the owner of a program for original registered computers. Meeting such strict criteria is beneficial for firms in many ways; for instance, innovative startups have many fiscal advantages and the possibility to collect capital through authorized equity crowd funding portals. All the criteria required, ensure that the companies listed as "innovative startups" are similar to research RSOs, in terms of size, social objective and level of education of the workforce, which is why I chose this kind of sample to corroborate my analysis. I excluded from this sample the RSOs listed as "innovative startups" and, according to the VAT numbers that I found in a special

[7] For instance, the spinoff called "Datamind S.r.l." is listed in Netval, but actually this firm simply rented an office inside the research institute called "Area science park"

section of the Ministry of economic development website, I obtained 2851 firms on BvD database. The second sample, hereinafter referred as "comparables", was drown by taking the Nace code (the four-digit code that indicates the statistical classification of economic activities in the European Community) from every RSO. Since every single code describes precisely the sector in which a company works, it seems reasonable to create a control sample by starting from it. I searched and downloaded (in Bvd) from every RSO all the firms with the same Nace code operating in the same county (which is, according to Guiso and Zingales 2004, the most appropriate dimensional geographic entity to develop analyses on small enterprises) of the RSO itself. I then used the propensity score method (Rosenbaum and Rubin 1983) to create the control sample. The confounders used were 1) the age of the firms in years, 2) the average of the intangible assets divided by the total assets for all the years available, 3) the average of total assets for the years available, 4) a dummy variable equals to 1 if in the last year available the firms took out debt, equals to 0 otherwise, 5) the EBITDA divided by total assets of the last year available. I then used the nearest neighbor matching method (Friedman *et al* 1977) to select a single comparable for every RSO, taken among those comparables operating in the same country. At the end of this procedure I obtained a control sample of 711 companies. The number of firms in this sample is far below the number of RSOs: this is because often the same "comparable" refers to many RSOs since, in several cases, inside the same research institute or university, different RSOs have the same Nace code and the same characteristics in terms of size, debt situation and profitability.

3.2 Model and definition of variables

The empirical model used considers RSOs' performance as a function of a set of gender diversity variables, jointly with some controls, as it follows:

$$\text{RSOs' performance} = f(\text{female variables, control variables})$$

The dependent variable to be analyzed is the accounting based profitability of RSOs, measured, as common in literature, as the ratio between the Ebitda (Earnings Before Interest, Taxes, Depreciation and Amortization) and the total assets of the firm. From Bureau Van Dijk database I downloaded for all firms a panel dataset from 2006 to 2014, containing financial, ownership and management variables.

In particular, as for financial variables, I took in to account the following: *intangible assets, total assets, earnings before interest tax depreciations and amortizations to the book value* (EBITDA).

The management variables considered were: *the total number of managers from all levels of management (upper-level, middle-level and lowest-level as per traditional pyramid form of organizational structure)*[8] *, their age and gender, their date of appointment and their eventual participation in the shareholder base*.

Finally, I considered ownership variables, in particular: *the number of shareholders, their gender, the number of shares owned*. Moreover, I went in depth on the composition of the shareholding, underlying the possible presence of venture capitalists. All of the continuous variables are winsorized at the 1st and 99th percentiles to limit the influence of outliers and data typing errors. Starting from these data I created a new set of variables more suitable to my analysis, mainly based on the continuous variable related to the percentage of female acting as manager into the firm, namely *the number of women with an executive roles divided by the total number of managers*. Tables 1 gives a description of all the variables used in the present work.

Table 1 – Variables' descriptions.

Variables	***Descriptions***
Dependent variables	
Profitability	Ratio between Ebitda (earnings before interests tax depreciation and amortizations) and the value of total assets
Main explanatory variables	
% female manager	Variable that specifies the ratio between the number of female managers in the company and the total number of managers
Female x RSO	% of female manager for RSOs only
Female x Start-ups	% of female manager for Innovative Start-ups only
Female x Comparables	% of female manager for Comparables only
Dummy RSOs	Dummy that identifies the RSOs

[8] At lowest level of management, first-line managers may be called supervisors or shift managers, who manage the work of non-managerial employees like district managers, department managers, or office managers. Middle-level managers manage the work of first-line managers and can be found between lowest and top levels of organizations, such as regional managers, project leaders, store managers or division managers. At upper-level of organizations are top-managers, who are responsible for making organization-wide decisions and establish plans and goals that affect the entire organization. These managers typically have the titles like vice president, president, managing directors, chief operating officer or chief executive officers. (For more information- see in Stephen P. Robbins and Mary Coulter, Management Book 11th Edition).

Dummy Comparables	Dummy that identifies the comparables
Dummy Startups	Dummy that identifies the innovative start-ups
Dummy dominant female manager	Dummy equal to 1 if the % of female manager is greater than 0.5, 0 otherwise
Dummy dominant female manager in firms with female owners	Dummy equal to 1 if the variable "Dummy dominant female manager" is equal to 1 and there is at least one female owner in the board, 0 otherwise
Dummy female	Dummy equal to 1 if there is at least a woman in the board of managers, 0 otherwise
Dummy all females in management	Dummy equal to 1 if the variable "% female manager" is equal to 1, and so all the managers in the firms are female
Dummy Female × Age of Female	Interaction between Dummy female and average age of female managers
Control variables	
Management tenure	Ratio between the average permanence in the firm of all managers (each permanence is calculated in days from the appointment date) and the life (in days) of the firm itself
Growth Opportunities	Value of the intangibles divided by total assets
Size	Natural log of total assets
Dummy Financial Debt	Dummy equal to 1 if the firm has debt of any kind (short/long), 0 otherwise
Dummy Venture Capital	Dummy equal to 1 if in the board there is at least one venture capitalist, 0 otherwise
Ownership	Natural log of the total number of shareholders
Dummy North	Dummy equal to 1 if the firm is located in the northern Italy, 0 otherwise
Instrumental variables	
Average female manager RSO (industry mean)	Average value of the percentage of women inside the board of manager for RSOs at industry level
Average female manager Startups (industry mean)	Average value of the percentage of women inside the board of manager for Innovative start-ups at industry level
Average female manager Comparables (industry mean)	Average value of the percentage of women inside the board of manager for Comparables at industry level
Instrumental variables used for robustness tests	
Separation	Marital separation rate calculated every year for each county
GPI	Quotient of the number of females by the number of males enrolled in a given stage of education (primary, secondary, etc.) calculate every year.
Dummy Foreign Ceo	Dummy equal to 1 if in the board of managers there is at least one foreign manager, 0 otherwise
Voting	Percentage of people, in each county, who cast their votes either in politic or administrative elections
Extortion	Number of extortions reported for each county

3.3 Models

At this stage of analysis I faced the problem of endogeneity. There are mainly two causes of endogeneity: there could be some unobservable factors that influences both independent and dependent variables of the model, and a simultaneous causality relationship between

the independent and dependent variables of the model. For instance, the percentage of women with an executive role within the firm can influence the performance and, at the same time, can be influenced by the performance itself. To overcome this problem, I used a Two Stage Least Squares model. Moreover, I performed a VIF test to exclude multicollinearity among variables. The variables to be instrumented are the ones concerning the female representation in the board of managers, namely: *% female manager, Dummy dominant female manage, Dummy dominant female manager in firms with female owners, Dummy female, Dummy all females in management, Dummy Female × Age of Female*, since they can either influence the firm performance (as I expect) or being influenced by it. For instance: there could be a reverse causality since the presence of women, positively influencing the so called "management diversity", boosts the performance of firm and, at the same time, high performance of firm can influence the hiring of employees (among whom some women). I use three instrumental variables to deal with the problem of endogeneity. However, it is very difficult to find fully excludable instrumental variables. The implementation of instruments requires valid and strong instruments that fulfill the following two conditions: 1) instrument should be correlated with the endogenous variable; 2) instrument should be unrelated with the error term. To instrument the variables concerning the female managers, I considered as instruments *the average values of the percentage of women with an executive role within the firm* for all the three samples at industry level and a proxy of social capital, namely *the voting rate at county level.* As robustness I performed the two stage least square model using other instrumental variables. The instrumental variables considered are the following. I used a dummy variable that I called "*Dummy Foreign CEO*", equals to one if a foreign manager works in the RSO, zero otherwise; a variable called "*GPI*" (acronym of gender parity index), created and updated yearly by the World Bank that expresses the relative access to education of males and females in each country; a variable called "*Extortions*" that expresses the number of extortions for each county and for each year of my analysis; a variable called "*voting*" that expresses the number of people for each county who casted their vote in every election held, divided by the total number of people living in that county; a variable called "*Separation*" that expresses the number of marital separations for each county. To test my first hypothesis I conducted two different regression models. The first is an ordinary least square model (OLS) whose *dependent variable* is the *profitability* of the firms measured as *the ratio between the Ebitda and total assets* and whose *independent* variable are: *%female manager; Management tenure; Growth Opp.; Size; Dummy Financial Debt; Dummy Venture Capital; Ownership (log); Dummy North*, defined in table 1. The second regression is a two stage least square (2SLS)

with the same variables of the first, in which the variable of interest, namely *%female manager*, is instrumented as explained above. As a robustness test I also performed a 2SLS in which the dependent variable is lagged by three years and the phenomenon of interest, namely *the presence of women within the board of managers*, is considered from different point of views. At first I consider as main variable of interest the usual *percentage of women in the board*. Then I use a dummy variable called "*dummy_female*" which is equal to 1 if there is at least a woman in the board, 0 otherwise. Finally, I use the interaction between the previous variable and the average age of women with an executive role inside the firm. All the previous variables are instrumented as in the first regression. The second hypothesis is tested through a 2SLS model. In this case, leaving untouched the dependent variable, I consider the following independent variable to investigate the impact of female representation in top management on the firm's performance: *Dummy dominant female manager, Dummy all females in management, Dummy female manager&shareholder*, defined in table 1. These three variables are instrumented as in the previous models. The third hypothesis, namely the impact of female representation within the board of manager on young RSO performance, is tested by using the same 2SLS as described for the first hypothesis. According to Mustar et al. (2008) it is used a timeframe of six years to discriminate young and mature RSOs. Specifically, RSOs are considered young if they have less of six years old. Moreover, I excluded the sample of innovative startup because it includes only young firms by definition.

Main Model:

First stage:

$$\%Female\_manager = \alpha_0 + \alpha_1 \text{Average}\%Female\_manager + \alpha_2 \text{Voting\_rate}$$

And

Second stage:

$$Profitability = \beta_0 + \beta_1 Instrumented\%Female\_manager + \beta_h Control\ variables + \varepsilon$$

Robustness model:

First stage:

$$\%Female\_manager = \alpha_0 + \alpha_1 \text{Dummy foreign CEO} + \alpha_2 \text{ separations in marriage} + \alpha_3 \text{ voting rate} + \alpha_4 \text{ extortions rate} + \alpha_5 \text{ Gender parity index}$$

Second stage:

$$Profitability = \beta_0 + \beta_1 Instrumented\%Female\_manager + \beta_h Control\ variables + \varepsilon$$

The main model is also compared with an ordinary least square model. Moreover, as a further robust analysis, the second model (previously called "robustness model") has been performed also with the dependent variable lagged by three years.

3.4 Instrumental variables: justifications

Fisman and Svensson (2007) use industry averages of bribe and tax as instrumental variable for corruption measures. Accordingly, I employ the average of the female percentage representation in the board of manager at industry level for all the three samples. I assume that the probability of a firm to hire female managers is likely to be influenced by industry-level. The reasons of using the separation rate as an instrument can be found in several studies. Levinger (1966) studied the causes of divorce for 600 couples facing marital problems. He compared marital complaints of husbands versus wives finding that one of the root causes of divorce for women is the occurrence of financial problems in the household. Also Kitson (1992) found that the economic nonsupport of husbands toward wives is an underlying cause of divorce. Voydanoff, (1991) indicates that education and income facilitate marital success. Also White (1991) demonstrated that household socio economic status is inversely related with the risk of divorce. Moreover, according to Kitson (1992), people facing a low socioeconomic status are "*more likely to complain about physical abuse, going out with the boys/girls, neglect of household duties, gambling, criminal activities, financial problems, and employment problems.*." OL Fawole (2008) observed that "*most studies on gender-based violence (GBV) have focused on its physical, sexual, and psychological manifestations.. Economic violence experienced included limited access to funds and credit; controlling access to health care, employment, education, including agricultural resources; excluding from financial decision making; and discriminatory traditional laws on inheritance, property rights, and use of communal land... At home, some were barred from working by partners; while other men totally abandoned family maintenance to the women…*". Moreover, previous studies demonstrate that marriages in which the wife works face I higher risk of divorce (Cherlin, 1979; Spitze and South, 1985; South and Spitze, 1986; Greenstein, 1990; Tzeng and Mare, 1995). Bowles and Seitz (2006) found clear evidence that women respond to abuse via employment and divorce. They state that "*The policy experiments illustrate an important link between employment and domestic violence: Women can use employment as a means to prevent a first incident of abuse in marriage. However, once the marriage has become abusive, the only means for preventing future abuse is for women to divorce their spouses*." All this considered, it seems reasonable to believe that abused women facing a low

socio economic status at home are more likely to leave their partners when they find a financial stability. In other words, wives living in a low income household tolerate their husband's violence until they found a job and leave their partners. This is why I felt that it was important to include the marital separation rate among the instrumental variables to remove possible endogeneity bias from my model. Also the GPI index is strongly correlated with the instrumented variable. This index is updated every year, and it is calculated as the quotient of the number of females by the number of males enrolled in a given stage of education (primary, secondary, etc.). Since is more likely for a high educated woman to find a job, it seems reasonable including such index in my instrumental variables set. The top management team diversity (TMT) is the main reason to justify the instrument "Dummy Foreign Ceo". TMT increases when managers inside the firms have different backgrounds. The presence of a foreign manager inside an RSO demonstrates that that particular company is, so to speak, "open-minded", namely it is show a high degree of TMT and it is not prejudiced toward women and indeed it is available to hire them. The variable "voting" is strongly correlated with the concept of Social Capital. Woolcock and Narayan (2000) define the social capital as "the *norms and networks that enable people to act collectively—enjoyed a remarkable rise to prominence across all the social science disciplines*". For Putnam (1993) the Social Capital is the set of rules that regulate the coexistence and the civic associations networks, improving the efficiency of social organization through the promotion of initiatives taken by mutual agreement (Putnam 1993). The social capital affects the behavior of people leading to an absence of opportunism. In fact, people living in a context with high social capital degree, tend to trust in each other and in institutions. Social capital can be seen as a resource that establishes its existence in social relationships. Degli Antoni (2010), measures the impact of social capital by developing a set of indicators able to grasp the extent of reliability that characterize different communities. Mayoux (2001) analyzing the impact of micro-finance states "*...micro-finance programs which build social capital can indeed make a significant contribution to women's empowerment*". Putnam (1995) mentioned, among others, the decreased level of political participation of U.S. citizens to measure the declining of social capital. I accordingly used the variable "voting" seized as the percentage of people, in each county, who casted their votes either in politic or administrative elections. This because a higher extent of participation to political life of citizens, is a symptom of a high degree of social capital. High degrees of social capital smooth inequalities between men and women and create better opportunity to find a job. Labor market can be also influenced by the rate of criminality. Economic reasons are often sources of criminal behavior. Criminal behavior,

according to economic theory, would obey to the rule of rationality. The offender, would be sensitive either to the benefits or to the estimated costs of its behavior. A link between economy and crime concerns the relationship between crime and markets (Quinney, 1964). Economy and criminology help us to understand the relationships between economic cycle and crime, as well as provide elements to understand how crime distorts markets, making flow in them a great quantity of money. When this wealth is invested in legal economy (after being recycled), it alters the conditions of the market of products, labor, capital (Savona 2012). To better understand the concept of economic crime I analyze the traditional distinction between different kinds of crimes. Murder is violence while robbery is a property crime (Savona, 2011). Ming-Jen Lin (2007) found evidence of the positive relationship between unemployment rate and property crime rate. Daniele (2009) examined the regional distribution and the social costs of some crimes (in particular extortion). He states that "*In Italy too is possible to see the existence of a correlation between unemployment levels and some crimes. If one considers data on a provincial level* (county level), *for example, then unemployment is positively and highly correlated to extortions, homicides and attacks, while it is negatively correlated with thefts*". I accordingly use the number of extortions per county as instrument for the percentage of executive women working in RSO.

4. Descriptive statistics

Table 2 shows the main descriptive statistics. It shows that the variable *%female manager* is significantly correlated with profitability. with regard to control variables, the dependent variable *profitability* is significantly and positively correlated to *size, ownership* and *dummy north*, while it is significantly and positively correlated to *management tenure* and *growth opportunities*. Table 3 reports the correlation matrix. In general, there are no problem of multicollinearity that can bias the empirical results.

Table 2 – Descriptive statistics.

	Academic Spin-off			**Comparables**			**Innovative Start-ups**		
	Mean	Median	SD	Mean	Median	SD	Mean	Median	SD
Profitability	0.007	0.047	0.414	0.021	0.049	0.356	-0.096	0	0.485
% female manager	0.164	0	0.336	0.045	0	0.177	0.085	0	0.255
Female manager's age (years)	9.445	0	18.266	3.595	0	13.477	4.765	0	13.443

Dummy dominant female manager	0.181	0	0.385	0.049	0	0.215	0.104	0	0.306
Dummy all females in management	0.117	0	0.322	0.024	0	0.154	0.06	0	0.238
Dummy female manager&shareholder	0.102	0	0.302	0.045	0	0.207	0.03	0	0.171
Management tenure	0.509	0.4	0.351	0.497	0.497	0.413	0.69	0.898	0.353
Growth Opp.	0.147	0.043	0.21	0.114	0.012	0.186	0.293	0.205	0.267
Size	531.353	178.965	1.156.033	1.141.330	247.550	2.565.573	289.110	82.825	698.518
Dummy Financial Debt	0.426	0	0.495	0.583	1.000	0.494	0.377	0	0.485
Dummy Venture Capital	0.06	0	0.238	0.036	0	0.188	0.171	0	0.377
Ownership	7.908	7.000	6.081	6.866	4.000	10.988	4.683	4.000	4.691
Dummy North	0.626	1.000	0.484	0.769	1.000	0.422	0.685	1.000	0.465

Notes: Number of Academic Spin-off = 1074. Number of Comparables = 711. Number of Innovative Start-ups = 2851. Industry dummies are not reported. Industry dummies are not reported. In the descriptive statistics the variable Size refers to total asset in Euros (in the regression it is used the log) and the variable Ownership concerns the number of shareholders (in the regression it is used the log).

