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Empowering female entrepreneurs through university affiliation: evidence from Italian academic spinoffs

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Abstract Female entrepreneurship, despite increasing attention, is still largely understudied, especially in the academic context. By adopting the lenses of entrepreneurial ecosystems and feminist theories, the paper investigates the firm performance of female entrepreneurs. We provide empirical evidence of the underperformance of women-led firms, being academic spinoffs or not, compared to men-led firms in terms of growth and their overperformance in terms of survival rate. In addition, we focus on differences in the performance of women-led firms only by comparing Italian academic and nonacademic companies. In virtue of their university affiliation, women-led academic spinoffs result to grow more than women-led nonacademic spinoffs and tend to show lower survival rates, which makes them more similar to men-led companies.

Plain English Summary Although female entrepreneurs are still discriminated against compared to their male counterparts in academia as well as outside, in terms of resources as well as business preferences, we demonstrate that university support is beneficial to female academic entrepreneurship with respect to other forms of female entrepreneurship. In virtue of their university affiliation, women-led academic spinoffs result to grow more than women-led nonacademic innovative startups. At the same time, they tend to show lower survival rates, which makes them more similar to men-led companies. Therefore, the principal implication of this study is that female academic entrepreneurship is relevant for entrepreneurial ecosystems and the entire society in terms of generating growth opportunities. Thereby, the role of universities is fundamental, as they provide resources, skills, and competencies through which female entrepreneurs may be empowered.

Keywords Female entrepreneurship · Academic spinoffs · Gender · Growth · Survival rate

JEL Classification I23 · L25 · L26 · M13

1 Introduction

Entrepreneurial ecosystems are structures where the interaction of multiple actors fosters innovation and economic advancement by creating a supportive environment for entrepreneurship (Acs et al., 2018; Isenberg, 2010; Stam, 2015). Improving their effectiveness can influence entrepreneurial behavior and

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enhance the survival and growth of established businesses (Acs et al., 2011; Welter, 2011).

One of the ways to do so is by focusing on female entrepreneurship, which has been contributing more and more to economic development and well-being (Acs et al., 2011; Ozkazanc-Pan & Muntean, 2021). Yet, what has emerged from previous studies is that entrepreneurship is a gendered phenomenon (Jennings & Brush, 2013), where the rates of female entrepreneurs remain significantly lower than a male counterparts in both developed and developing countries (Acs et al., 2011), and where women-led firms underperform their men-led counterparts in terms of sales, employment, and growth (see Ahl, 2006; Jennings & Brush, 2013). Feminist theories have suggested as an explanation that women are characterized by either lower resource endowment and discrimination (liberal feminist theory) that prevent their business to grow or different attributes and aspirations (social feminist theory), which lead them to consider an alternative measure of business success (Fischer et al., 1993). Entrepreneurship literature, instead, in explaining the causes of the different rates and success of women entrepreneurship has focused on multiple archetypes of entrepreneurial ecosystems, such as policies (Foss et al., 2019; Terjesen et al., 2016), culture (Bardasi et al., 2011; Hechavarría & Brieger, 2022; Hechavarría et al., 2017), financial resources (Lauto et al., 2022) social capital and networks (Neumeyer et al., 2019), and universities (Di Paola, 2020; Rodríguez-Gulías et al., 2018; Shane et al., 2015).

Academic entrepreneurship plays a central role in entrepreneurial ecosystems. By incentivizing academic staff, including female academics, to disseminate the results of their research, they can generate knowledge spillover, high-quality employment, and innovativeness (Acs et al., 2009; Hayter, 2013). The university, however, is one of the contexts where women are most underrepresented, and the reasons behind it are far from being fully investigated (Di Paola, 2020; Micozzi et al., 2016; Rosa & Dawson, 2006; Shane et al., 2015). The role of the university context within the flourishing literature on gender in entrepreneurship thus has long been overlooked (Jennings & Brush, 2013; Perkmann et al., 2021). This is surprising because academic entrepreneurship studies have emphasized the characteristics of the university context and thereby the mechanisms adopted to promote general entrepreneurial activity and performance (see Miranda et al. (2018) for a review).