Table 3 – Correlations.

	Academic spinoff sample	1	2	3	4	5	6	7	8	9	10	11	12	13
1	Profitability	1.000												
2	% female manager	0.077	1.000											
3	Female manager's age (years)	0.074	0.911	1.000										
4	Dummy dominant female manager	0.082	0.940	0.891	1.000									
5	Dummy all females in management	0.060	0.908	0.697	0.777	1.000								
6	Dummy female manager&shareholder	0.059	0.586	0.628	0.544	0.444	1.000							
7	Management tenure	-0.135	0.019	0.009	0.025	0.008	0.063	1.000						
8	Growth Opp.	-0.129	0.036	0.078	0.013	0.018	0.039	0.123	1.000					
9	Size	0.056	-0.111	-0.078	-0.093	-0.107	-0.118	-0.250	0.061	1.000				
10	Dummy Financial Debt	-0.021	0.067	0.102	0.071	0.041	0.027	-0.074	-0.016	0.373	1.000			
11	Dummy Venture Capital	0.074	-0.052	-0.053	-0.056	-0.017	-0.035	-0.189	-0.085	0.117	0.130	1.000		
12	Ownership	0.053	-0.081	-0.096	-0.092	-0.035	-0.082	-0.153	-0.066	0.159	0.007	0.442	1.000	
13	Dummy North	0.073	-0.056	0.004	-0.015	-0.113	-0.053	-0.046	-0.019	0.156	0.120	-0.091	-0.120	1.000

	Comparables sample	1	2	3	4	5	6
1	Profitability	1.00					
2	% female manager	0.02	1.00				
3	Female manager's age (years)	0.03	0.84	1.00			
4	Dummy dominant female manager	0.04	0.90	0.86	1.00		
5	Dummy all females in management	0.01	0.85	0.46	0.69	1.00	
6	Dummy female manager&shareholder	0.03	0.65	0.77	0.59	0.34	1.00

Industry dummies are not reported. Correlations greater than 0.03 or lower than -0.03 are statistically significant at the 0.05 level or lower.

	Innovat. Start-ups sample	1	2	3	4	5	6
1	Profitability	1.00					
2	% female manager	0.03	1.00				
3	Female manager's age (years)	0.03	0.90	1.00			
4	Dummy dominant female manager	0.05	0.94	0.91	1.00		
5	Dummy all females in management	0.00	0.91	0.68	0.74	1.00	
6	Dummy female manager&shareholder	-0.03	0.52	0.45	0.51	0.46	1.00

Industry dummies are not reported. Correlations greater than 0.03 or lower than -0.03 are statistically significant at the 0.05 level or lower.

5. Empirical Results

Tables below show the main results of the econometric analysis. In particular, Table 4 shows the results with regard to hypothesis H1a concerning the effect of female on RSO performance. Table 4, columns (1) and (2) using OLS and 2SLS alternatively, confirmed hypothesis H1a. The results, show a positive relation between the percentage of female representation in top management teams and accounting-based firm performance in RSOs. By contrast, for innovative startup and comparables the investigated relationship is not statistically significant. This result is supposed to be in line with hypothesis H1b, suggesting that the effect of women in management positions on firm performance exists in RSO, while it has no statistical relevance in similar samples of high-tech comparables that do not come from research context. The three samples, indeed, include technology oriented firms, but only the RSO sample has a strong tie with the academic world. This give to women the freedom to fully express their professionalism, given the egalitarianism and assimilation that the academic context provides. Women with an executive role within a RSO, more than in other firms, feel free to work shoulder to shoulder with their male colleagues without any inferiority complex because of the common academic background. Moreover, in this research context, female-specific attributes are showed to be a valuable resource in supporting the business and firm performance.

Table 4 - Results concerning percentage of female representation in top management and firms' performance in research spin-off, innovative start-ups and comparables.

	(1) performance OLS	(2) performance IV model
%Female x RSO	0.146***	0.273***
	(0.000)	(0.000)
%Female x Startups	0.115	-0.00645
	(0.203)	(0.963)
%Female x Comparables	0.0461	0.696
	(0.653)	(0.246)
Dummy RSOs	-0.0315	-0.0631
	(0.628)	(0.199)
Dummy Comparables	-0.0222	-0.0647
	(0.768)	(0.303)
Dummy Startups	-0.0641	-0.0653
	(0.389)	(0.167)
Management tenure	-0.110***	-0.105***
	(0.009)	(0.000)
Growth Opportunities	-0.215***	-0.216***
	(0.000)	(0.000)
Size	0.0224**	0.0242***
	(0.049)	(0.000)
Dummy Financial Debt	-0.0740**	-0.0821***

	(0.017)	(0.000)
Dummy Venture Capital	0.0482	0.0559
	(0.179)	(0.143)
Ownership (log)	-0.00374	-0.00556
	(0.850)	(0.710)
Dummy North	0.0621*	0.0634***
	(0.080)	(0.002)
Observations	2101	2101
Adjusted R^2	0.054	0.038
Underidentification test (Anderson canon. corr. LM statistic)		131.624
		(0.0000)
Weak identification test (Cragg-Donald Wald F statistic)		34.403
Sargan statistic		1.024
		(0.3117)
Endogeneity test		3.403
		(0.0651)

p-values in parentheses. Industry and Year fixed effect are included as controls. In columns (1) it is used an OLS model. In column (2) it is used the IV technique using the following IV: = Average value of the percentage of women inside the board of manager for RSOs Innovative start-ups Comparables at industry level, voting rate at county level* p < 0.10, ** p < 0.05, *** p < 0.01. The intercept has been omitted to allow full interaction term

As a further test to provide some robustness of previous results, I have run the previous regression model using the value of the profitability variables after three years. This is a way to test whether the female effect on performance is still ongoing. As showed in Table 5 the effect of female participation in management teams is still statistically significant, meaning that the effect of women in management is long lasting. In addition, appendix 1 confirmed results of Table 4 by an investigation of the role of female on performance. Also in this case it is only statistically significant the effect with regards to RSO sample and not considering the other two samples of high-tech firms.

Table 5 - Robustness: Percentage of female representation in top management and firms' performance after three years in research spin-off, innovative start-ups and comparables.

	(1) Profitability after 3 years	(2) Profitability after 3 years	(3) Profitability after 3 years
%Female x RSO	0.187*		
	(0.073)		
%Female x Startup	0.0816		
	(0.972)		
%Female x Comparables	0.243		
	(0.818)		
Dummy female RSO		0.157*	
		(0.072)	
Dummy female Start-ups		0.0190	
		(0.987)	
Dummy female Comparables		0.134	
		(0.860)	

Dummy female RSO x Age female RSO			0.003*
			(0.073)
Dummy female RSO x Age female Startups			0.002
			(0.942)
Dummy female RSO x Age female Comparables			0.003
			(0.858)
Dummies "Samples"	Yes	Yes	Yes
Control Variables	Yes	Yes	Yes
Observations	846	846	846
Adjusted R^2	0.081	0.085	0.083
Underidentification test (Anderson canon. corr. LM statistic)	34.253 (0.0000)	34.607 (0.0000)	37.299 (0.0000)
Weak identification test (Cragg-Donald Wald F statistic)	8.545	8.637	9.340
Sargan statistic	0.009 (0.9240)	0.014 (0.9057)	0.011 (0.9154)
Endogeneity test	0.235 (0.6280)	0.150 (0.6989)	0.128 (0.7205)

p-values in parentheses Industry and Year fixed effect are included as controls. In all the columns it is used the IV technique. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ The intercept has been omitted to allow full interaction terms

Going through the second hypothesis I tested whether the dominant presence of females inside the management, has a positive effect on performance in comparison to the other two samples.

The dominance of female in top management has a positive effect on firm performance and this impact is stronger in research spin-off (RSO). For startup and comparables the results are not statistically significant. In fact, the more is the number of women in the top management team, the higher is the "collegial support" and all the attributes and capabilities are amplified. In this case I can say that the dominance is significant at rising degrees. At a low level of dominance, I find a board of managers in which women outnumber men. At a medium level, the board is made up of women only. The highest level of dominance refers to the situation in which women outnumber men in the board of managers and at least one of them is at the same time a manager and a shareholder.

Tables 6 and 6a show rising coefficients as the degree of female dominance increases within RSOs. The coefficients concerning the control samples are not significant, therefore the hypothesis H2b is also proved.

Table 6 - Results concerning dominant female representation in top management and firms' performance in research spin-off, innovative start-ups and comparables.

	(1) Performance IV model	(2) Performance IV model	(3) Performance IV model
Dummy dominant female manager RSO	0.225***		
	(0.000)		
Dummy dominant female manager Start-ups	0.010		
	(0.939)		
Dummy dominant female manager Comparables	0.509		
	(0.295)		
Dummy all females in management RSO		0.346***	
		(0.000)	
Dummy all females in management innovative start-ups		-0.018	
		(0.900)	
Dummy all females in management comparables		1.236	
		(0.222)	
Dummy female manager&shareholder x RSO			0.362***
			(0.000)
Dummy female manager&shareholder x Start-ups			0.053
			(0.816)
Dummy female manager&shareholder x Comparables			0.702
			(0.235)
Dummies "Samples"	Yes	Yes	Yes
Control variables	Yes	Yes	Yes
Observations	2101	2101	2101
R^2	0.060	0.026	0.043
Adjusted R^2	0.042	0.007	0.024
Underidentification test (Anderson canon. corr. LM statistic)	76.171	51.227	45.575
	(0.0000)	(0.0000)	(0.0000)
Weak identification test (Cragg-Donald Wald F statistic)	19.485	12.908	11.414
Sargan statistic	0.555	0.208	2.335
	(0.4562)	(0.6483)	(0.1265)
Endogeneity test	3.746	7.137	7.287
	(0.0529)	(0.0076)	(0.0069)

p-values in parentheses Industry and Year fixed effect are included as controls. In all the columns it is used the IV technique. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ The intercept has been omitted to allow full interaction terms

Table 7 shows the evidences with regard to hypothesis 3 concerning the potentially different role of female on performance along the life cycle of the firm.

Table 7 - Female representation in top management and performance in young (<6 years) vs. mature (>=6 years) firms, with regards to research spin-off and comparables.

	(1) Performance IV model young firms	(2) Performance IV model mature firms
Female x RSO	0.492***	0.0718
	(0.000)	(0.370)
Female x Start-ups	-0.0406	-
	(0.795)	
Female x Comparables	1.120	0.264
	(0.279)	(0.702)
Dummies "Samples"	Yes	Yes
Control variables	Yes	Yes
Observations	1288	813
R^2	0.070	0.108
Adjusted R^2	0.043	0.073
Underidentification test (Anderson canon. corr. LM statistic)	129.708	31.912
	(0.0000)	(0.0000)
Weak identification test (Cragg-Donald Wald F statistic)	34.964	10.636
Sargan statistic	0.690	0.322
	(0.4061)	(0.5703)
Endogeneity test	5.267	0.177
	(0.0217)	(0.6738)

p-values in parentheses Industry and Year fixed effect are included as controls. In all the columns it is used the IV technique. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ The intercept has been omitted to allow full interaction terms. In this table innovative start-ups are not included in the column (2) because all these firms in my sample are young by definition (less than 6 years old).

The positive relationships between female representation in top management teams and firms' performance in younger RSOs is proved. According to Mustar et al. (2008) it is used a timeframe of six years to discriminate young and mature RSOs. Thus H3a is confirmed. Comparing the results related to RSO to the ones concerning the comparables sample (results concerning innovative startups are not reported from this analysis because these firms are young firms by definition) it can be noticed that in the latter case the results are not statistically significant (this result also proves H3b). Management diversity is relevant for young RSOs since people working in such contexts have the opportunity to live in an environment, at least in the first stage of the firm life cycle, with strong international links, horizontal vision of the power and the gender inclusion. Young RSOs are inherently riskier than other business ventures as they are likely to involve technological and market uncertainty; in the first stage of spin-offs' life cycle, also networking is a crucial activity for RSOs. Thus, female coming from research contexts have the capabilities to positively deal with a dynamic, competitive and turbulent environments. Moreover, they have the right amount of tenacity, networking capability and pragmatism to breast with riskiness and uncertainty.

The first stage of a RSO's life cycle is particularly tough. It is common knowledge that in the first years the rate of bankruptcy of RSOs is extremely high. It goes without saying that often the goodness of the RSO's project is not the only crucial factor in order to achieve good results. One the main activities of RSOs' managers in the first period is promoting the project among a good number of stakeholders (banks, venture capitalist, etc.) to gather funds that are vital for the development of RSO itself. This problem is even more pronounced for those RSOs coming from counties with a low degree of financial development. These firms, unable to find some other kind of fund, are often strongly linked to those public contributions awarded in the so-called startup competitions (contests restricted to young and high-technology based firms). In such a context, the ability to networking and promoting, that are activities in which women are naturally cut out for, are key factors for RSOs' survival and also to get success and good performance.

6. Conclusion and discussion

The purpose of this paper is to evaluate the influence of the proportion of women in top management on RSOs' performance, in comparison to a sample of innovative startup and a sample of comparables, both non-science based.

The focus on RSOs activities, dealing with this issue of technology transfer, has both a real-world impact as well as an empirical motivation in academia. It is well known that this topic is of interest for policy makers to foster innovation diffusion on the market by business activities and promote economic growth. The empirical motivation comes both from the increasing focus on the gender composition of top directors of firms and the increasing number of women who reach top positions in RSOs.

The outcomes of the research show statistically that RSOs with females in top management positions are associated with an increase in firm profitability, while this doesn't result in innovative startup and other comparables non-science based firms. These results could be explained with specific context characteristics and some attributes owned by women working in research contexts.

In research environment, that are highly competitive, females in top management positions face a tough process of selection that starting from the academic career could reach a top management position also in a RSO. So, because of this strong selection, female managers may not only be quite different from male but also quite different from representative women in the population. Women working in such competitive environments, experiment also at least some degree of assimilation, so a female executive has become a "male" manager. Moreover, women managers in inclusive and tolerant contexts, with greater gender parity are likely to have superior performance in several skill areas like: conflict resolution,

adapting to change, developing others' capabilities, and motivating and inspiring coworkers. Moreover, they develop self-confidence and self-efficacy beliefs which can enhance their creativity and participation in decision-making processes. Females in research contexts are open to change and they provide more innovative insights and ideas for running a firm than just male executives. Moreover, multitasking skills that women play in their personal lives, increase comprehensiveness in decision making and enhance organizational performance and improve the networking capabilities of firms.

These findings are in harmony with the arguments of Rosener (1995) and Katzenbach et al. (1995) who contend that women in management positions hold the keys to better firm performance; even more, if there is enough of a "critical mass" of females at the top management levels.

The research demonstrated that within RSOs an high representation of women with an executive role can either positively influence the performance of the firm. Other studies (Matsa and Miller, 2013) show that mandatory gender quotas among listed firms affect corporate decisions leading to a deterioration of profitability in the short run. I demonstrated that this is not true for RSOs. Women work as managers in these research – based firms, find a context in which the gender parity is taken for granted; they are allowed to freely express their ideas and professionalism, giving a great contribution to the firm in terms of profitability, to whom also venture capitalists give a fundamental role. So, women are crucial for these firms and their presence could be also necessary for a completion of the RSO's life cycle. These aspects could be deepened and fully understood in future researches.

The paper's results also have important ramifications for policy and practice and may be a strong argument for having more women on boards in science based firms.

The results of the research, in fact, could give important hints to technology transfer offices (TTO), accelerator/incubator programs, academic incubators, mentoring programs, universities and business plan competitions, during the building of entrepreneurial teams.

Also policy makers could have very interesting suggestions in the definition of public policy to encourage successful academic entrepreneurship.

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Appendix 1 - Robustness: Percentage of female representation in top management and firms' performance in research spin-off, innovative start-ups and comparables.

	(1) Profitability OLS RSOs	(2) Profitability IV model RSOs	(3) Profitability OLS innovative start-ups	(4) Profitability IV model innovative start-ups	(5) Profitability OLS comparables	(6) Profitability IV model comparables
% female manager	0.148***	0.934***	0.139	0.434	0.0588	0.0288
	(0.000)	(0.004)	(0.195)	(0.544)	(0.611)	(0.967)
Management tenure	-0.134**	-0.113***	-0.0229	-0.0501	0.0619	0.0594
	(0.046)	(0.005)	(0.780)	(0.618)	(0.487)	(0.495)
Growth Opportunities	-0.225***	-0.279***	-0.104	-0.110	-0.537*	-0.536***
	(0.004)	(0.000)	(0.369)	(0.224)	(0.058)	(0.000)
Size	0.00981	0.0335**	0.0557	0.0579***	0.0902**	0.0901***
	(0.566)	(0.016)	(0.123)	(0.001)	(0.026)	(0.000)
Dummy Financial Debt	-0.0733*	-0.157***	-0.110	-0.123**	-0.108	-0.108**
	(0.052)	(0.000)	(0.144)	(0.044)	(0.103)	(0.037)
Dummy Venture Capital	0.0992**	0.134**	-0.0562	-0.0924	0.118	0.116
	(0.013)	(0.034)	(0.516)	(0.420)	(0.358)	(0.359)
Ownership (log)	0.0120	0.0190	0.0655	0.0804	0.0380	0.0368
	(0.773)	(0.505)	(0.177)	(0.109)	(0.311)	(0.389)
Dummy North	0.0775	0.115***	-0.00242	-0.000732	0.225**	0.225***
	(0.117)	(0.000)	(0.974)	(0.990)	(0.027)	(0.000)
Observations	1396	1396	432	432	247	247
R^2	0.075	-0.300	0.067	0.045	0.242	0.242
Adjusted R^2	0.055	-0.327	0.007	-0.016	0.164	0.164

p-values in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Industry and Year fixed effect are included as controls. In columns (1), (3) and (5) it is used an OLS model. In column (2), (4) and (6) it is used the IV technique using the following instrumental variables Dummy foreign CEO (at firm-level), separations in marriage, voting rate and extortions rate (at provincial level), Gender parity index

Appendix 2 - Robustness: Percentage of female representation in top management and firms' performance in research spin-off, innovative start-ups and comparables.

	(1) Profitability lagged by 3 years IV model research spin-off	(2) Profitability lagged by 3 years IV model research spin-off	(3) Profitability lagged by 3 years IV model research spin-off	(4) Profitability lagged by 3 years IV model innovative start-ups	(5) Profitability lagged by 3 years IV model innovative start-ups	(6) Profitability lagged by 3 years IV model innovative start-ups	(7) Profitability lagged by 3 years IV model comparables	(8) Profitability lagged by 3 years IV model comparables	(9) Profitability lagged by 3 years IV model comparables
% female manager	0.656**			0.394			-0.824		
	(0.031)			(0.254)			(0.351)		
Dummy Female		0.842***			-0.0982			-0.286	
		(0.001)			(0.778)			(0.436)	
Dummy Female × Age of Female			0.0210***			0.00177			0.00215
			(0.002)			(0.830)			(0.765)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	679	1396	1396	31	432	432	129	247	247
R^2	-0.011	-0.404	-0.527	0.481	0.048	0.067	-0.060	0.179	0.245
Adjusted R^2	-0.048	-0.433	-0.560	-0.198	-0.013	0.007	-0.256	0.094	0.168

p-values in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Industry and Year fixed effect are included as controls. In all the columns it is used the IV technique

Appendix 3 - Robustness: Results concerning dominant female representation in top management and firms' performance in research spin-off, innovative start-ups and comparables

	(1) Profitability IV model research spin-off	(2) Profitability IV model research spin-off	(3) Profitability IV model research spin-off	(4) Profitability IV model innovative start-ups	(5) Profitability IV model innovative start-ups	(6) Profitability IV model innovative start-ups	(7) Profitability IV model comparables	(8) Profitability IV model comparables	(9) Profitability IV model comparables
Dummy dominant female manager	0.868***			0.0861			-0.446		
	(0.007)			(0.780)			(0.495)		
Dummy all females in management		1.084**			0.829			-0.677	
		(0.018)			(0.395)			(0.644)	
Dummy female manager&shareholder			1.143*			0.100			0.161
			(0.054)			(0.836)			(0.791)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1396	1396	1396	432	432	432	247	247	247
R^2	-0.364	-0.444	-0.423	0.067	-0.048	0.059	0.165	0.172	0.243
Adjusted R^2	-0.392	-0.475	-0.453	0.007	-0.116	-0.001	0.079	0.087	0.165

p-values in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Industry and Year fixed effect are included as controls. In all the columns it is used the IV technique.

Appendix 4 - Robustness: Female representation in top management and performance in young (<6 years) vs. mature (>=6 years) firms, with regards to research spin-off and comparables.

	(1) Profitability IV model young research spin-off	(2) Profitability IV model mature research spin-off	(3) Profitability IV model young comparables	(4) Profitability IV model mature comparables
% female manager	1.221**	-0.108	-0.897	-0.0172
	(0.026)	(0.647)	(0.372)	(0.947)
Control variables	Yes	Yes	Yes	Yes
	(0.001)	(0.592)	(0.648)	(0.498)
Observations	578	818	104	143
R^2	-0.199	0.076	0.209	0.315
Adjusted R^2	-0.249	0.045	0.030	0.202

p-values in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Industry and Year fixed effect are included as controls. In all the columns it is used the IV technique. In this table innovative startup are not included because all these firms in my sample are young by definition (less than 6 years old).

Chapter 2

Does local financial development affect research spin-off performance?

Abstract

The aim of this work is to examine how the performance of research spin-offs (RSOs), firms created within Universities and Research Institutes, are conditioned by the local financial environment. RSOs, as special kind of firms aimed at applying industrially the results of academic research, are supposed to offer above the average returns, showing, however, an extremely high rate of stagnation along the years, not always linked to the goodness of their project. Empirical results show that local financial development doesn't affect at all RSOs performance at the time of incubation, while there is a positive and growing effect when RSOs enter into the product market and become independent from the University. Moreover, the effect of local financial development on RSOs is different compared to what results from a sample of innovative start-ups, which operate in the same technological sectors and local area but, since they do not come from the academic context, they have no incubation period and linkage with Universities, entering their products or services into the market immediately after their incorporation.

Key words: local financial development, institutional context, research spin-off, innovation, firm performance.

1. Introduction

The firm's success, typically, depends on a wide number of internal drivers (i.e. management's talent and preferences, availability of physical and human resources, R&D investment, etc.) and external opportunities to be exploited (related to the environment in which the company operates). Manzocchi et al. (2014, page 2) state that "*External drivers encompass various aspects of the environmental context in which a firm operates, such as the standard and efficiency of the public administration, national or regional credit conditions, physical infrastructures and intangible capital. Most of these external factors may affect the productivity performance of rather similar firms if they are located in different areas of the same country"*. Among these different external factors a leading role is played by the financial system.

Joseph Shumpeter (1912) stated that "*well-functioning banks spur technological innovation by identifying and funding those entrepreneurs with the best chances of successfully implementing innovative products and production processes*". He argued that the services provided by financial intermediaries are essential for technological innovation and economic development. Economists in general agree on this potential relationship. King and Levine (1993), for instance, show that the financial development is important for the overall economic growth at country level. At micro level, many studies suggest that a more developed banking system is significantly correlated to a better access to external markets (Demirgüç-Kunt and Maksimovic 2002), to more credit availability (Beck et al. 2004, Cetorelli and Strahan 2006) and to a lower probability for firms of being financially constrained (Love 2003). With regards to the effect on new firms' performance, Aghion, Fally and Scarpetta (2007), suggest that financial development promotes post-entry growth, while Musso and Schiavo (2008) report that an easier access to external finance reduces the probability that firms exit from the market. In general, when firms operate in a well-functioning financial system, the access to external sources is easier for them (Goldsmith (1969), McKinnon (1973), and Shaw (1973)), this is undoubtedly beneficial for firms themselves that can found their projects by making the most of the availability of funds and indirectly influences the growth of the economy as a whole. As it is well known, the potential exploitation of external financial resources and the eventual difficulty to access to these represents the greatest challenge that a firm must overcome nowadays. Financial issues are at first place in constraining small and medium sized firms (SMEs) priorities, as a consequence the degree of development of the local financial system strongly shapes business activities. In fact, Guiso et al. (2004) suggest that it is the local context that is considered as a priority by SMEs. Therefore, the characteristics of the local environment in which firms operate is at the core of the potential success of a firm, and specifically, among the wide range of features related to the environments, the role of the financial system is noteworthy in affecting the

competitiveness of a firm. A large part of the literature shows the importance of financial development for the growth and performance of firms, even strongly considering small firms. Beck et al. (2005) show that financial development weakens the negative impact that financial constraints have on growth, and that small firms are the ones that benefit most from this development. The amount of credit available and the conditions provided by banks can differently affect firms' performance through the time, according to the areas where the firm is located. In terms of financial development, some areas can do a better work in supporting firms compared to others, and at the same time, the degree of local financial development can change along the years. The access to external financial resources is essential to improve the performance, in particular of small firms, which are those with the greatest financial constraints. SMEs are supposed to grow faster in economies characterized by major financial development. Also Beck et al (2005), studying the impact of the level of financial development on firms' growth, found a positive relationship, especially on small and young firms.

In particular, concerning firm performance, Castelli et al. (2009), consider the relationship between banks and firms jointly with a variable of geographical proximity. They noticed that business performance (measured both as the return of assets and the return of equity) is negatively correlated to the number of bank-firm relationships. A possible explanation lies in the fact that a limited number of banks relationships allows a more solid banking relationship development and limits problems related to asymmetric information, leading to better corporate performance. If a bank and a company have long-term relationships, the bank is able to capture a greater amount of information about the quality of the company itself and provides better financial solutions that fit the firm's needs. Therefore, Castelli et al. (2009) suggest that the optimal strategy for a small firm is to establish long-term relationships and to borrow from a limited number of banks.

Productivity and innovation of firms are strongly influenced by the development of the financial system. Innovation is expensive and requires mature financial systems, therefore, in a condition of funding absence, productivity is constrained. Gatti and Love (2008) measured the impact of credit access easiness on the productivity of firms and detected a strong positive connection between productivity and access to external financing. In countries with greater financial development, companies are more likely to innovate (Sharma, 2007) and, in general, innovation is higher in firms that have access to external resources (Ayyagari et al, 2007). Well-developed financial systems have a positive effect also on entrepreneurship, growth and, as a result, company's performance. Although Guiso et al. (2004) highlight that local financial development increase entrepreneurship rate, there are still just a few papers investigating how local financial development affect business activities of new firms. For example, Deloof, La Rocca and Vanacker (2016) study the financial

decisions of start-ups shaped by local financial development. Accounting for this knowledge gap, this paper aims to examine the effect of local financial development on performance of a particular kind of new firms, namely the research spin-offs (RSOs). RSOs are very special start-up firms incorporated within Universities or research institutions by faculty members (assistant, associate and full professors but also lecturers and researchers as well as PhD, graduate and undergraduate students), and whose target is the commercialization of the results of scientific activities.

Considering that innovation is at the root of economic success and development of a country, an effective way to transfer technology from University and Research institutes into the market is indeed provided by RSOs. Thus, to understand the way the financial local context can affect the performance of these firms can provide practical implication to sustain their development and, in general, the economic growth of nations.

Literature about RSOs is extensive, however the role of the local financial context in under investigated. While some papers does not take into account measures of local context (Iacobucci and Micozzi 2015), in others (Fini et al. 2009) the role of the local context is directly investigated. However, there is a gap in the literature due to the fact that nobody scrutinized the role of the local financial context. From one side, it could be argued that the degree of development of the financial system does not affect RSOs business because these kind of firms work under the wing of University, in a sort of protected environments where financial resources mainly come from public contributions and research projects. However, on the other side, this could be true in the early stage of the RSOs life cycle, namely within the time necessary to enter the market and to reach the steady state production. At this point of RSOs' life cycle, for many reasons (the need to have a wider production plane to deal with commercialization, the need to have financial support to deal with debts and credits toward suppliers and customers with different time horizons, etc.) the degree of financial development in the local area where a firm is based could become very relevant. Therefore, I intend to deepen the contribution that the local financial development gives to RSOs' performance, along the different stage of their life cycle.

Another important aspect regarding RSOs should be taken into account in order to fully understand their nature and properly investigate their financial performance: the potential sources of money available for these firms arising from the participation to public competitions, restricted to high tech firms in possession of particular requirements, and subsidies obtained by public institutions. In some papers (i.e. Iacobucci and Micozzi 2015) it is used as a measure of performance the level of sales. But, for RSOs, sales are not the only source of revenues. In particular, as previously said, they also get money from public contributions, above all during the first phase of their life. In general, the real independence of RSOs from Universities and Research Institutes is not a matter of time.

RSOs are different from each other, so setting up an average incubation period to carry out the analysis is not correct. For instance, RSOs dealing with chemical or pharmaceutical experiments, need more time to develop their products then those dealing with informatic algorithm. Which is why I thought to set the real end of incubation period when the revenues from sales are greater than all the other revenues. Thus, it is important to consider the different source of revenues of RSOs, to be able to appraise the stage of life cycle they are involved in. Indeed, according to the stage in their life cycle, there are different drivers of performance and a different role of the local financial context.

The structure of this paper is the following. The following paragraph describes the background framework and main literature. The third paragraph presents the hypotheses. It follows the description of the data available, the model and the variables. The fourth paragraph represents descriptive statistics of my data set and the results of the empirical analysis. Finally, the last section, offering concluding remarks, focuses on the managerial implications of the achieved results as well as on future research directions.

2. Background framework and literature review

A spin-off is a new legal and economic entity, created through the "separation" of a resource from an existing entity (parent organization) to carry out a new task, or reorganizing a task previously carried out in the entity of origin. When it comes to RSOs, it can be referred to those entities created through the separation from a resource (typically a new technology derived from academic research result), transferred to a new company through a voluntary process supported by the University (Palumbo, 2010). Therefore, in this process it is possible to distinguish: 1) a producer of technology that possesses technical skills, 2) an individual who develops and transfers technology to users (Williams, Gibson, 1990). Consequently, a RSO is a new firm in which two elements can be found: 1) the initiative must involve faculty members (assistant, associate and full professors but also lecturers and researchers as well as PhD, graduate and undergraduate students), 2) the new entity must acquire a technology developed within the University itself and, after a phase of development, it transfers this technology to market (Carayannis et al. 1998). Spin-offs represent, along with the technology licensing, the main tools to achieve the technology transfer from academic environments to market. Once defined the RSOs and clarified their role, it is important to underlying that these legal entities are important because: 1) they contribute to the local economic development; 2) they make easier the commercialization of new technologies; 3) they provide support to main activities of research; 4) they have above-average performance; 5) they generate, if compared to licensing, more revenues for universities (Shane, 2004).

The literature about RSO is extensive. From the purely theoretical point of view there are many studies on the performance of academic spin-off. Recently, Clarysse et al. (2011) underlined that the degree of innovation, the stage of development of the technology and the ability to protect innovations through patents, affect the performance of academic spin-off. As reported in literature, the creation of a company by a research organization is a great way to commercialize the results of public research, this contributes to economic and social welfare by influencing the entire regional development (Bellini et al, 2002). In fact, the generation and application of new ideas, technologies and scientific knowledge are widely recognized as a prerequisite for economic development, job creation and the formation of a competitive industrial structure (Atasu et al, 2009). Bellini et al. (1999), carried out a comparative investigation between 12 Italian and Swedish spin-offs. It has been reported an increase in productivity, in terms of public research results, due to the activity RSOs. Additionally, Chiesa and Piccaluga (2000) have published a study about the "transfer" of public research from public research organization to market. They considered in their study 48 Italian spin-offs showing that RSOs are a great tool to exploit and disseminate the results of public research. Czarnitzki, Rammer and Toole (2013) highlighted the importance of fostering the creation of RSOs, since they represent a mechanism by which public knowledge and technologies, developed inside universities, are subsequently transferred to the private sector through commercialization. However, RSOs, contemplating the transfer of one or more researchers from the public sector to the private one, lead to higher social cost compared to the cost of creating a normal start-ups. In order to compensate this major social cost, the spin-offs must produce higher performance. Kriegesmann (2000) highlighted the importance of the six factors affecting the performance of RSOs: 1) autonomy of the founder; 2) need of leadership of the founder; 3) assumption of personal responsibility from the founder; 4) business risk taking of the founder; 5) horizontal structure of the company; 6) formal contacts between universities and RSOs. Either Bleibst and Lautenschlager (2004) or Gassmann et al. (2003) in their study identify the career orientation of the RSO founder as being the key factor that affects the performance of RSO. Smilor and Matthews (2004) have shown that the support provided by University to spin-off may increase its success. They, then, considered the following factors as crucial in order to obtain good performance: 1) financial involvement of University; 2) competent staff within the technology transfer offices; 3) transparency and clarity of policy support; 4) access to entrepreneurial skills. Among those factors that represent the local context in which the spin-offs work, many studies have highlighted the role played by the *financial system*. Financial system is intended as the set of instruments, institutions and mechanisms that ensure the transfer of financial resources from surplus to deficit subjects (financial resources allocation function). Thus, the ability of companies to access

to external finance resources with positive effects in the long run is determined also by the presence of a well-developed financial system (Christopoulos and Tsionas; 2004). In the start-up phase which precedes the process of commercialization of technologies, firms need capital to finance the activities of development, prototyping and engineering of their innovations (Fernández-Alles, Leal, Ordaz, 2014). These capitals are found by recourse to money lenders, which represent a fundamental step for the transition of technologies from a development phase to a phase of commercialization. A company can fund its activities either through internal or external resources. However, RSOs are not able to internally generate enough financial resources, and finding them outside can be hampered by the condition of information opacity caused by information asymmetries that typically affect RSOs[9]. Therefore, from one side I find a need of RSOs to get financial resources especially after the product market entry to sustain their business success, while on the other side, it is difficult to get money from financial markets, because of the intrinsic opacity of this kind of firms.

This work wants to investigate empirically how the local financial context affects the performance of research spin-offs. I analyze the local context considering the level of development of the local financial system. Literature highlights that the access to financial resources is a crucial element for the success of spin-offs, (Ortín et al, 2007; Patzelt and Shepherd, 2009). The presence of money lenders represents a fundamental step to go from a technology development phase to a phase of commercialization (Keuschnigg and Nielsen, 2004; Wright et al., 2006). The choices of management about how to finance the activities, seem not to depend only on the characteristics of the company but also on external factors (La Porta et al. 1998). Focusing on resource allocation function, I want to understand how a well-developed financial system increases the chances of RSOs to benefit from the availability of external funds, with positive effects on their accounting based performance.