Therefore, the aim of the study is to investigate the role played by academic context in shaping female entrepreneurship and its performance. In response to Welter, (2011), which claims the importance of the context, we focus on the female academic entrepreneurship phenomenon. By conjugating feminist theories with concepts of entrepreneurship (Ahl, 2006; Rodríguez-Gulías et al., 2018; Yadav & Unni, 2016), we enlighten the debate about the underperformance of women-led firms by demonstrating the positive role played by university affiliation.

By relying on the population of 1055 Italian academic spinoffs (henceforth ASOs) and 7644 Italian innovative start-ups established from 2006 to 2018 and 2010 to 2018, respectively, we adopt a conditional-difference-in-difference (henceforth DID) approach to assess the performance of women-led firms in terms of growth and survival compared to men-led firms and, therefore, to compare differences in performance between different women-led businesses, namely academic spinoffs (henceforth ASOs) and nonacademic innovative startups (see Delmar & Davidsson, 2000 for similar reasoning on nascent entrepreneurs). ASOs are new entrepreneurial companies created by academic personnel (Colombo et al., 2010) to exploit technological knowledge that originated within universities (Fini et al., 2011). They are considered a specific case of the broader category of innovative start-ups, namely new entrepreneurial companies with a high innovation characterization (Audretsch et al., 2020). Due to their peculiar genetic characteristics, ASOs are endowed with different initial competence configurations in terms of resources, capabilities, and business models compared to innovative non-ASOs, which lead to different development strategies and objectives (Colombo & Piva, 2012; Soetanto & Jack, 2016; Zahra et al., 2007). We, therefore, expect that they can play a different role also in relation to women's entrepreneurship.

We provide empirical evidence that women-led firms survive more but grow less than men-led ones, regardless of the type of business. However, when considering the performance of women-led ASOs relative to a control group of women-led non-ASOs, the university support does make the difference. The support from parent organizations gives women access to resources, skills, and networks to establish companies

able to grow over time, making them more similar to non-women-led firms.

This contributes to shedding light on the importance of university support in academic entrepreneurship, especially under the gender lens. This may have important implications, both theoretical and practical, to address the disadvantaged situation of female entrepreneurs within the academic context (Di Paola, 2020) and in the entrepreneurship field in general (Acs et al., 2011; Jennings & Brush, 2013). It will contribute also to the entrepreneurial ecosystem literature by providing evidence of the empowering role of university support and the increasingly central role played by universities as entrepreneurship enablers and discrimination inhibitors (Foss et al., 2019).

The rest of the paper is organized as follows: In the next section, the literature review discusses women's entrepreneurship literature in the light of feminist theories and presents the main studies investigating the topic within the framework of the entrepreneurial ecosystem. Thereby, the role of universities within entrepreneurial ecosystems is highlighted, as well as the relevance of the academic entrepreneurship phenomenon. Finally, based on the empirical evidence about the underrepresentation of women in entrepreneurship in general and in academic entrepreneurship in particular, as well as on the relevance of universities in overcoming traditional barriers to entrepreneurship, we develop a set of hypotheses. Afterward, the data and methodology adopted are explained in the research design section. The main results are presented and discussed. A final section with remarks, implications, and venues for future research closes the paper.

2 Literature review and hypotheses development

2.1 The entrepreneurial ecosystems as the theoretical framework

The entrepreneurial ecosystem is the set of interacting elements which create a supportive environment for new venture creation and growth (Acs et al., 2018). Entrepreneurial ecosystems are composed of several elements: policies, regulatory framework and infrastructures, funding and finance, culture, social capital and network, human capital and training, mainly delivered by universities (Isenberg, 2010), which concur to a different extent to influence women entrepreneurship. Among the factors affecting women more than men's entrepreneurship, Foss et al., (2019) suggest that appropriate education, training, and mentoring can provide women with entrepreneurial and management skills that are fundamental for business establishment and performance. Similarly, incubators, laboratories, and equipment are physical facilities that address issues women face in accessing appropriate resources and funding to start and grow their businesses (Foss et al., 2019). In addition, an increasing emphasis had been placed on policies (Foss et al., 2019; Terjesen et al., 2016).