3. Research hypothesis

Fini et al. (2011) concentrated on the role of the local environment on the creation of new RSOs finding a positive relationship between the level of regional development calculated as the probability that a household is shut off from the credit market for each region and the number of new RSOs incorporated. However, the creation of a new RSO is not guarantee of success *per se*. As Agarwal and Bayus (2002) showed, *"it takes on average 14 years before a technology patented at a research institute reaches 2% of its peak sales at market maturity*". Typically research RSOs face a

[9] The difficulties in accessing to external financial resources increases the dependence of the firm from internal resources, namely, that share of earnings produced by the firm itself aimed to fund firm's activities (Sarno, 2008), and on this way it is like a dog that wants to bite his tail.

long incubation period before the commercialization of the product. Although the different phases of RSO's life cycle vary a lot across the different industries, there is, in general, a considerable timeframe between the first phase of their life cycle and the sales takeoff. RSO's life cycle can be summed up (Rasmussen, 2011) as follows. A research phase, during which the researchers involved in the project are engaged in turning their ideas into a prototype. A second phase characterized by an intense activity of fundraising, that can be called the opportunity framing phase (Vohora et al., 2004), or alternatively the gestation (Vanaelst et al., 2006) or pre-start-ups phase. A third phase characterized by an intense activity to develop the prototype in order to understand if it can have an effective commercial use; this phase may be labelled the proof of viability phase (Vanaelst et al., 2006). Once the RSO has productively commercialized its product, established contracts with customers and its sales take off, then it enters in a new phase which may be labelled the post-start-ups (Clarysse and Moray, 2004) or maturity phase (Vanaelst et al., 2006).

Also Denys and Moray (2004) describe the various stages of the life cycle of the spin-off dividing them into: idea phase, pre start-ups phase, start-ups phase, post start-ups phase. During the first three phase RSOs are usually located inside dedicated areas that Universities make available for free to them (also known as "incubators"). RSOs then make the most of this opportunity to exploit all academic assets (laboratories, staff, etcetera) to develop at their best their product concept. During the incubation period, RSOs are strongly committed both on the product development and on fundraising activity. In this phase sales are mainly equal to zero, while revenue in terms of non-operational earnings represents an essential kind of financing for RSO. Non-operational earnings can show up in the shape either of non-refundable resources that the Government makes available to foster small firms or in terms of cash prizes that RSOs can receive from participating to the numberless start-up competitions set up all over the EU. This aspect is not secondary having the goal to study in depth the impact of local financial development on RSO performance. In fact, the dependence on public contribution is fundamental to assess the real stage of the RSO lifecycle. As it can be easily understood, during the incubation period RSOs are far away from realizing substantial earnings through sales. Even though the average incubation period is calculated in three years (Grimaldi and Grandi, 2005), it is more effective to set it in a more general way. To discuss about the average incubation period of a RSO and positioning a firm in a specific phase, we must take into account the many peculiarities of different RSOs; i.e. the kind of industries they come from or the features of the markets (customers) they want to address. For instance, a RSO that operates in the molecular biology field takes more time to commercialize its "product" compared to a RSO that develops a smartphone applications, since the latter in general does not need a particular protection through a patent application (process that lasts several months to be completed), and addresses the

market faster than the former. Thus, it results scientifically more rigorous, and more convenient for empirical purposes, to appraise the different phases of a RSO life cycle, according to the extent to which a RSO moves from a stage with no sales and only revenues in terms of government contributions and/or research projects, to a stage where the RSO is financially autonomous from the previous mentioned kind of revenues.

When the incubation is still ongoing, the spin-off works on the prototype, preparing the product launch and figuring out how to set up the equipment for a production under steady conditions. The real end of the incubation period can be assessed when RSOs are fully dependent from Universities and public contributions. Financial resources availability from financial institutions or public markets play a subordinate role at this stage of the RSO. Until this stage lasts, the role of the external financial context is meaningless and negligible.

It is at the time of the entrance in the product market, when a RSO faces costumers, competitors and different financial issues, that its way of doing business is going to change. RSO starts to become independent from Universities and public contributions.

It is at this time that local financial development can positively influence RSO performance. In presence of a higher degree of local financial development, the access to external sources of financing should be easier for spin-offs. Financial institutions and public markets will be able to provide the financial support that best fit RSO financial needs. The potential support that the financial markets provide to RSOs yield benefits once the product is commercialized and sales outnumber non-operational earnings. There is a support provided by the financial system both in the short-run, to deal with all the economic transactions raised into the market, and also in the long-run, providing the right financial tool to support the acquisition of an industrial building, machines and equipment. In this case, the degree of development of a financial system represents a resource that gives the possibility to spin-off to commercialize innovations.

At the time a RSO has sales equal to zero and its survival is totally and uniquely dependent from non-operational earnings, it means that this company is *de facto* a "proto-company" still *in nuce* but not really operative. As long as the survival of RSO depends on collecting money from public contributions and start-up competition awards more than on their own sales, the degree of financial system development does not influence the performance of RSOs. This independence is realized when corporate sales are greater than zero, and all non-operational earnings are approximately equal to zero. The intermediate situations are those presenting a mix of both sources, i.e. when the non-operational earnings exceed the sales, namely when the ratio sales/non-operational earnings is lower than one (situation that might be labelled as "semi-dependence state),or when sales outnumber non

operational earnings, namely when the ratio sales/non operational earnings is greater then 1 (situation that might be labelled as "semi-independence state").

Therefore, it means that the composition of different kind of revenues a RSO is based on and the degree of financial independence from Universities and public contributions specify the stage in the life-cycle the RSO itself is in. At the time of incubation, when sales are equal to zero, local financial development doesn't play any role for spin-off performance. Instead, the development of local financial markets influences positively RSOs, originally created within universities and Public Research institutes, at a greater extent when they become fully independent and completely free from public contributions, namely, when non-operational earnings are equal to zero. As a consequence, the first hypothesis can be formulated as follows:

> ***Hypothesis 1*****:** *The local financial development is irrelevant for RSOs' performance during their incubation period.*

Once the prototype is drown up, RSO's needs of financial resources begin to grow. Now a RSO is totally comparable to a normal start-up. All the money it needs to finance the production (technical equipment, production site rent, employees' salaries) and the normal business activity (for instance, the possible time discrepancy between receipts and payments arising from the normal corporate operations) cannot be found but by recurring to external money lenders. In fact, however important for RSOs' survival at the initial stage of life, all the tools set up to foster RSOs' creation (eventual involvement of university, start-up competitions, tax benefits) turn out to be, actually, widely inadequate in the following phases. Also Hemer et al. (2005) conducting a survey on 20 German research spin offs point out that: *"Loans from banks are practically insignificant for firm founding, in the west as in the east. They rather appear in later phases of the company development, often brokered by already known investors"* A possible explanation of this strict dependence of spin offs (and in general of start up companies) from the bank system lies in the fact that these firms being in the first stage of their life cycle are unable to generate substantial returns, so that they can not draw on internal financing as the pecking order theory (Myers and Majluf, 1984) would postulate, but they rather rely on external resources. A well developed financial system not only make significant amount of money available for firms, but it also ensures effective ways of clearing and settling payments, facilitating the trade; provides a mechanism for sharing resources and subdividing the risk in many firms; transfers resources through the time and among industries. In a context with a well functioning financial system either investors or start ups seeking financial resources can find an environment plenty of opportunities. As previously said, RSOs after the incubation period act

like normal start up firms, but as long as they rely more on non operational earnings then on their own sales, namely as long as the incubation period lasts, surviving inside the protect environment of the University or the research institute it comes from, although legally incorporated, a RSO is in a state of partial dormancy because of its research and development activity. Once the prototype is put in place, sales start to grow until they outnumber non operational earnings. From this stage onwards a RSO is completely bathed in a new environment: the market. Now the local financial development can finally exert a role on RSO's success. This role is gradually growing to such measures as and when the RSOs become more independent and rely less on non operational earnings. As a consequence, the second hypothesis can be formulated as follows:

> ***Hypothesis 2:*** *The local financial development has a positive effect on performance of RSOs after their incubation period, at a greater extent when they become more independent from University or Research Institute.*

As previously said, RSOs are firms with specific characteristics either with regard to their life cycle (which is linked to the particular context they come from) or the high technological content of their "product" (being the expression of academic research). Letting aside the academic background, RSOs can be considered as high tech start up firms and, as a matter of fact, after the incubation they are completely comparable. In accordance with the literature, high-tech start-up firms are likely to undergo most the imperfections of financial markets. Specifically, accessing to credit is often difficult for them (Carpenter and Petersen, 2002). First of all, future cash flows are very uncertain for these firms; since they represent a risky investment for money lenders, the credit conditions they obtain are such to compensate their high risk of failure. Moreover, problems related to information asymmetries are likely to be considerable for these firms. In fact, high-tech entrepreneurs in general possess better information about risks and returns of their projects than money lenders: it is quite difficult for banks to appraise the quality of an innovative investments of firms without any track record. Although we find many problematic issues related to the financing of high tech start up firms, many of them are overcome when we are in presence of an advanced financial markets. As a matter of fact the review Forbes lists the following four cities as the best in the world for start ups seeking funding: San Francisco and the Bay Area, New York, Seattle and Singapore, while San Francisco, Los Angeles and London are the best cities for investors. It goes without saying that the previous cities are expression of well developed financial systems. All this considered, and either as an extension or a robustness of my analysis, I formulate the third hypothesis as follows:

> ***Hypothesis 3:*** *The local financial development positively shapes high-tech no-research-based start-up firms performance since their incorporation.*

4. Data and model

4.1 Sample selection

This work started by implementing a database including 1074 RSOs actually existing on the Italian national scene, identified through the website Netval, a non-profit association involved in the promotion of academic research. Netval represents 54 Italian public universities as well as the following public research institutes: the Italian Aerospace Research Centre (CIRA) the National Research Council (CNR), the Committee for Research and the Experimentation in Agriculture (CRA), ENEA the National Authority for Atomic Energy and INFN, the National Authority for Nuclear Physics. Netval main target is the promotion and enhancement of academic research; for this purpose it provides a wide variety of services, supporting the exploitation of research results through the organization of specific courses (e.g. summer schools) and networking with institutions the world of business and that of finance. Netval website states that in Italy there are about one thousand two hundred active RSOS. Unfortunately, in trying to confirm the validity of this database I did not found an exact match with such figure. In fact, at first I conducted a search on Bureau Van Dijk (Bvd) by using the Vat numbers. Bvd is a database that provides financial information (i.e. financial statements, ratios, activities, and information on managers and ownership structure) about both types of listed and unlisted companies in Europe. Since the total number of active firms found was far below the one indicated by Netval, I went on depth on this search by using the company names. As a result, I found that, in several cases, the firms indicated in Netval were not indeed research RSOs. To sort out this problem I contacted, either by email or telephone, each Italian University (public and private) and public research institute listed in the Ministry of Education website to obtain a list of RSOs from each of them (when not available directly on their websites). All the data that I used were taken from Bureau van Dijk website. In particular I considered a time horizon of nine years (from 2006 to 2014) and downloaded data regarding the balance sheet and the ownership. More particularly, regarding the fiscal data I considered the following items: intangible assets, tangible assets, total assets, financial debts. I considered also ownership variables, in particular: the number of shareholders. Moreover, I went in depth on the composition of the shareholding base, underlying the possible presence of venture capitalists, Banks and financial companies and industrial firms. For comparison, in my analysis I created a control sample.

This sample is called in this study “innovative-start-ups” and includes firms that benefit of tax advantages laid down by Italian law for those small firms that operate in high tech industries.. Italian government with such law aimed to develop those firms whose business objective is the developing and the production of innovative high-tech products or services. To benefit from this law companies have to meet many requirements: being new or have been operational for less than 5

years; having their headquarters in Italy or in another EU country, but with at least a production site branch in Italy; having a yearly turnover lower than 5 million Euros; do not distribute profits; producing, developing and commercializing innovative goods or services of high technological value; not being the result of a merger, split-up or selling-off of a company or branch; being of innovative character, which can be identified by at least one of the following criteria: 1. at least 15% of the company's expenses can be attributed to R&D activities; 2. at least 1/3 of the total workforce are PhD students, holders of a PhD or researchers; alternatively, 2/3 of the total workforce must hold a Master's degree; 3. the enterprise is the holder, depositary or licensee of a registered patent (industrial property) or the owner of a program for original registered computers. Meeting such strict criteria is beneficial for firms in many ways; for instance innovative start-ups have many fiscal advantages and the possibility to collect capital through authorized equity crowd funding portals. All the criteria required by the mentioned law, ensure that the companies listed as "innovative start-ups" are similar to RSOS, in terms of size, social objective and level of education of the workforce, which is why I chose this kind of sample to corroborate my analysis. I excluded from this sample the RSOS listed as "innovative start-ups" and, according to the VAT numbers that I found in a special section of the Ministry of economic development website , I got 2851 firms on Bvd database. All of the continuous variables are winsorized at the 1st and 99th percentiles to limit the influence of outliers and data typing errors.

4.2 Model and variables

The main model is based on a regression where a measure of performance is the dependent variable as a function of local financial development and a set of other control variables.

$$\text{Performance} = f(\text{local financial development, control variables})$$

Table 1 provides a description of the dependent and explanatory variables used in this analysis.

Table 1 – Variables description.

Variables	Descriptions
Profitability	Dependant variable. It measures the performance of the firms and it is defined as the ratio between the earnings before interests tax depreciation and amortization (EBITDA) and the total value of assets.
Bank Branch Density	Variable that expresses the total number of bank branches per each 1000 inhabitants of every Italian county.
Growth opportunity	Value of intangibles divided by total assets
Tangibility	Value of tangibles divided by total assets
Size	Natural log of the value of total assets plus 1
Dummy Debt	Dummy equal to 1 if the firm has debt of any kind (short/long), 0 otherwise
Dummy Venture Capital	Dummy equal to 1 if in the board there is at least a venture capitalist, 0 otherwise
Dummy Industrial Firm	Dummy equal to 1 if in the board there is at least an industrial company, 0 otherwise
Dummy Bank	Dummy equal to 1 if in the board there is at least one a Bank or a financial institution, 0 otherwise
Dummy Member Group	Dummy equal to 1 if the spin-off is a member of an industrial group , 0 otherwise
Dummy North	Dummy equal to 1 if the firm is located in the northern Italy, 0 otherwise

Although in start-ups and spin-offs large part of the attention is paid to growth (Wiklund 1999), as suggested by Delmar et al. (2003), to measure the performance at the time to start-up the business is better to avoid to consider sales growth as a measure of performance, because start-ups and high-tech companies can experience high rates of employment or a considerable increase of assets before sales are made[10]. Since business growth cannot be sustained without returns to be reinvested within the activity of the company and considering entrepreneurship as the ability to create "incomes" through innovation (Stewart, 1991) I considered as measure of profitability particularly suitable for my purposes the level of earnings before interest taxes depreciation and amortization (Ebitda) divided by the total value of assets.

Moreover, I consider as "local", the county, similarly to what is done by the large majority of empirical works based on Italian context (Guiso et al. 2004,) and also because, citing Guiso et al.

[10] Chandler and Baucus (1996) note that when the sales growth is used as a measure of performance, a faster growth is desirable. However, the observation that a faster growth leads to better performance cannot be universally true. Rapidly growing companies may need to exploit excessively their resources, and this may lead to under-performance and, in some cases, to bankruptcy.

(2004): "*According to the Italian Antitrust authority the "relevant market" in banking for antitrust purposes is the province, a geographic entity very similar to a US county. This is also the definition the Central Bank used until 1990 to decide whether to authorize the opening of new branches*". My measure of banking competition in provinces is Branch density, that is, the number of bank branches per thousand inhabitants in the county. This variable has been often used as a measure of local banking development (e.g., Bonaccorsi di Patti and Gobbi 2001; Degryse and Ongena 2005; Benfratello et al. 2008; Alessandrini et al. 2009; Cariola et al. 2010; Deloff and La Rocca 2014) and it's characterized by a great dispersion in branch density across Italian provinces (Benfratello et al. 2008). Data about the local financial development have been found through the Bank of Italy website, while the distribution of Italian population divided by counties have been downloaded from Istat (Italian National Institute of Statistics) website.

4.3 Endogeneity

At this stage of analysis an important problem to face concerns endogeneity. There are mainly two causes of endogeneity: there could be some unobservable factors that influences both independent and dependent variables of the model, and a simultaneous causality relationship between the independent and dependent variables of the model. For instance, the number of Bank branches can influence the performance of firms because a greater number of Bank branches mean greater availability of funds and higher capability to caught growth opportunity and exploit asset in place and, at the same time, the number of bank branches can be influenced by the firms' performance itself because a good number of firms with high corporate performance mean an attractive market for banks, therefore available to open new branches in that area. This is the reason why I choose to used a Two stage Least Square Model: finding good instrument variables allow us to avoid problems related to reverse causality. According to Guiso et al. (2004) "*To deal with the potential endogeneity of financial development we instrument my indicator with some variables that describe the regional characteristics of the banking system as of 1936. A 1936 banking law, intended to protect the banking system from instability, strictly regulated entry up to the middle 1980s, and differentially so depending on the type of the credit institution (saving banks vs. national banks). As a result, the composition of branches in 1936 greatly influenced the availability of branches in the subsequent 50 years. For this reason, we use the structure of the banking market in 1936 as an instrument for the exogenous variation in the supply of credit in the 1990s, period when the market was fully deregulated*". I followed the same solution by using, as instruments for the number of bank branches per 1000 inhabitants of each county, the following variables: 1) nsport, namely the

number of bank branches every 1000 inhabitants for each Italian county in 1936; 2) nsportrpopr36, namely the number of cooperative banks every 1000 inhabitants operating in each Italian county in 1936; 3) totalbanks36, namely the total number of banks every 1000 inhabitants operating in each Italian county in 1936.