Although the awareness from extant research about obstacles faced by women associated with structural conditions (Acs et al., 2011; Welter, 2011), new insights to address specific elements of the entrepreneurial ecosystem are still necessary, as the less than proportionate entrepreneurial role played by women suggests (Acs et al., 2018; Ahl, 2006). Women tend to be less involved than men in entrepreneurial activities as testified by the Global Entrepreneurship Monitor (Acs et al., 2011; Bardasi et al., 2011; Hechavarría & Brieger, 2022; Hechavarría et al., 2017). When they are, their businesses grow slower, are smaller, and are characterized by lower performance in terms of size, revenues, assets, and profits (see Jennings & Brush, 2013 for a complete review of the topic). In terms of survival, the evidence is mixed (Jennings & Brush, 2013).

Our study attempts to contribute to the entrepreneurial ecosystem literature by deepening the role of universities in fostering women's entrepreneurship through the phenomenon of academic entrepreneurship, which is still largely understudied (Di Paola, 2020; Rodríguez-Gulías et al., 2018).

2.2 The gender perspective in entrepreneurship

Research on women's entrepreneurship has its roots in two different sometimes overlapping areas of research: the gender and occupation literature and the feminist theories (Jennings & Brush, 2013). The former examines the role of women in society and acknowledges their occupational segregation; the latter assumes the subordinated role of women and attempts to amend it (Ahl, 2006; Foss et al., 2019). We adopt the second stream of literature as the theoretical framework. Feminist theories are classified

into three different categories: liberal feminism, social feminism, and post-structuralist feminism (Ahl, 2006; Foss et al., 2019).

The first one considers men and women as similar and imputes the difference in resources available and their different achievements. With regard to the underperformance of women-led firms, three are the main causes: human capital (mainly education and previous experience), social capital and network, and access to capital. Empirical research shows that when work experience and education are equal among women and men, they do not differ in terms of participation in entrepreneurship (Brush et al., 2017). However, women's human capital often results to be inadequate as their educational background is traditionally oriented to human and social instead of technical disciplines and therefore characterized by competencies only partially applicable in the entrepreneurial profession (Piva & Rovelli, 2022). In addition, they tend to be segmented into a few sectors, where firms are smaller and less efficient (Bardasi et al., 2011; Jennings & Brush, 2013). Concerning social capital, in the case of women, it is mainly based on informal relations, which lead to the creation of smaller and denser networks (Farr-Wharton & Brunetto, 2007) that entail lower quality information and fewer and redundant resources (Hampton et al., 2011). This reduces their access to networks of individuals able to provide resources and competencies essential for entrepreneurial entry (Greve & Salaff, 2003). Related to performance, Neumeyer et al., (2019) point out that women have less social capital, which is a fundamental element of entrepreneurial ecosystems, which in turn prevents them from creating high-growth companies. Finally, women struggle with access to capital. They are discriminated against by resource providers, especially capital providers (Carter et al., 2003), who associate poorer evaluations with their business ideas (Carter et al., 2007; Kanze et al., 2018). Due to the scarce access to resources, whenever women concur to establishing a company, this turns out to be small with few possibilities to grow (Davis & Shaver, 2012). Small-size companies make female-led ventures perceived as riskier and thus even less attractive for capital providers (Amit et al., 1990; Coleman, 2000).

Based on arguments from the liberal feminist theory, we formulate the following hypothesis:

H1: Women-led firms grow less than men-led firms.

The second one instead assumes that men and women are substantially different in their attitudes, aspirations, and values, so they adopt different approaches than men but equally valid. Studies belonging to this way of thinking are those that focus on alternative business models for women due to their role in society (i.e., family-work conflict) or to their female traits (i.e., attention to the next, societal wellbeing, orientation toward relations, and collaboration) (Acs et al., 2011). Hechavarría et al., (2017) show that women entrepreneurs value social and environmental goals more than economic goals when they create their own companies and that this is a result of the cultural context they are exposed to. Cultural practices are essential also to determining the propensity toward social entrepreneurship (Hechavarría & Brieger, 2022). The differences in women's business preferences may also be shaped by their assigned social roles as the ones in charge of the family (Aldrich & Cliff, 2003). Women may wish to limit the size of their business (Cliff, 1998) because smaller size enables them to maintain control over the organization and to devote a reasonable amount of time and energy to the family (Davis & Shaver, 2012; Shinnar et al., 2012). Shinnar et al., (2012) thus argue that mothers become entrepreneurs not to grow a business but to pursue a more favorable and flexible balance between work and private life through long-lasting ventures.

Based on arguments from the social feminist theory, we formulate the following hypothesis:

H2: Women-led firms are more likely to survive than men-led firms.

The two abovementioned approaches categorize men and women as equivalent to a sex distinction and are used in entrepreneurial studies mainly as explanatory variables. By contrast, post-structuralist feminism defines gender as societally constructed; thereby, men and women can be characterized by both masculine and feminine traits, and entrepreneurship behavior is determined by the combination of these two components. This approach has not been frequently used in entrepreneurship literature, with the relevant exceptions of Gupta et al., (2009) and

Hechavarria & Ingram, (2016). The former study the effects of socially constructed gender stereotypes on the entrepreneurial intentions of male and female young adults in three different countries. Entrepreneurship has for both men and women male-like characteristics, and they do not differ in their entrepreneurial intentions whenever they perceive themselves as similar to males. The latter applies the concept of masculinity and femininity to the propensity to be engaged in commercial and social entrepreneurship. Social entrepreneurship is positively related to femininity, but in a society dominated by masculinity, women are less inclined than male entrepreneurs to pursue social organizational structures.

Although the claim for greater adoption of post-structuralist feminism to highlight the importance of social embeddedness of women entrepreneurship (see Ahl, 2006; Baughn et al., 2006; Hughes et al., 2012), in line with the vast majority of the extant studies on the topic, we rely on liberal feminist and social feminist theories to build our first two hypotheses.

2.2.1 The gender perspective in academic entrepreneurship

Academic entrepreneurship and the role played by universities in fostering it is gaining great attention by virtue of its contribution to the economic growth of the entire society (Acs et al., 2009; Hayter, 2013). Yet, as in the general context, female entrepreneurship is still uncommon in academia in different countries (Micozzi et al., 2016; Rosa & Dawson, 2006). According to the review from Di Paola, (2020), several reasons concur to create such a situation, first the lower level of seniority. Given the positive association between seniority and commercialization activity, the actual number of women involved is small (Klofsten & Jones-Evans, 2000), and their visibility in scientific networks, in which senior scholars are usually much more integrated, is limited in terms of the number of patents, interactions with the industry, and licensing agreements (Abreu & Grinevich, 2017). Moreover, few female scholars hold positions of responsibility within the universities as regards technology transfer and business creation (Foss & Gibson, 2015), and in general, women are underrepresented in research fields where entrepreneurship rates are higher (for instance, engineering; Micozzi et al., 2016; Piva & Rovelli, 2022). This reflects the lower availability of resources in terms of capital, knowledge, networks, training, and infrastructures (Huyghe & Knockaert, 2015; Sinell et al., 2018). Moreover, they are forced to carefully ponder their priorities in career goals (Sinell et al., 2018; Stigliani, 2020).

According to the academic entrepreneurship literature, however, the parent university plays a beneficial role for ASOs (Bercovitz & Feldman, 2008; Rasmussen et al., 2014; Sørensen, 2007), which may enjoy the advantages of university affiliation compared to companies without it (Bercovitz & Feldman, 2008; Clarysse et al., 2011; Wennberg et al., 2011). Among other benefits, university engagement with the industry allows scientists to get access to the network of relationships with numerous players, which provides information and opportunities for innovation, solutions to eventual issues that arise, and support in terms of complementary resources, knowledge, skills, and funding (Bekkers & Bodas Freitas, 2008; Sauermann & Stephan, 2013). University networks facilitate entrepreneurs in securing assets for the creation, growth, and success of ASOs (Fini et al., 2020). They are extremely precious for academics who might have few relationships with firms and other outside players (Bekkers & Bodas Freitas, 2008), like female academics. Thus, a university well-established network may be beneficial for women as they enlarge women's social network (Rodríguez-Gulías et al., 2018), which is according to the work from Neumeyer et al., (2019), the reason behind the low growth of women-led firms. Moreover, rich and close industry ties provided by universities could be viewed as positive signals to investors, which significantly increases the possibility of ASOs obtaining financial support (Huynh, 2016). Being affiliated with a university may represent a guarantee for the investors of the quality of female-led firms, boosting their credibility (Lauto et al., 2022; Rodríguez-Gulías et al., 2018).