Therefore, the model to be tested by the Two stage Least Square approach is the following:

First stage:

$Bank\ Branch\ Density = \alpha_0$ nsport + α_1 nsportrpopr36 + α_2 totalbanks36

and

Second stage:

$Profitability = \beta_0 + \beta_1$ Instrumented $Bank\ Branch\ Density + \beta_h\ X + \varepsilon$

5. Empirical Analysis

5.1 Descriptive statistics

A preliminary study of my data sample provided the main descriptive statistics of dependent and explanatory variables. Tables 2 and 2a show the main descriptive statistics for the variables used in the analysis in the two samples.

Table 2 – Descriptive statistics for RSOs

	count	mean	p50	sd	min	p25	p75	max
Profitability	1396	0.007	0.047	0.414	-4.706	-0.025	0.136	0.686
Bank Branch Density	1363	0.603	0.607	0.159	0.236	0.503	0.718	1.074
Growth opportunity	1396	0.147	0.043	0.210	0.000	0.005	0.208	0.923
Tangibility	1396	0.087	0.032	0.131	0.000	0.006	0.106	0.862
Size	1396	5.163	5.193	1.520	1.160	4.128	6.197	9.399
Dummy Debt	1396	0.426	0.000	0.495	0.000	0.000	1.000	1.000
Dummy Venture Capital	1396	0.060	0.000	0.238	0.000	0.000	0.000	1.000
Dummy Industrial Firm	1396	0.653	1.000	0.476	0.000	0.000	1.000	1.000
Dummy Bank	1396	0.139	0.000	0.346	0.000	0.000	0.000	1.000
Dummy Member of a group	1396	0.259	0.000	0.438	0.000	0.000	1.000	1.000
Dummy North	1396	0.626	1.000	0.484	0.000	0.000	1.000	1.000

Table 2a – Descriptive statistics for Innovative start-ups

	count	mean	p50	sd	min	p25	p75	max
Profitability	434	-0.097	0.000	0.485	-4.706	-0.123	0.078	0.686
Bank Branch Density	409	0.564	0.561	0.157	0.209	0.463	0.654	1.050
Growth opportunity	434	0.292	0.205	0.267	0.000	0.060	0.489	0.923
Tangibility	434	0.060	0.016	0.112	0.000	0.000	0.063	0.775
Size	434	4.460	4.433	1.610	0.365	3.338	5.590	9.163
Dummy Debt	434	0.378	0.000	0.485	0.000	0.000	1.000	1.000
Dummy Venture Capital	434	0.171	0.000	0.377	0.000	0.000	0.000	1.000
Dummy Industrial Firm	434	0.465	0.000	0.499	0.000	0.000	1.000	1.000
Dummy Bank	434	0.150	0.000	0.357	0.000	0.000	0.000	1.000
Dummy Member of a group	434	0.357	0.000	0.480	0.000	0.000	1.000	1.000
Dummy North	434	0.687	1.000	0.464	0.000	0.000	1.000	1.000

A brief review of the two samples shows that the means and medians of several of the variables were asymmetrically distributed. However, since small and medium-sized firms typically constitute a heterogeneous group, this result was expected.

In the descriptive statistics all the dummies referring to industries and years are not reported.

Table 3 – Correlation matrix for RSOs

		1	2	3	4	5	6	7	8	9	10	11
1	Profitability	1										
2	Bank Branch Density	0.04	1									
3	Growth opportunity	-0.12***	0.06	1								
4	Tangibility	-0.00	0.06*	-0.11***	1							
5	Size	0.05*	0.07**	0.06*	0.11***	1						
6	Dummy Debt	-0.02	0.00	-0.01	0.05*	0.37***	1					
7	Dummy Venture Capital	0.07**	-0.09***	-0.08**	0.08**	0.11***	0.13***	1				
8	Dummy Industrial Firm	0.05*	0.09***	-0.05+	0.02	0.11***	-0.03	0.06*	1			
9	Dummy Bank	0.05	0.00	-0.05+	-0.08**	0.10***	0.01	0.36***	0.07**	1		
10	Dummy Member of a group	0.107***	0.06	-0.12***	-0.01	0.20***	0.06**	0.07**	0.06*	0.15***	1	
11	Dummy North	0.07**	0.25***	-0.01	0.02	0.15***	0.12***	-0.09***	0.00	0.01	0.11***	1

Table 3a – Correlation matrix for Innovative start-ups

		1	2	3	4	5	6	7	8	9	10	11
1	Profitability	1										
2	Bank Branch Density	0.13**	1									
3	Growth opportunity	-0.07	-0.06	1								
4	Tangibility	0.080	-0.07	-0.25***	1							
5	Size	0.16***	-0.01	-0.08+	0.12**	1						
6	Dummy Debt	-0.02	-0.01	0.043	0.03	0.35***	1					
7	Dummy Venture Capital	0.02	-0.23***	-0.03	0.02	0.11*	0.05	1				
8	Dummy Industrial Firm	0.06	-0.05	-0.03	-0.01	0.21***	0.17***	0.28***	1			
9	Dummy Bank	0.03	0.02	-0.06	0.04	0.04	0.03	-0.00	0.13**	1		
10	Dummy Member of a group	-0.02	0.04	0.13**	-0.11*	-0.02	-0.10*	-0.03	0.06	-0.02	1	
11	Dummy North	0.01	0.40***	-0.06	-0.05	0.05	0.07	-0.27***	-0.01	0.10*	0.08+	1

The correlation matrices in tables 3 and 3a show that the level of profitability is negatively correlated with the size of intangibles (growth opportunities) while the Bank debt seems not influence the performance. Moreover the territorial aspect seems to be important: as it can be noted, the dummy north (which indicates that the RSO is located in one of northern Italian Provinces) is positively correlated with the level of profitability. In general, also observing the test VIF, do not seem to emerge particular problems of multicollinearity.

5.2 Results

The determinants of performance for academic spin-offs, also in comparison with the a groups of innovative start-ups, were investigated by exploring the role of local financial development and the set of explanatory variables. These results are presented in the following tables.

First of all, I am interested in test whether this effect is different according to the degree of dependence of RSO on the University or Research Institute. It means that until the time the RSO strictly gets money from research projects or activity related to the University the role of local financial development is meaningless (*hypothesis* H_1), while it becomes positive and statistically significant when RSO get rid of such a strong financial connection from University (*hypothesis* H_2). Table 4 reports the results concerning the hypothesis formulated.

Table 4 - Results concerning Local financial development and performance in RSO

	(1) performance of RSO with sales =0	(2) performance of RSO with sales /non operating revenues <1	(3) performance of RSO with sales /non operating revenues >1	(4) performance of RSO with sales >0 and non operating revenues =0
Bank Branch Density	-0.385	-0.411	0.289**	0.658*
	(0.547)	(0.363)	(0.021)	(0.065)
Growth opportunity	0.701***	0.450***	-0.305***	0.0478
	(0.003)	(0.004)	(0.000)	(0.786)
Tangibility	0.974**	0.274	-0.198**	-0.139
	(0.023)	(0.260)	(0.021)	(0.576)
Size	-0.0260	-0.0810***	0.0374***	0.0622**
	(0.486)	(0.009)	(0.000)	(0.025)
Dummy Debt	-0.308**	0.0570	-0.0869***	-0.196**
	(0.028)	(0.486)	(0.000)	(0.041)
Dummy Venture Capital	0.670	0.419**	0.118**	0.542**
	(0.285)	(0.050)	(0.015)	(0.011)
Dummy Industrial company	0.104	0.240***	-0.0290	-0.0293
	(0.467)	(0.004)	(0.211)	(0.668)
Dummy Bank	-0.533*	-0.0756	-0.00278	0.123
	(0.059)	(0.604)	(0.935)	(0.309)
Dummy Member of a Group	0.0748	0.0874	0.0267	0.0120
	(0.733)	(0.384)	(0.286)	(0.888)
Dummy North	0.389***	0.283***	-0.00316	-0.0693
	(0.007)	(0.001)	(0.899)	(0.319)
Observations	143	236	1127	206
R^2	0.228	0.161	0.093	0.182
Adjusted R^2	0.079	0.075	0.069	0.084

Notes: *p*-values in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Industry and Year fixed effect are included as controls. It is used the IV technique, using the following instrumental variables: Number of bank branches every 1000 inhabitants in 1936 (at county level), Number of cooperative banks every 1000 inhabitants operating in 1936 (at county level), Total number of banks every 1000 inhabitants operating in each Italian county in 1936 (at county level).

In order to prove the independence of RSO from the local financial system, I insert the first constraint in the regression (Table 4 column 1). It is investigated the impact of local financial

development on firm's performance when sales are equal to zero. Often RSOs, although incorporated since many years, do not have sales because still in the stage of applied research, so it is incubated in Universities or Research Institutes. During this stage of their life cycle they are not affected by the financial system. In fact, as it can be noted, the impact of the variable Bank Branch Density is not statistically significant. During this stage the investment in intangibles (Growth opportunity) seems to provide a positive impact on performance. However, profitability at this stage is only made up of non-operational earnings, namely, public contributions and prize coming from the participation at start-up competitions. This results confirm my first hypothesis H1.

Next column in Table 4 shows the regression results when the ratio sales/non operating revenues is less then1. Table 4 column 2 still shows that local financial development seems not to influence the RSOs performance. RSOs begin to have revenues by selling in the product market, nevertheless their major source of income still come from non operating revenues, in a few words, they still strongly depend from public subsidies. As already said, often for RSOs is at the core the presence of other contributions for financial support; this is why they do not care about the quality in the relationship with banks. Their revenues at this stage come mainly from other sources than sales.

Table 4 column 3 reports the coefficient of local financial development on RSO performance when the ratio Sales/ Non-Operational Earnings (or other revenues) is greater than 1. At this stage RSOs are not exclusively dependent from non-operational earnings and they start to become "real" start-ups. These are RSO operating in the market but having still financially connections with the University, although not so tight as in the situation concerning Table 4 columns 1 and 2.

In general, the real independence of RSOs from Universities and Research Institutes is not a matter of time. RSOs are different from each other, so their incubation period depends on the industry they operate.

The results of Table 4 column 3 is crucial for this study. I found evidence that RSOs coming from universities and research institutes start to act as normal start-ups when the dependence from non operational earnings decrease.

The impact of local financial development is positive and statistically significant showing that the financial system affect these firms when they become detached from those entities they were incubated in.. Since the sales are become the major source of income, the investment in intangibles is not beneficial any longer. In fact the variable Growth opportunity is negative and statistically significant, in defiance of its sign with sales equal to zero.

The regression in Table 4 column 4 reinforce my previous result. I added another constraint in the model, namely, I focus on the impact of local financial development on RSOs when sales are greater than zero and, at the same time, non-operational revenues are equal to zero. With this

constraint I am pretty sure that RSOs are not incubated anymore, are completely independent from non-operational revenues and they are fully comparables with the other firms on the market. The role of local financial system become even more important for RSOs since the value of the variable Bank Branch Density is greater. It means that when RSOs deal with market without any other source of revenues, become financially strictly interested on the local financial development. This result proves my second hypothesis H2.

As robustness, Table 5 shows the same columns of Table 4 but including also a proxy of the local structure of the financial market, with regard to the degree of bank concentration, a proxy of the local enforcement system and a proxy of the local social capital available at provincial level. In particular, as a measure of concentration in the local bank market it is used the Herfindahl-Hirschman on bank branches (HHI), based on the data provided by Aiello and Bonanno (2016) and based on Bank of Italy data. Moreover, considering that local banking market is related to local quality of the judicial system to control criminality (Bonaccorsi di Patti 2009) I included in the analysis a proxy of enforcement of the judicial system al local level (Local Enforcement), based on the work of Agostino et al. (2012) and measured as the ratio of backlog of pending civil trials to incoming civil trials (first degree of judgement). Finally, in line with Guiso et al. (2004b), I measure social capital (Local Social Capital) by the average voter turnout at the province level for referenda in Italy in the years 2003, 2005, 2006, and 2009.

Table 5 - Results concerning Local financial development and performance in RSO

	(1) performance of RSO with sales =0	(2) performance of RSO with sales /non operating revenues <1	(3) performance of RSO with sales /non operating revenues >1	(4) performance of RSO with sales >0 and non operating revenues =0
Bank Branch Density	-1.390	-0.993	0.495**	1.127**
	(0.149)	(0.297)	(0.021)	(0.028)
HHI	0.168	-0.477	1.062**	1.324
	(0.948)	(0.884)	(0.042)	(0.173)
Local Enforcement	-0.00101	-0.000516	0.0000641	0.000108
	(0.176)	(0.427)	(0.705)	(0.858)
Local Social Capital	-0.00446**	-0.00239	0.000305	0.00167
	(0.018)	(0.189)	(0.425)	(0.104)

Control variables	Yes	Yes	Yes	Yes
Observations	142	232	1121	205
R^2	0.250	0.163	0.090	0.182
Adjusted R^2	0.080	0.061	0.063	0.068

Notes: *p*-values in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Industry and Year fixed effect are included as controls. It is used the IV technique, using the following instrumental variables: Number of bank branches every 1000 inhabitants in 1936 (at county level), Number of cooperative banks every 1000 inhabitants operating in 1936 (at county level), Total number of banks every 1000 inhabitants operating in each Italian county in 1936 (at county level). HHI is the Sum of squared market shares of banks operating in the province, based on the number of bank branches in 2009. Local Enforcement is the ratio of backlog of pending civil trials to incoming civil trials (first degree of judgement). Local Social Capital is the average voter turnout at the province level for referenda in 2003, 2005, 2006, and 2009.

Table 5 shows that the main results of Table 4 are fully confirmed also controlling for the local structure of the banking system, the enforcement system and the degree of social capital in the province.

With regard to the hypothesis 3, I also conducted the same analysis of Table 4 for the control sample concerning innovative start-ups. In particular, it is interesting to test if the pattern reported considering RSOs is similar to the one concerning a sample of comparables, named innovative start-ups. These firms are still high-tech but not directly related to University or Research Center. Table 6 shows the results for this analysis, applying the same approach of Table 4.

Table 6 - Results concerning Local financial development and performance in Innovative start-ups

	(1) performance of Innovative start-ups with sales =0	(2) performance of Innovative start-ups with sales /non operating revenues <1	(3) performance of Innovative start-ups with sales /non operating revenues >1	(4) performance of Innovative start-ups with sales >0 and non operating revenues =0
Bank Branch Density	1.110*	0.442*	0.772**	-0.145
	(0.082)	(0.065)	(0.025)	(0.802)
Growth opportunity	0.537**	-0.0130	0.0376	-0.0423
	(0.027)	(0.912)	(0.751)	(0.854)
Tangibility	0.676	0.447*	0.315	0.686
	(0.384)	(0.069)	(0.251)	(0.290)
Size	0.151***	-0.0536***	0.0933***	0.0990**
	(0.001)	(0.007)	(0.000)	(0.018)
Dummy Debt	-0.355*	0.0143	-0.129*	0.0353
	(0.054)	(0.839)	(0.055)	(0.804)

Dummy Venture Capital	-0.173	0.123	-0.00149	0.212
	(0.482)	(0.261)	(0.986)	(0.233)
Dummy Industrial company	0.213	0.0396	0.0790	-0.101
	(0.214)	(0.571)	(0.220)	(0.435)
Dummy Bank	0.0448	0.100	0.0263	-0.116
	(0.814)	(0.301)	(0.748)	(0.506)
Dummy Member of a Group	0.0677	-0.0664	-0.0480	-0.0657
	(0.641)	(0.399)	(0.451)	(0.642)
Dummy North	-0.109	-0.0401	-0.0903	0.135
	(0.600)	(0.643)	(0.263)	(0.353)
Observations	103	75	332	84
Adjusted R^2	0.023	0.102	0.033	-0.155
Underidentification test	55.03	52.72	128.9	37.01
(p-value)	(0.000)	(0.000)	(0.000)	(0.000)
Weak Ident.	29.44	41.81	64.40	15.56
Sargan-Hansen test	0.294	0.154	1.045	5.772
(p-value)	(0.863)	(0.926)	(0.593)	(0.0558)

Notes: *p*-values in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Industry and Year fixed effect are included as controls. It is used the IV technique, using the following instrumental variables: : Number of bank branches every 1000 inhabitants in 1936 (at county level), Number of cooperative banks every 1000 inhabitants operating in 1936 (at county level), Total number of banks every 1000 inhabitants operating in each Italian county in 1936 (at county level).

Table 6 columns 1 to 3 shows the positive impact of the variable Bank Branch Density on firm performance for the first three different situations considered, namely sales equal to zero, sales positive and sales overcounting non-operational sales. Considering the sample of "innovative start-ups", as it can be noted, the development of the financial markets is crucial: they do not face an incubation period and they do not receive any contributions, which is why they enter to market right away after their incorporation. For these kind of companies then the presence of a bank system is decisive for their growth and their performance.

Similarly to what it has been done in Table 5, also with regard to a sample of high-tech no-research based firms I tested as robustness in Table 7, if the results of Table 6 concerning local financial development are confirmed also controlling for the bank structure in the local market (HHI), the local quality of the judicial system to control criminality (local enforcement), and for a measure of social capital at local level (Local Social Capital).