Relying on these studies, we assume that university affiliation is beneficial for women-led firms because it provides the resource endowments necessary for women-led ASOs to grow (Rodríguez-Gulías et al., 2018). Therefore, we formulate:

H3: Women-led ASOS grow more than women-led non-ASO, due to the support provided by the university affiliation.

Although women-led firms traditionally exhibit a high survival profile, we suggest that university support does not increase the survival rate of women-led ASOs but rather makes them more similar to men-led firms, which means less oriented to survival. We assume thus that university affiliation is not beneficial only in terms of resource provision for women, but it enables the complex process of empowerment. Women's empowerment has been at the center of the female entrepreneurship debate for a long time (Ahl, 2006; Hughes et al., 2012). Researchers still claim for a better understanding of the reasons why women are oppressed and, more importantly, for offering some tools and techniques that can be used to strengthen and empower women.

Universities enhance entrepreneurship at the department level through shared and commonly accepted norms, for example, the integration of entrepreneurship activities in the scientists' individual evaluation (Rasmussen et al., 2014). Moreover, by offering different perspectives, as in departments characterized by higher levels of interdisciplinarity, due to the continuous exposure to diversity, academics are expected to develop a wider range of skills and knowledge as well as bring in the various types of expertise required to implement entrepreneurial ideas (Fini et al., 2020). In addition, at an institutional level, the availability of technology transfer offices, infrastructures like incubators, accelerators, and science parks, and ad hoc educational programs for supporting entrepreneurial scientists (Siegel & Wright, 2015) provides information, resources, and competencies to incentives entrepreneurship among academics (see the review from Hossinger et al., 2020).

Coherently, these arguments can be applied to women's entrepreneurship in academia. The first line of the study argues the importance of entrepreneurial education offered by universities, which allow especially women to possess adequate human capital to pursue an entrepreneurial career. Piva & Rovelli (2022) demonstrate the importance of university education and the university-industry relation for student female entrepreneurship. A second strand of studies on women's empowerment suggests that the presence of role models leads to greater entrepreneurial activities from women (Nanda & Sørensen, 2010). Kacperczyk, (2013) provides evidence that the entrepreneurial experience of peers enhances entrepreneurial behaviors among individuals who work with them and that this effect is greater when they share the same gender. Female peers are effective in transmitting information about new opportunities and in reducing the uncertainty associated with entrepreneurship for other female academics. Observing successful female entrepreneurship within the academic context may be useful as an individual woman may acquire greater confidence with the typical activities of the entrepreneurial path, activating a training process to make decisions according to the role models (Abbasianchavari & Moritz, 2021; BarNir et al., 2011). Finally, a third stream of literature focuses attention on the support provided by academic institutions to business creation (Di Paola, 2020). Women are encouraged to undertake an entrepreneurial initiative when they know they can count on an academic system capable of supporting them with acceleration programs and business incubation structures or on experts in innovation and intellectual property (Newman et al., 2019). The assumption that the empowerment of female academic entrepreneurs derives from their affiliation with universities leads to the formulation:

> H4: Women-led ASOS are less likely to survive than women-led non-ASOs, due to the support provided by the university affiliation.

3 Research design

3.1 Sample and data

We rely on two populations: ASOs and innovative startups. The initial population of 1,055 ASOs is retrieved by the Spinoff Italia database[1] from the Italian Ministry of Education, Universities, and Research (MUR), which provides data referring to denomination, year of foundation, industry, location, and parent university. It is matched with the AIDA database (*Analisi informatizzata delle aziende* by Bureau van Dijk), which provides financial and economic information from 2006 to 2018. A sample of 709 ASOs

[1] Source: (Spin-off Italia, 2018) retrieved by https://www.spinoffitalia.it/. Notice that Spin-off Italia comprises both spin-offs created by universities and by public research organizations. We rely here only on the population of university-based spinoffs.

is derived.[2] We then collect information on the entrepreneurial teams, especially the presence of female members, through official company websites, when available, and LinkedIn. Full information is available for a final sample, which consists of 420 ASOs.