Table 7 - Results concerning Local financial development and performance in Innovative startups

	(1) performance of Innovative startups with sales =0	(2) performance of Innovative startups with sales /non operating revenues <1	(3) performance of Innovative startups with sales /non operating revenues >1	(4) performance of Innovative startups with sales >0 and non operating revenues =0
Bank Branch Density	1.240*	0.537*	1.086**	0.0779
	(0.091)	(0.072)	(0.027)	(0.936)
HHI	-0.137	0.412	0.758	-0.932
	(0.948)	(0.662)	(0.634)	(0.807)
Local Enforcement	-0.000739	-0.000714	0.000391	0.000504
	(0.741)	(0.421)	(0.662)	(0.802)
Local Social Capital	0.00375*	0.00126	0.00134	0.00103
	(0.087)	(0.261)	(0.249)	(0.704)
Observations	103	75	325	83
Adjusted R^2	0.024	0.084	0.022	-0.187

Notes: *p*-values in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Industry and Year fixed effect are included as controls. It is used the IV technique, using the following instrumental variables: Number of bank branches every 1000 inhabitants in 1936 (at county level), Number of cooperative banks every 1000 inhabitants operating in 1936 (at county level), Total number of banks every 1000 inhabitants operating in each Italian county in 1936 (at county level). HHI is the Sum of squared market shares of banks operating in the province, based on the number of bank branches in 2009. Local Enforcement is the ratio of backlog of pending civil trials to incoming civil trials (first degree of judgement). Local Social Capital is the average voter turnout at the province level for referenda in 2003, 2005, 2006, and 2009.

Table 7 shows that the main results of Table 6 concerning a sample of high-tech no-research based firms, used as comparables for the RSO sample, are fully confirmed also controlling for the local structure of the banking system, the enforcement system and the degree of social capital in the province.

6. Conclusions

King and Levin (1993), among others, show the crucial role of local financial development for the economic growth of a country. The access to external financial sources represent the major challenge for firms to overcome. Innovation is expensive and requires mature financial systems, therefore, in the absence of funding, productivity is constrained. In countries where there is greater financial development, companies are more likely to innovate (Sharma, 2007) and innovation is higher in firms that have access to external resources (Ayyagari et al, 2007). Well developed financial systems have a positive effect on entrepreneurship, growth and, as a result, company's performance. The present study deepens the relationships between the Local Financial system and

the performance of RSOs developed within Universities and Public Research Institutes, taking into account a sample of 1074 Italian RSOs and a control sample. Researchers agree on the positive impact of local financial development on firms' profitability, however the impact of a superior development of financial system on RSOs coming from Universities and Public Research Institutes is not clear cut since these special firms, although incorporated, show an high rate of stagnation. This is due mainly to the intrinsic nature of these firms: they are the result of high technological research, so they need a long period (incubation period) during which this research result needs to be refined and engineered before being commercialized. During this period the main revenues of RSOs are made up of public contributions and prizes obtained from the participation to startup competitions. This is why, in my opinion, setting an average incubation period in years is useless. The end of incubation period is achieved when the level of sales is greater than the level of other revenues, namely, all non operational earnings that are produced through the participation to competition dedicated to high tech firms or through public granting .my findings show that the impact of Local Financial Development on RSOs' performance is positive only when the ratio sales/other revenue is greater than 1, while for the control samples, which do not face an incubation period, the impact is always positive.

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Chapter 3

Gender Diversity, Cash holdings and The Role of Institutional Environment: Empirical Evidence in Europe

Abstract

While substantial evidence is emerging internationally on the higher risk aversion among women compared to men, there is less evidence on women' business choices. I explore some of the reasons explaining the relationship between the gender diversity in the board of managers and the firm's cash holdings. Specifically, this paper focuses on the choices involving the stock of cash held by companies in which women have executive roles and, as a consequence, can exert a crucial influence on the companies themselves. I find that the presence of women affects the level of cash holdings. My study shows a positive relationship between the presence of women with executive roles in the firm and the cash holdings. Notably, the study demonstrates that the quality of the institutional context in which the firm is based, has an impact on the relationship between gender diversity and cash holdings. I find that in efficient institutional contexts, the positive effect of female presence in the firm on cash stock grows. I further find that opportunistic contexts do not impact on the relationship between gender diversity and cash holdings. Moreover I deepened my analysis by considering different kinds of industries, according to their degree of innovation, and I find that the presence of women with executive roles increases the amount of cash held, especially in high innovative firms. In summary, women, tend to make more conservative choices because they are less overconfident then men. This propensity has an impact on firms when women play a leading role, since they can influence the financial choices of firms themselves.

Key words: gender diversity, female in management, cash holdings, corporate liquidity, institutional environments.

1. Introduction

The role of gender differences on firm's activities is a hot topic within the business community, drawing researchers' attention under different points of view (Bertrand 2011, Burgess and Tharenou 2002, Croson and Gneezy 2009, Erhardt et al. 2003, Hillman et al. 2002, Lyons et al. 2008, Terjesen et al. 2009, Van der Walt and Ingley 2003). Recent social changes and new trends led to "forced" changes in the composition and functioning of corporate management (Van der Walt and Ingley 2003). In particular, women can represent a significant buffer of talent, not entirely exploited, especially in such a significantly complex entity represented by the firm. Including women in the management allows companies to access to a wider range of intellectual capital, enjoying a greater variety of points of view and opinions which have the potential to strengthen firm's capacities, to improve corporate responses to stimuli of market, increasing this way the potential value of the company itself. The contribution given by women to firm management, the so called gender diversity, introduces a policy of power sharing (e.g., Bradshaw et al. 1992).

Therefore, according to the attributes owned by females, their active role in the firm, not as secretaries but in executive positions, can provide a non trivial contribution in business. A fundamental argument is that, while the literature considering the effect of women on firm performance is becoming wide, the effect of women on corporate financial decisions is underrated and deserves more attention. This paper focuses on gender diversity and its managerial implications, analyzing the impact of these differences on financial policies adopted by firms, with particular attention to cash holding.

The aim is to investigate whether and how the presence of women, with executive role within the firm, may affect corporate cash holding choices, in line with the idea that in general they tend to safeguard the financial flexibility of firm.

Moreover, while the existing gender diversity literature underlines a positive growth in the participation of women within both the management and owner's boards (e.g. Klettner et al.2016), the question remains whether and how much gender diversity drives financial decisions at international level. My second objective in the present study is to address this question. Specifically, I want to examine whether differences in the quality of institutional environment in which firms operate can magnify or exacerbate the potential effects on cash holdings that females in the management team can exert.

In addition, I intend to further broaden the analysis by examining whether women play an anti-opportunistic role, investigating the relationship between female and cash holding in sub-sample of firms having different sensitivities to opportunistic behaviors. Finally, I want to examine whether there is an industry effect that influences my main relationship. It may be that in more innovative

industries, where the risk is higher, female can exert pressure to adopt prudential and conservative corporate policies, in order to cope with unexpected adverse contingencies potentially dangerous for corporate balance. These choices should lead to an increase of cash stock (e.g. Lyandres e Palazzo 2015).

By investigating the impact of gender diversity on cash holdings, I respond to the call for research on what the role of gender diversity for firm financial policies is (e.g. Croson, and Gneezy, 2009). Furthermore, I provide evidence that not only the gender diversity is tied to financial policies but also that country's institutional environment impacts sensitively this relationship.

This work is structured as follows. Section 2 describes the research hypotheses, while the Section 3 describes the sample and the empirical model. In the Section 4 I reported the descriptive statistics. In the Section 5 are presented and discussed the results obtained in the study. Section 6 examines the impact of the presence of women with executive role on cash holding, also considering subsamples constructed according to the possibility of opportunistic behaviors and the riskiness of the sector. The paper ends up with conclusions.

2. Gender Diversity: Theoretical Perspectives and Research Hypotheses

Previous studies generally found that women behave differently than men. As suggested by Matsa and Miller (2013, pg 138) "*experiments find that women are generally more long-term oriented (..) and altruistic (..) than are men and survey evidence documents corresponding sex difference in corporate directors' preferences and values*". A factor that well explains the difference in preferences, behaviors and decisions of women compared to men is the different interpretation of risky situations, according to which women are more nervous and more afraid of men in view of negative outcomes (Leslie and Brody 1993; Fujita, Diener and Sandvik 1991). Specifically it is widely accepted that a woman is more risk averse than a man (e.g. Croson, and Gneezy, 2009; Arano et al., 2010; Booth and Nolen, 2012; Borghans et al., 2009). While men consider stimulants risky situations, women are skeptical and prefer to avoid, as far as possible, situations of risk; risky decisions are considered as threats to them. Powell and Ansic (1997) analyzed the different approach to financial decisions between women and men. They found evidence that women are less risk-seeker, although this result does not say anything about the final outcome in terms of performance. The prevalent economic and socio-psychological literature documents the presence of gender-related differences in terms of risk aversion and, in general, in terms of propensity to competition (Bernasek and Shwiff, 2001, Johnson e Powell, 1994, Sundén and Surette, 1998). Gender differences emerge, for example, with regard to risk preferences in the financial sector in terms of portfolio choice (Bernasek and Shwiff, 2001, Jianakoplos and Bernasek, 1998, Sunden e

Surette 1998; Barsky et al. 1997, Powell and Ansic 1997), or in terms of corporate strategy formulation (Adams and Ferreira, 2009, Ahern and Dittmar ,2012, Weber and Zulehner ,2010). Such higher risk aversion of women has an impact on two fundamental aspects. First, firms managed by women CEOs are characterized by less risky choices, profit and cash flows with lower level of volatility and higher chance of survival than those obtained from male CEO-led companies (Faccio et al. 2016 Arano et al., 2010; Bernasek and Shwiff,2001, Booth and Nolen, 2012; Borghans et al. (Croson and Gneezy, 2009). In addition, risk-aversion can even leads women to "*leave money on the table"* giving up risky projects, although they show a positive NPV, with a reduction of efficiency in capital allocation process due to underinvestment problems (Faccio et al. 2016). Also Huang and Kisgen (2013, pg 18) proved that women with executive roles within firms are more conservative than men. They state that "*I also confirm that women are less likely to make acquisitions than their matched male CFOs*" and again "*..women are less likely to make acquisitions, and women are less likely to issue debt*". Therefore, managers and especially female CEOs tend to be more risk-averse, showing a willingness to avoid investment and funding opportunities that present a higher risk profile, but with higher expected value. As a result, women are supposed to have the propensity to adopt prudential and more conservative behaviors. It is such risk-avoidance behavior that can lead to distortions in the investment policies of the company (Faccio et al 2016). Not only women are less risk-prone, they also tend to be less overconfident and behave less competitively. As suggested by Beckmann and Menkhoff (2008) women, compared to men, prefer to shy away from competitions. If gender diversity influences risk propensity and overconfidence, it is likely that this different approach will be reflected in the cash policy decisions since cash is a liquidity asset that allows for managerial discretionary spending (Jensen, 1986; Opler et al., 1999; Harford et al., 2008).

Moreover, cash reserves can be accumulated to cope with unexpected and adverse contingencies that in presence of adequate liquidity buffers would not represent significant shocks for the company. Constrained firms have a great stimulus to accumulate savings when the future levels of cash flow is unclear (Han and Qiu 2007). Moreover holding a great amount of cash is helpful to cope with future hedging needs (Denis and Sibilkov 2009). In addition, keeping a stock of cash will allow to ensure greater financial flexibility so that, for example, eventual growth opportunities can be exploited (Keynes 1936; Fazzari et al. 1988, Opler et al. 1999).

Thus, the precautionary reasons that lead to accumulate a stock of cash in order to safeguard the company's financial flexibility, reducing problems related to financial constraints, get on well with the lower risk propensity of women and their inclination towards cautious behaviors. In presence of imperfections of financial markets, agency costs between managers and money lenders and high

transaction costs, internal and external financial sources are not perfect substitutes, determining a condition of *financial constraints*, namely a dependence of investments, and therefore of firm growth and development processes, from internal availability of liquidity. The excessive cost of external sources compared to internal ones can create to companies difficulties to access to credit and, as a consequence, a situation characterized byfinancial constraints that hinder growth and development, preventing the possibility of exploiting growth opportunity (Fazzari et al. 1988). Financially constrained firms tend to adopt specific policies of cash holding, accumulating as much liquidity as higher is the degree of the financial constraint (Almeida et al. 2004). Moreover, an internal capital market would allow a greater degree of redeployability of assets if the investments have bad performance (Gertner et al. 1994). Thus, firms tend to hold cash in order to avoid the negative effects of financial constraint or, as a different face of the same coin, to preserve their financial flexibility. Stock of cash will allow the management to easily expand the source of finance available, for example through a better access to bank credit. Thus, holding a good amount of cash makes possible to exploit growth opportunities (Dittmar et al. 2003, Keynes 1936, Myers and Majluf 1984), to reduce problems arising from future deficit (Lins et al 2010) and to avoid negative effects arising from the volatility of cash flow (Dittmar et al. 2003).

In terms of cash holding policy, the gender composition of the management can influence the approach to these types of financial choices. Graham and Harvey (2001) revealed that financial flexibility is at first place in the management mind, highlighting the relevance of policies that are able to safeguard the firm capability to exploit growth opportunity.

Thus, especially nowadays, where the environment is constantly changing and hyper-competitive, with no space an eventual recovery after wrong decisions, firms have to be reactive and able to grasp growth opportunities.. I suppose that the presence of women within the firm influences cash holding policy conditions, first and foremost, in terms of risk aversion (Arano et al. 2010, Bernasek e Shwiff 2001, Booth e Nolen 2012, Borghans et al. 2009, Croson e Gneezy 2009). If women tend to be less prone to risk than their male counterparts, it follows that for precautionary reasons, they urge to hold greater liquidity, to cope with any future contingencies that might prevent the company to capture growth opportunity. In the light of what has just been considered, I can formulate the first hypothesis of this study:

> ***Hypothesis 1:*** *The presence of women with executive roles, given their greater risk aversion, leads to an increase in the amount of cash held by firms, for precautionary reasons and to safeguard the financial flexibility.*

A growing line of research has focused on countries institutional initiatives to achieve gender equality, measures mainly aiming to reach a given gender quota in the boards of directors (e.g. Klettner et al.2016). In a broad sense, many studies have tried to understand, according to La Porta et al. (1999) and Levine (2005), as an efficient institutional context influences corporate financial decisions.

La Porta et al. (1999) and Levine (2005) define a country as "quality intensive" whether it protects property rights, clearly defines taxes and rules and provides efficient public services. Harford et al. (2012, pg. 3) state that "*firms with weak shareholder rights, low insider ownership, and higher board independence have smaller cash reserves than those with strong shareholder rights, high ownership, and less independent boards*".

The link between institutional governance and cash holding is widely studied (Chen et al. 2014, Harford et al. 2008, Pinkowitz et al. 2006). A low degree of investor protection at the national level may be associated with higher costs of opportunism arising from *managerial entrenchment and overinvestment* (Claessens et al. 2002, Kalcheva e Lins 2007, La Porta et al. 2002, Lemmon e Lins 2003), based on the larger use of cash to pursue private benefits and expropriation of value.

Moreover, when either the governance or the investor protection at national level are strong, with better transparency of firm's activities and better communication with the markets and when the law and the enforcement system are efficient and, in general, information asymmetries are lower, the problems of opportunism and expropriation will be lessened. Under the point of view of controlling shareholders, it has been underlined (Doidge et al. 2009) how they are often less keen to list their companies in countries with high levels of investor protection because legal and regulatory constraints will force them to reduce the consumption of private benefits. Instead, considering the role of female managers in countries with better governance protection, where female precautionary way of thinking, along with their sense of opportunism-avoidance, women executives will tend to become more sensitive to financial constraints and the need to be able to exploit future growth opportunities. Thus, according to the female precautionary perspective, women with executive roles operating in countries with high governance quality will take care, as first order problem, of financial constraints and they need to keep a buffer of cash to be able to face financial problems.

The notion that insiders (controlling shareholders and managers) aim to obtain private benefits by drawing on the corporate savings is worldwide accepted. Leuz et al. conducted a comparison among the earnings management across 31 countries finding a strong correlation between the earnings management and the level of investor protection. The analysis suggests that economies with strong investor protection exhibit lower levels of earnings management than countries with weak investor protection, and less developed stock markets. It goes without saying that the earnings management

is not a problem for minority shareholders only, but for the firm in its entirety. Kalcheva et al. (2007, pg 1088) state "*I find that when external country-level shareholder protection is weak, firm values are lower when controlling managers hold more cash*". External investors take into account the availability of great amount of cash for managers and, fearing agency problems, tend to underestimate firms showing such peculiarities.

According to these previous considerations, a favorable institutional context with greater investor protection determines fewer opportunities for managerial opportunism and, as a consequence, the positive effect stemming from the presence of women executives on the cash holding will be amplified. Their higher risk aversion, as well as the limited problems of opportunism determined by the institutional environment, generate a higher women's sensitivity towards financial constraint's issues. In an institutional context that ensures greater security and protection to investors (shareholders and creditors), limiting the possibility of any opportunistic behaviors, women encourage the holding of cash stock in order to have a buffer against adverse contingencies. In particular, I investigate whether the impact of the presence of women on liquidity can change magnitude and direction according to the quality of institutional context. Thus, I can then formulate the fourth hypothesis of the study:

> ***Hypothesis 2:*** *In a well-functioning institutional contexts, which protect property rights, with clearly defined rules and efficient enforcement system, the sensitivity of women towards financial constraints issues increases, and the positive effect of their presence in the firm on cash stock for precautionary reasons grows*.

3. Sample and research design

To address my questions, I gathered information about gender diversity, thanks to the availability of names for the members of the companies and accounting data for all companies included in the Amadeus database edited by Bureau van Dijk, which include includes European privately held and publicly traded companies that satisfy specific criteria. The time span covered by this empirical analysis refers to the period 2004-2008. The sample considered for this analysis includes companies from 18 European countries, for which the details about gender are available: Austria, Belgium, Cyprus, France, Finland, Germany, Greece, Ireland, Italy, Netherlands, Norway, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom. To eliminate the effect of outliers, I winsorized my data at the 1st and 99th percentile. My final sample includes a total of 12,466 firm-year observations. Table 1 presents the distribution of the sample by countries (Panel A) and by years (Panel B).

Table 1 - Sample composition by country and year.

Panel A: Sample composition by country		
Countries	*Observations*	*Percentage*
Austria	97	0.78
Belgium	333	2.67
Cyprus	38	0.3
Finland	370	2.97
France	2,020	16.20
Germany	1,419	11.38
Greece	943	7.56
Ireland	76	0.61
Italy	392	3.14
Netherlands	382	3.06
Norway	616	4.94
Portugal	83	0.67
Slovakia	296	2.37
Slovenia	50	0.4
Spain	370	2.97
Sweden	915	7.34
Switzerland	915	7.34
United Kingdom	3,958	31.75
Total	*12,466*	*100.00*
Panel B: Sample composition by year		
Year	*Observations*	*Frequency*
2004	1,666	13.36
2005	2,046	16.41
2006	2,447	19.63
2007	3,006	24.11
2008	3,301	26.48
Total	*12,466*	*100.00*

The main model used is the following:

$$CASH_{it} = \beta 1(\text{Gender diversity})_{it} + \beta_2(Lev)_{it} + \beta_3(Own)_{it} + \beta_4(Roi)it + \beta_5(Tang)_{it} + \beta_6(Size)_{it} + \beta_7(Age)_{it} + \beta_8(Growth\_Opp)_{it} + \beta_9(GDP)_{it} + \beta_{10}(Unemploy\_fem)_{it} + \beta_{11}(Mark\_Cap)_{it} + \beta_{12}(Stre\_Leg)_{it} + \alpha_i + u_{it}$$

The dependent variable, Cash holding (CASH) is the cash held by the firm, measured as cash and cash equivalent scaled by total assets.

To identify the women executives within the database Amadeus, I considered the “gender" column right beside the member of management name’s column, as indicated in the database itself. In the absence of such information I referred to the title ("Mr." versus "Ms/Mrs/Miss" or "Dr." versus "Dr.ª", most commonly used in Portugal). In those cases where the information was not available , I

made a country specific internet search, in order to identify the gender, based on the first name of each member[11]. Finally, in line with Faccio et al. (2016), when it was not possible to identify the name's gender from lists provided on internet, I used Linkedin, Facebook and Google in order to determine whether a specific name belonged to a man or a woman.

In the econometric analysis I use two metrics for my key independent variable GENDER DIVERSITY. The first measure is % WOMEN_EXE, measured as the percentage of women with executive role scaled by the total number of officers or directors within the same firm. The second measure is D_CEO_WOMEN, a dummy variable that takes a value of 1 if a women is the CEO of firms.

I control, across all regressions, for other observable firm characteristics that might affect corporate cash holdings.

I first consider the variable LEVERAGE, measured as the ratio between total amount of financial debts and total assets of the company, in order to invastigate as an increase of debt could reduce the level of cash held by firms. Ferreira and Vilela (2004), Hardin et al. (2009) show a negative relationship between cash holdings and leverage. According to Bates et al. (2009) if the debt is constraining, companies could use the cash to reduce their leverage level, thus the relationship between these two variables is negative. I also consider the variable OWN, a measure of ownership concentration calculated as the sum of the percentage of shares owned by the first three largest shareholders of each company, that could be either positively related to cash holding in line with an entrenchment orientation of management or negatively with an incentive alignment effect between insider and outsider (e.g. Ozkan and Ozkan, 2004). Following Drobetz et al. (2009) I also expect a negative relationship between the variable TANGIBILITY, ratio of tangible assets to company's total assets, and cash holding. I also control for firm performance (the variable ROI). Mikkelson and Partch (2002) find that the performance of US firms with high cash levels is comparable to the performance of firms with normal levels of cash. In line with previous studies I expect a negative relationship between the variable SIZE, natural logarithm of total assets, and cash holdings. Dittmar et al. (2003), Drobetz et al. (2010) and Saddour (2006) find that larger firms hold less cash stock than smaller ones; moreover larger companies show minor asymmetries and face lower costs of external financing (Falla and Petersen 1993) and they have the ability to finance themselves in a simple and less costly way, even through the use of external sources; In addition, they can obtain cash from the sale of non-core assets during periods of financial distress (Lang et al. 1995; Bigelli, Sánchez-Vidal 2011). I also expect a negative relationship between the variable AGE, the natural

[11] The use of country-specific research is important to avoid misclassification. For example, the name Andrea is used for women in Germany and for men in Italy. Likewise, Simone is used for women in France and for men in Italy.

logarithm of the age of the firm plus 1 (to avoid problems in case of first year of incorporation) and cash holdings since younger and riskier (more financially constrained) firms tend to hold more cash (Baker and Sánchez-Vidal 2011). Also the variable Growth_Opp, percentage change in sales from year t to t + 1, is a relevant control variable since an increase of growth opportunities could increase the cash holding. Denis and Sibilkov (2010) and Kim et al; (2011) observed that holding cash is more valuable for companies with greater opportunities for investment or for firms for which the investment opportunities are subject to constant change, especially if these firms are financially constrained. Finally, I also consider a set of country's characteristics as the GDP, the female unemployment rate (UNEMPLOY_FEM), the market capitalization (MARK_CAP) and the strength of legal rights index (STRE_LEG). Appendix A provides definitions and sources for all variables used in the empirical analysis.

4. Descriptive Statistics

Table 2 reports summary statistics for the variables used in the baseline analysis.

Table 2 - Descriptive statistics of variables used in the model.

Variables	Mean	Standard Deviation	1° Quartile	Median	3° Quartile	Min	Max
CASH	0.131	0.153	0.027	0.076	0.175	0.001	0.749
% WOMEN_EXE	0.033	0.140	0	0	0	0	1
D_CEO_WOMEN	0.020	0.142	0	0	0	0	1
LEV	0.195	0.191	0.019	0.150	0.313	0	0.826
OWN	0.377	0.328	0.101	0.260	0.625	0.002	1
ROI	0.033	0.132	-0.003	0.051	0.102	-0.320	0.347
TANG	0.241	0.242	0.039	0.160	0.377	0	0.999
SIZE	11.48	2.083	9.989	11.28	12.54	7.057	15.57
AGE	3.078	0.998	2.397	2.992	3.828	0.693	5.030
GROWTH_Opp	0.773	1.415	-0.026	0.106	0.579	-0.999	3.700
GDP	4.52e+12	1.11e+12	4.54e+11	2.26e+12	2.69e+12	21.50451	28.91851
UNEMPLOY_FEM	7.443	3.265	4.7	7.3	9.7	2.4	19.1
MARK_CAP	87.60	42.39	54.81	82.31	126.79	0.051	2.99
STRE_ LEG	7.38	2.22	6	7	10	0	10

This table shows that the mean cash holdings value is around 13%. With regard to gender variables, the mean of the variable % WOMEN_EXE is around 3.3%. The mean of variable

D_CEO_WOMEN is 2%. Certain firm characteristics variables, such as Size, appear to be symmetrically distributed, whereas others, such as Ownership, are asymmetrically distributed.

Table 3 provides mean value for accounting and ownership firm-specific variables for my full sample according to the variable D_WOMAN_EXE and D_CEO_WOMEN. I report t-statistics for the differences in means. The mean value suggests that in firms where woman play a managerial role, epecially CEO of a firm, the cash holdings appear significantly higher compared with firm where the woman doesn't cover a managerial role. There is also a significant difference in the variable LEV, OWN and SIZE.

Table 4 provides a correlation matrix. Globally, multicollinearity problems are negligible with none of the correlations large in magnitude.

Table 3 - Statistics for woman executives and woman CEOs.

Variables (mean value)	D_WOMAN_EXE =0	D_WOMAN_EXE =1	t test	p-value	D_CEO_WOMEN =0	D_CEO_WOMEN =1	t test	p-value
CASH	0.117	0.133	3.12	0.001	0.131	0.149	1.91	0.055
LEV	0.240	0.191	7.77	0.000	0.216	0.194	1.84	0.064
OWN	0.410	0.374	3.25	0.001	0.376	0.420	2.48	0.013
ROI	0.033	0.039	1.45	0.146	0.033	0.040	0.79	0.428
TANG	0.302	0.236	8.15	0.000	0.240	0.260	1.26	0.204
SIZE	11.35	11.49	2.01	0.044	11.49	10.90	4.53	0.000
AGE	3.15	3.07	2.44	0.014	3.07	3.17	1.53	0.124
GROWTH_Opp	0.561	0.695	1.83	0.063	.773	0.640	1.48	0.136

Table 4 - Correlations matrix.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1 CASH	1													
2 % WOMEN_EXE	0.02	1												
3 D_CEO_WOMEN	**0.03**	**0.61**	**1**											
4 LEV	0.36	0.03	0.02	1										
5 OWN	-0.02	0.02	0.02	0	1									
6 TANG	-0.31	0.03	0.01	0.29	0.09	1								
7 ROI	-0.09	0.01	0.01	-0.04	-0.01	0.08	1							
8 SIZE	-0.25	-0.04	-0.04	0.23	-0.23	0.2	0.32	1						
9 AGE	-0.18	0	0.01	0.11	0.02	0.19	0.19	0.29	1					
10 GROWTH_Opp	0.05	-0.04	-0.01	-0.01	0.17	0.01	0.04	-0.01	-0.05	1				
11 GDP	0.11	-0.17	-0.08	-0.02	-0.17	-0.21	0.01	0.08	-0.02	-0.02	1			
12 UNEMPLOY_FEM	-0.09	0.05	0.09	0.11	0.26	0.09	0.06	-0.08	0.15	0.07	-0.29	1		
13 MARK_CAP	0.04	-0.05	-0.03	-0.05	-0.2	-0.02	0.05	0.09	-0.02	0.05	0.22	-0.42	1	
14 STRE_ LEG	0.06	-0.13	-0.09	-0.08	-0.19	-0.05	-0.04	-0.01	-0.14	-0.05	0.46	-0.58	0.45	1

Notes: Correlations greater than 0.03 or lower than -0.03 are statistically significant at the 0.05 level or lower.

5. Main empirical results

5.1 Baseline regression results

Table 5 reports my main regression results.

Table 5 The relationship between gender diversity and cash holdings

	Baseline model		Robustness
	(1)	(2)	(3)
VARIABLES	CASH	CASH	CASH
% WOMEN_EXE	0.023***		
	(0.009)		
D_CEO_WOMEN		0.029***	
		(0.000)	
D_WOMEN_EXE			0.015*
			(0.065)
LEV	-0.213***	-0.213***	-0.213***
	(0.000)	(0.000)	(0.000)
OWN	-0.015	-0.015	-0.014
	(0.103)	(0.104)	(0.104)
TANG	-0.110***	-0.110***	-0.110***
	(0.000)	(0.000)	(0.000)
ROI	-0.032	-0.032	-0.032
	(0.241)	(0.245)	(0.242)
SIZE	-0.010***	-0.010***	-0.010***
	(0.000)	(0.000)	(0.000)
AGE	-0.012***	-0.012***	-0.012***
	(0.000)	(0.000)	(0.000)
GROWTH_Opp	0.006***	0.006***	0.006***
	(0.000)	(0.000)	(0.000)
GDP	0.012***	0.012***	0.012***
	(0.002)	(0.002)	(0.001)
UNEMPLOY_FEM	-0.002	-0.002	-0.002
	(0.338)	(0.307)	(0.333)
MARK_CAP	0.007	0.007	0.007
	(0.367)	(0.383)	(0.371)
STRE_ LEG	-0.003	-0.003	-0.003
	(0.131)	(0.126)	(0.139)
Observations	12,460	12,460	12,460
R-squared	0.214	0.214	0.214
Industry FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Country FE	Yes	Yes	Yes

Note: Appendix A provides details on the construction of the regression variables. Robust standard errors are reported in brackets. (*), (**) and (***) indicate significance at the level of 10%, 5% and 1% respectively.

In column 1 I find that a 1 % increase of women executives determines an increase of cash held by the firm of 2.3%. In column 2 I find that firms with a female CEO own 2.9% more cash than those with a male CEO. As robustness test, in column 3, results are based on a dummy which is equal to 1 if there is at least one female among the executive of a firm as member of management. In particular, the mean (SD) is equal to 7.7% (26%), highlighting that there are very few firms having women as part of the executives. The results in column 3 of Table 5 show that firms that have at

least a female executive have 1.5% more cash than firms that do not have women with executive role.

These results confirm my prediction in H_1. In line with most studies (e.g. Arano et al. , 2010; Booth and Nolen, 2012; Borghans et al., 2009) women, driven by precautionary reasons, are less inclined to risk compared to male counterparts and tend to hold greater cash holdings as a safeguard of financial flexibility, being interested in short term survival and long term capacity to catch growth opportunities.

Regarding the control variables, in line with Bigelli, Sánchez-Vidal (2011) I find a negative relationship between the variable SIZE and cash holding. Regarding the variable LEV, a negative relationship can be noticed in line with previous studies (e.g. Ferreira and Vilela, 2004). Interesting is the positive relationship between the variable GROWTH_Opp and cash holding, suggesting how an increase of growth opportunities for the company increases the stock of cash held (Denis and Sibilkov, 2010). The negative sign found for the variable TANG is supported by the study of Drobetz et al. (2009). I also highlight a negative relationship between the variables AGE and cash holding in line with Baker and Sánchez-Vidal (2011). Finally, the results show no statistically significant coefficients for variables OWN, ROI and for country-level control variables.

5.2 Regression results concerning gender diversity, cash holdings and the role of country's institutional features

The research hypothesis H2 focuses on country-specific differences in terms of institutional governance, checking the impact of the presence of women with executive role on cash holding according to the quality of the institutional environment.

As proxies for the institutional quality of a country, I use five Kaufman et al. (2002) governance indicators taken from World Bank[12]site , since they are the most commonly used indicators in literature[13]: rule of law; control of corruption; voice and accountability in the political system; government effectiveness; regulatory quality. In addition, I examine the robustness of my results by including the anti-director rights index proposed by Spamann (2010) as alternative measures of the quality of the legal and institutional environment. The detailed description of these variables and their sources are summarized in Appendix A. These institutional variables have been already used

[12]http://databank.worldbank.org/data/views/variableselection/selectvariables.aspx?source=world-development-indicators

[13] Dyankov et al. (2006) stated that countries with good regulation grow faster. Licht et al. (2007) use these governance indicators to prove the relationship between national culture and social institutions. Kaufmann et al. (2002) use the following indexes: "Voice and accountability", "Government effectiveness", "Regulatory Quality", "Rule of law" and "Control of corruption" with the aim to obtain updated estimates of six dimensions of governance for 175 countries in 2000-01, and then repeatedly updated along the years these measures..

in several studies on cash holding determinants (Stulz 2005, Caprio et al. 2010, Desai et al. 2007, 2010, Fauver Durnev and Ayyagari et al 2010), but never with reference to the role of women as decision makers within a firm.

For the paper purpose in the empirical analysis I consider firms below the 1st quartile (low quality of the institutional environment) and beyond the 3rd quartile (high quality institutional context) in order to better investigate if the effect of the female presence on cash holdings is more relevant when the quality if institutional environment is high. Results are given in Table 6.

Table 6 - Regression analysis considering institutional environment differences.

	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
	LOW_RULE		*HIGH_RULE*		*LOW_CONTR_CORRUP*		*HIGH_CONTR_CORRUP*	
Variables	CASH	CASH	CASH	CASH	CASH	CASH	CASH	CASH
% WOMEN_EXE	0.006		0.039**		0.001		0.032**	
	(0.598)		(0.022)		(0.884)		(0.027)	
D_CEO_WOMEN		0.000		0.036***		-0.001		0.025**
		(0.983)		(0.001)		(0.720)		(0.032)
Observations	3,288	3,288	3,407	3,407	3,667	3,667	2,894	2,894
R-squared	0.249	0.249	0.234	0.236	0.225	0.225	0.242	0.243

	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
	LOW_VOICE_ACCOUNT		*HIGH_VOICE_ACCOUNT*		*LOW_GOV_EFFECT*		*HIGH_GOV_EFFECT*	
	CASH	CASH	CASH	CASH	CASH	CASH	CASH	CASH
% WOMEN_EXE	0.010		0.032**		-0.003		0.033***	
	(0.537)		(0.019)		(0.784)		(0.008)	
D_CEO_WOMEN		0.003		0.025***		0.001		0.025***
		(0.492)		(0.007)		(0.671)		(0.001)
Observations	2,931	2,931	3,000	3,000	3,281	3,281	3,167	3,167
R-squared	0.253	0.253	0.231	0.232	0.261	0.261	0.230	0.231

	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
	LOW_REG_QUAL		*HIGH_REG_QUAL*		*LOW_ANTIDIR_RIGHTS*		*HIGH_ANTIDIR_RIGHTS*	
	CASH	CASH	CASH	CASH	CASH	CASH	CASH	CASH
% WOMEN_EXE	0.016		0.024***		0.015		0.026***	
	(0.424)		(0.000)		(0.482)		(0.000)	
D_CEO_WOMEN		0.004		0.025***		0.012		0.022***
		(0.499)		(0.000)		(0.244)		(0.000)
Observations	3,119	3,119	3,629	3,629	2,601	2,601	4,399	4,399
R-squared	0.229	0.229	0.187	0.187	0.240	0.241	0.196	0.196

Note: Appendix A provides details on the construction of the regression variables. All control variables are included but the coefficients are not reported. Robust standard errors are reported in brackets. (*), (**) and (***) indicate significance at the level of 10%, 5% and 1% respectively.

Results shown in table 6 are based on six different governance indicators used to measure the quality of the institutional context. I notice that the number of female executives, in the case of high efficiency of the context, affects positively the cash stock. These results confirm the hypothesis H_2. The positive effect of the presence of female executives on cash detention for precautionary reasons, which is in general justified with the higher risk aversion of women, is strengthened in well-functioning institutional contexts, which mitigate the problems of opportunism. In high quality institutional contexts the female risk aversion and the higher concern of women for possible future negative contingencies from which to hedge through most conservative financial choices, will become dominant. In this regard, the positive impact of women on cash holdings, in strong institutional contexts that reduce the possibility of using discretionary power to achieve private benefits, is stronger than the negative impact that could be caused by a reduction of the financial constraints due to the high quality of the institutional environment. The coefficients of the gender variables are indeed positive in all cases characterized by good quality of the institutional environment. On the contrary, in the case of low-quality country-level governance, the presence of women executives in firms is not significant.