A control sample of comparable firms is employed to understand the supposed positive effect of university affiliation. According to extant studies (see Civera et al., 2019 for further details), innovative start-ups are selected as comparable companies, as the ASO category is considered a special case of innovative startups. In Italy, by law (Legislative Decree 221/2012, commonly called the Startup Act) to be an innovative startup one of the following criteria must be fulfilled: (1) being an academic spinoff; (2) having a percentage of R&D expenditures greater than 15%; (c) a percentage of Ph.D. students, Ph.D. holders, or staff highly qualified in research activities greater than 30%. The source of data is the Italian Registry of Innovative Firms,[3] providing information on the denomination, year of foundation, industry, geographical location, and company's website. From the intersection with the AIDA database, we extract a dataset of 7644 Italian innovative start-ups established from 2012 to 2018. Table 1 reports information on the samples used for our analysis.

Table 1 ASOs and innovative start-ups distribution. The table reports the number of ASOs and innovative start-ups born in Italy between 2006 and 2018, classified by year and by NUTS-1 regions

	ASOs		*Innovative start-ups*	
Year	No	%	No	%
2006	1	0.24	0	0
2007	1	0.24	0	0
2008	4	0.95	0	0
2009	64	15.24	0	0
2010	62	14.76	1	0.01
2011	60	14.29	5	0.07
2012	38	9.05	68	0.89
2013	22	5.24	196	2.56
2014	12	2.86	241	3.15
2015	49	11.67	1224	16.01
2016	76	18.10	1881	24.61
2017	29	6.90	2174	28.44
2018	2	0.48	1854	24.25
Total	420	100.00	7644	100.00
Macro-regions				
Northwest	130	30.95	2542	33.25
Northeast	102	24.29	1680	21.89
Center	94	22.38	1570	20.54
South	69	16.43	1419	18.56
Islands	25	5.95	433	5.66
Total	420	100.00	7644	100.00

3.2 Methodology: Propensity score matching

To examine the firm growth and survival (our dependent variables) of women-led firms (our response variable) compared to men-led firms, and whether women-led ASOs differ from other women-led firms (treatment vs. control group), we must select all and only comparable companies. Since the process leading to including female members in the team is likely to be driven by the same factors affecting firm growth and survival, a potential endogeneity issue may raise. In addition, these factors are likely to be partially unobservable (e.g., quality, open-mindedness). This is why we are implementing a conditional DID methodology (Heckman et al., 1997), combining the benefit of the DID approach and propensity score matching (PSM).

The PSM is implemented by estimating the probability that an observed firm in the sample, comprising ASOs and other innovative firms, is an ASO. The PSM associates each treated unit (ASO) and the control units (innovative firms) with exactly the same propensity score, p(X) (Rosenbaum & Rubin, 1983). The bias in the evaluation of treatment effects is produced by unobservable confusing factors, so it cannot be eliminated but only reduced (Rosenbaum & Rubin, 1983), thanks to a comparison among treated and control units that are as similar as possible (Becker & Ichino, 2002). The possible size of bias removed depends on the quality and quantity of the control variables used to perform the match (Heckman et al., 1998). Since p(X) is a continuous variable, the probability of finding units with the same propensity score tends to be zero. We solve this problem by applying nearest-neighbor matching, which takes each treated unit and searches for the control unit with the nearest

[2] AIDA.
[3] http://startup.registroimprese.it/

value of the propensity score. It is used with replacement and single neighbor so that associates at each spinoff only one start-up, but a start-up can constitute the best association for more than one spinoff (Becker & Ichino, 2002).