5.3 Robustness tests

5.3.1 Gender diversity, cash holding and opportunistic behaviors

Although my hypothesis H1 allows to appreciate the role of females in terms of precautionary motivations either to make firms survive in the short-run or with the intent to safeguard their financial flexibility in order to be able to catch future growth opportunities, there might be a potential different explanation shaping cash holding decisions of female executives. This motivation is based on the more ethical nature of women who typically show less opportunistic behaviors.

Indeed, observed differences between men and women that highlight 'natural' behavioral differences may be the result of other confounding variables, including the opportunistic context. Despite the are many relevant benefits in holding cash, such as lower financial constraint and higher financial flexibility (Graham and Harvey 2001) that gives the possibility to exploit growth opportunities (Dittmar et al. 2003, Myers and Majluf 1984), cash is the easiest tool to draw private benefits to detriment of shareholders; this phenomenon might be considered the "dark side" of the detention of cash reserves (Brealey et al. 2003). In fact, the detention of liquidity involves the occurence of potential problems related to agency costs,

information asymmetries and managerial opportunism. Information released by companies run by males tend to be more opaque compared to companies where women are predominantly present (Faccio et al 2016). In this regard, the presence of women in the firms tends to mitigate problems associated with managerial opportunism, leading to a greater transparency of information (Srinidhi et al. 2011). Jensen (1986) discussed about situations in which opportunism prevail within the firm.

I assume that in an environment *à la* Jensen (1986), namely conducive to the occurrence of opportunistic behaviors (namely, low growth opportunities, low debt and plentiful cash flows), female executives exert pressure in order to reduce the cash stock, so that they can curb ”hidden thoughts” of managers who abuse of their positions to pursue private benefits. In such contexts, where the probability of opportunistic behaviors is higher, the greater fairness and social responsibility of women should exert a negative effect on the stock of cash. (Chi and Lee, 2010; and Jensen, 1986) Therefore, it could be interesting to test whether in contexts suitable to managerial opportunism, the presence of women executives reduces the stock of cash, limiting managerial discretion to pursue private benefits. For this purpose I created two subsamples using observations in the first and third quartile to better investigate whether the effect of woman on cash holdings is higher when opportunistic behavior is higher. The subsample named HIGH_OPP_BEHAVIORS includes firms for which growth opportunity and corporate debt are below the first quartile and the cash flow is higher than the third quartile, otherwise they will be included in the other sub sample named LOW_OPP_BEHAVIORS. The detailed descriptions of subsample construction are summarized in the Appendix. Results are reported in table 7.

Table 7 - Results for subgroups of firms with high opportunistic behaviors vs low opportunistic behaviors

	HIGH_OPP_BEHAVIORS			LOW_OPP_BEHAVIORS		
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	CASH	CASH	CASH	CASH	CASH	CASH
% WOMEN_EXE	0.060			0.068		
	(0.562)			(0.104)		
D_CEO_WOMEN		0.046			0.114***	
		(0.321)			(0.009)	
D_WOMEN_EXE			0.008			0.056**
			(0.728)			(0.036)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Observations	423	423	423	512	512	512
R-squared	0.194	0.202	0.198	0.237	0.208	0.263

Note: Appendix A provides details on the construction of the regression variables. All control variables are

included but the coefficients are not reported. Robust standard errors are reported in brackets. (*), (**) and (***) indicate significance at the level of 10%, 5% and 1% respectively.

Results do not support the perspective of lower opportunism of female executives in cash holding decisions. In a framework conducive to the implementation of opportunistic behaviors, there is no statistically significant role of women. On the contrary, where potential problems of opportunism are absent, I note the positive role of women in trying to create liquidity buffers within the company in anticipation of future growth opportunities that could be exploited in contexts.

5.3.2 Gender diversity, cash holding and R&D intensive firms

In order to better characterize the effect of women on corporate financial choices, I take into account the riskiness of the industry in which firms operate. I investigate whether the impact of the presence of women on cash holding can change direction according to the level of innovation as a factor affecting the relationship between gender diversity and cash holdings.

Several studies have tried to understand how financial choices can change (in particular those relating tocash holding) according to the degree of riskiness of the sector in which a company works.

Innovative companies are a "bet on the future", they are highly risky and most of their assets are intangible. In the early stages of their life these firms have no accurate ideas and prototypes, and most of their assets, being made of knowledge and human capital, it is difficult to quantify. Previous studies find large amounts of cash and a steady increase in time of cash holdings in more innovative companies and in those characterized by a high investments in research and development (e.g. Gamba and Triantis, 2008; Bolton, et al. 2011; Lyandres e Palazzo 2015).

Due to their higher risk aversion, women push to hold greater quantities of cash to avoid or minimize the risk of incurring in situations of financial constraint especially in high tech and innovative sectors. As a result, a stronger positive relationship between gender and the cash holding is expected.

To test the role of business risk, in order to deepen the relationship between female executives and financial choices, I focus on sector-specific differences in terms of technology intensity, employing the Pavitt (1984) taxonomy that defines four industry categories with common characteristics in terms of sources of technology, nature and directions of innovation. Following previous studies I assume that science-based firms are the most R&D intensive ones and, conversely, firms in supplier dominated sector and scale-intensive are the less

R&D intensive ones. Accordingly, Table 8 reports my main regression results on the relationship between gender diversity and cash holdings which is estimated for the two groups of firms based on the R&D intensity.

Table 8 - Results for subgroups of firms: high R&D-intensive and low R&D-intensive

	HIGH R&D-INTENSIVE			LOW R&D-INTENSIVE		
VARIABLES	CASH	CASH	CASH	CASH	CASH	CASH
% WOMEN_EXE	0.057***			0.010		
	(0.004)			(0.449)		
D_CEO_WOMEN		0.083***			0.005	
		(0.000)			(0.374)	
D_WOMEN_EXE			0.032***			0.007
			(0.009)			(0.491)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4,777	4,777	4,777	7,683	7,683	7,683
R-squared	0.226	0.228	0.226	0.206	0.206	0.206

Note: Appendix A provides details on the construction of the regression variables. All control variables are included but the coefficients are not reported. Robust standard errors are reported in brackets. (*), (**) and (***) indicate significance at the level of 10%, 5% and 1% respectively.

I find that in the subsample of high R&D intensive firms, all gender variables have positive and statistically significant coefficients. Given the greater uncertain future of R&D intensive firms (e.g. Gamba and Triantis, 2008; Bolton, et al. 2011; Lyandres e Palazzo 2015), female presence in such companies leads to a higher cash holding detention for precautionary reasons in order to exploit growth opportunities and, above all, to deal with any eventuality through a proper liquidity buffer. Therefore, it is clear how the tendency of women to be more conservative and cautious, affects corporate financial decisions. In fact women tend to increase the stock of cash to support potential future growth opportunity and to reduce the risk of financial constraint. For the subsample of less R&D intensive firms, the coefficients of the variables related to gender diversity are not significant.

6. Conclusions

This empirical investigation focuses on a topic so far not very examined in literature, and could be used as a basis for future research, or as a support for policies aimed to increase the presence of women in management. This study found a positive impact of the presence of female executives on cash detention.. According to the literature, one of the main reasons that

push companies to hold larger amounts of cash, is “precautionarity”, in other words, the accumulation of cash is helpful to cope, , with the potential occurrence of unexpected events which would be generators of costs in absence of an adequate liquidity buffer. The aim is therefore to ensure greater financial flexibility to exploit any future opportunity of growth. Women, characterized by a greater risk aversion if compared to men, hold cash as a precautionary measure, namely, they tend to hold greater quantities of cash to have a liquidity buffer against adverse events or to make the most of the growth opportunities and reduce the problems of financial constraint. Interestingly, in line with my expectations, I find that such positive relationship between the presence of women executives and cash is strongly influenced by the quality of the governance at the institutional level of the country where the company operates. A favorable institutional context determines greater investor protection since it ensures greater tutelage.

Moreover, there is no relationship between the presence of women with executive role and the cash holding in context particularly suitable to opportunistic behaviors. Finally, the positive relationship between the variables of gender, and the detention of cash was detected to a greater extent in innovative sectors, characterized by a higher degree of risk with respect to traditional sectors, since the higher risk aversion of women pushes them to hold greater quantities of cash to limit the risks of financial constraint. For high-tech companies attracting external funding is typically very difficult, and so there may be situations of financial constriction, which could foreclose the possibility to make the most of important opportunities for investment

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Appendix 1

Variable	Definition	Source
Dependent variable		
CASH	The cash held by the firm, measured as cash and cash equivalent scaled by total assets.	Amadeus database
Independent variables: gender diversity		
% WOMEN_EXE	Percentage of women with executive role (management or board member) scaled by the total number of officers or directors.	Amadeus database
D_CEO_WOMEN	A dummy variable that takes the value of 1 if a women is the CEO of firms. 0 otherwise	Amadeus database
D_WOMEN_EXE	A dummy variable that takes the value of 1 if the women is member of management or board member. 0 otherwise	Amadeus database
Control variables		
LEV	A proxy of financial structure choices, is measured as the ratio between the total amount of financial debts and the total assets of the company.	Amadeus database
OWN	A measure of ownership concentration, is calculated as the sum of the percentage of shares owned by the first three largest shareholders of each company.	Amadeus database
ROI	Ratio between ebit (earnings before interest and tax) divided by the sum of debt plus equity.	Amadeus database
TANG	Ratio of tangible assets to company's total assets.	Amadeus database
SIZE	Natural logarithm of total assets.	Amadeus database
AGE	Natural logarithm of the age of the firm plus 1 (to avoid problems in case of first year of incorporation).	Amadeus database
GROWTH_Opp	Percentage change in sales from t to t + 1.	Amadeus database
GDP	Natural logarithm of GDP at purchaser's prices.	World Bank
UNEMPLOY_FEM	Unemployment rate of women, based on the percentage of the labor force consisting of women who are unemployed but willing to work or looking for a job.	World Bank
MARK_CAP	Ratio between the stock market price multiplied by the number of outstanding shares to GDP.	World Bank

STRE_LEG	The strength of legal rights index measures the degree to which collateral and bankruptcy laws protect the rights of borrowers and lenders and thus facilitate lending. The index ranges from 0 to 12, with higher scores indicating that these laws are better designed to expand access to credit.	World Bank
Variables used to test the role of country institutional features		
LOW_RULE and HIGH_RULE	Rule of law index captures perception of the extent to which agents trust society's rules and respect them; I refer, in particular, to the quality of contracts execution, to property rights protection, to police and courts effectiveness, as well as the likelihood of crime and violence. The esteem of this indicator gives the score of the country, in units of a standard normal distribution, with values ranging from about-2.5 to 2.5. Based on this index, I create two subsamples, named respectively, LOW_RULE and HIGH_RULE, discriminating countries with low and high values, on the basis of, respectively, the first and third quartile.	World Bank
LOW_CONTR_CORRUP and HIGH_CONTR_CORRUP	Control of corruption index, it captures the perception of the extent to which the public power is exercised for private purposes, including small and large forms of corruption. The esteem of this indicator gives the score of the country, in units of a standard normal distribution, ranging from about-2.5 to 2.5. Based on this index, I created two subsamples, named respectively,LOW_CONTR_CORRUP and HIGH_CONTR_CORRUP discriminating countries with low and high values, on the basis of, respectively, the first and third quartile.	World Bank
LOW_VOICE_ACCOUNT and HIGH_VOICE_ACCOUNT	Voice and accountability index, it captures the perception of the extent to which citizens are involved in the selection of their Government's members, as well as the perception of freedom of expression, freedom of association, and freedom of information disclosure. The esteem of this indicator gives the score of the country in units of a standard normal distribution, ranging from about-2.5 to 2.5. . Based on this index, I created two subsamples, named respectively, LOW_VOICE_ACCOUNT and HIGH_VOICE_ACCOUNT , discriminating countries with low and high values, on the basis of, respectively, the first and third quartile.	World Bank
LOW_GOV_EFFECT and HIGH_GOV_EFFECT	Government effectiveness index, it captures the perception of the quality of public services, the	World Bank

	quality of the civil service and the degree of its independence from political pressures, the quality of the formulation and implementation of policies and the credibility of the government for the realization of these policies. The estimate provides the country's score on the basis of an aggregate indicator, in units of a standard normal distribution, ranging from about -2.5 to 2.5. Based on this index, I created two subsamples, named respectively, LOW_GOV_EFFECT and HIGH_GOV_EFFECT , discriminating on the basis of first and third quartiles.	
LOW_REG_QUAL and HIGH_REG_QUAL	Regulatory quality index, it captures the perception of the Government's capacity to formulate and implement policies and rules in order to promote the private sector development. The esteem of this indicator gives the score of the country, in units of a standard normal distribution, ranging from about -2.5 to 2.5. Based on this index, I created two subsamples, named respectively, LOW_REG_QUAL and HIGH_REG_QUAL discriminating countries with low and high values, on the basis of, respectively, the first and third quartile.	World Bank
LOW_ANTIDIR_RIGHTS and HIGH_ANTIDIR_RIGHTS	Anti-director rights index, it increases when: (1) the country allows shareholders to vote by proxy; (2) shareholders are not required to deposit their shares before the general shareholder's meeting; (3) the slate voting or the proportional representation of minorities in the Board of directors are allowed; (4) a mechanism of oppressed minorities is feasible; (5) the minimum percentage of shares needed to request an extraordinary shareholders ' meeting is less than or equal to 10%; (6) shareholders have a right of option which can only be carried out by a shareholders ' meeting. This index ranges from 0 to 5. Based on this index, I created two subsamples, named respectively, LOW_ANTIDIR_RIGHTS and HIGH_ANTIDIR_RIGHTS , discriminating countries with low and high values, on the basis of, respectively, the first and third quartile.	Spamann (2010)
Variables used for robustness tests		
HIGH_OPP_BEHAVIORS and LOW_OPP_BEHAVIORS	Subsample named HIGH_OPP_BEHAVIORS includes firms for which growth opportunity and corporate debt are below the first quartile and the cash flow is higher than the third quartile. Subsample named LOW_OPP_BEHAVIORS includes firms for which growth opportunity and corporate debt are above the third quartile and the cash flow is lower than the first quartile.	Amadeus database

HIGH R&D-INTENSIVE FIRMS and LOW R&D-INTENSIVE FIRMS	Pavitt (1984) taxonomy, which divides the sectors into four groups on the basis of technology intensity, was used in order to take into account innovation intensity. Firms in science-based specialized supplier industries and in specialized Supplier industries, are the most R&D intensive ones and are named HIGH R&D-INTENSIVE FIRMS. Firms in supplier dominated and scale-intensive industries are the less R&D intensive ones and are named LOW R&D-INTENSIVE FIRMS.	Amadeus database and Pavitt (1984 taxonomy

Conclusion of the thesis

The outcomes of this research show statistically that RSOs with females in top management positions are associated with an increase in firm profitability, while this doesn't result in other control samples that I used to corroborate my analysis. Moreover, female managers working in inclusive and tolerant contexts, characterized by a greater gender parity level, are likely to have superior performance in several skill areas like: conflict resolution, adapting to change, developing others' capabilities, and motivating and inspiring coworkers. Females in research contexts are open to change and they provide more innovative insights and ideas for running a firm than just male executives. Multitasking skills that women play in their personal lives, increase comprehensiveness in decision making and enhance organizational performance and improve the networking capabilities of firms.

This conclusions also have important ramifications for policy makers and may be a strong argument for having more women on boards in science based firms .With this contributions I demonstrated that within RSOs an high representation of women with executive role positively influence the performance of the firm. Other studies (Matsa and Miller, 2013) show that mandatory gender quotas among listed firms affect corporate decisions leading to a deterioration of profitability in the short run. I demonstrated that this is not true for RSOs. The results of the second chapter deepen the relationships between the Local Financial system and the performance of RSOs. Researchers unanimously agree on the positive impact of local financial development on firms' profitability, however the impact of a superior development of financial system on RSOs is not clear cut since these special firms, although incorporated, show an high rate of stagnation. This is due mainly to the intrinsic nature of these firms: they are the result of high technological research, so they need a long period (incubation period) during which this research result needs to be refined and engineered before being commercialized. During this period the main revenues of RSOs are made up of public contributions and prizes obtained from the participation to start-up competitions. This is why, in my opinion, setting an average incubation period in years is useless. The end of incubation period is achieved when the level of sales is greater than the level of other revenues, namely, all non operational earnings that are produced through the participation to competition dedicated to high tech firms or through public granting .My findings show that the impact of Local Financial Development on RSOs' performance is positive only when the ratio sales/other revenue is greater than 1, while for the control samples, which do not face an

incubation period, the impact is always positive. The findings of the third chapter show a positive impact of the presence of women executives on cash detention within companies. According to the literature, one of the main reasons that pushes companies to hold larger amounts of cash, is “precautionarity”, namely the accumulation of cash to cope, prudentially, with potential occurrence of unexpected events which would be generators of costs in absence of adequate liquidity buffer. The aim is therefore to ensure greater financial flexibility to exploit any future opportunity of growth. Women, characterized by a greater risk aversion if compared to men, hold cash as a precautionary measure namely they tend to hold greater quantities of cash to have a liquidity buffer against adverse event or to make the most of the growth opportunities and reduce the problems of financial constraint. Interestingly, in line with my expectations, I find that such positive relationship between the presence of women executives and cash is strongly influenced by the quality of the governance at the institutional level of the country where the company operates.