In order to define the match, we refer to the ASO status as a dependent variable. The matching variables are chosen according to the recent research on the Italian context and spinoff phenomenon (Civera et al., 2019). Two relevant sets of control variables describe the firm performance in both academic and nonacademic environments. First, firm-level characteristics like the total asset as a size measure; the leverage (i.e., the debt-to-equity ratio) as a measure of financial solidity; EBITDA ratio that explains the earnings before interest, taxes, depreciation, and amortization as a general proxy of economic performance; high technology and knowledge-intensive services (HTKIS) sector to identify firms belonging to a high technology sector in manufacturing industries or to a knowledge-intensive service, according to the Eurostat's NACE-Rev 2 industry classification.[4] Second, contextual variables, such as studies about the entrepreneurial ecosystem explain, the impact of connections among different actors on firm performance and regional economic performance (Audretsch & Link, 2017). Taking into account other empirical studies (Horta et al., 2016; Meoli & Vismara, 2016), in this specific case, the context variables refer to NUTS-2[5] classification at the regional level and include regional GDP to consider the prosperity and economic stability of the region, regional R&D expenditures over GDP as an indicator of public interest in innovation projects. Moreover, the graduation gender difference, namely the gender difference (female–male) in the 25-year-old graduation rate (% of the 25-year-old population with a bachelor's degree, or higher tertiary education certificate) helps to detect regions where women in higher education are over/under-represented. The model presents also a set of dummy variables that refer to Italian macro areas according to NUTS-1 classification. All the variables refer to the year of the firm foundation. Accounting information at the firm level is collected from the AIDA database, while the regional data is derived from ISTAT (Italian National Institute of Statistics).

Notice that, analytically, PSM was implemented with a common support of 2.5%, thereby excluding observations (ASOs) that were characterized by an extreme (too high or too low) probability of being identified as spinoffs and were not proper candidates for the matching procedure. Matching was then applied using a replacement to avoid sort order and sample size bias (Dehejia & Wahba, 1999). Therefore, the matched sample is limited to 293 ASOs and an equivalent number of innovative start-ups, for which we verify the presence of female founders as we did for ASOs.

3.3 Methodology: Hypothesis testing

The difference in growth and survival of women-led firms vs. men-led firms (hypotheses 1 and 2), as well as of women-led ASOs vs. women-led innovative firms (hypotheses 3 and 4), are analyzed using a matched sample of ASOs and other innovative firms. Consistent with the DID approach, a deterministic parametric approach with ordinary least square OLS (for growth) and a Cox proportional hazard (for survival) regressions are estimated, including (1) the response variable (i.e., whether a firm is women-led or not); (2) a dummy identifying the treated group (i.e., ASOs); (3) a variable interacting women-led firms and the ASOs; (4) a number of control variables. Our hypotheses 1 and 2, on the lower growth and higher survival rate of women-led firms compared to men-led firms, are measured by the coefficient of the women-led firm in the growth and in the survival model, respectively. Our hypotheses 3 and 4, on the higher growth and lower survival rate of women-led ASOs compared to other women-led firms, by contrast, are validated by the interaction coefficient women-led firm (response variable) $\times ASOs$ (the treatment).

As dependent variables, growth is measured as the compound annual growth rate on revenues for the

[4] According to Eurostat, (2009), manufacturing industries are classified as high-tech, medium-tech, or low-tech according to their technological intensity (R&D expenditure/value added). Services are aggregated into knowledge-intensive services and less knowledge-intensive services based on their share of tertiary-educated employees.

[5] NUTS-2 and NUTS-1 are derived from the Nomenclature of Units for Territorial Statistics, and it is a standard code linked to the country division for statistical analysis. The classification is managed by the European Union, so there is a grouping at three levels only for EU members. In Italy, NUTS-2 regards regions, while NUTS-1 regards groups of regions.

third year of activity of the firm (see Visintin & Pittino, 2014) whereas survival is estimated as the probability of failure (Cox, 1972).[6]

As far as the explanatory variables are concerned, a women-led firm is a dummy variable equal to 1 if the firm is a female enterprise, according to the official definition, zero elsewise. The Italian official definition of female enterprise is provided by Law 215 (February 25, 1992), stating that the micro, small and medium-sized enterprises that fall within the definition of a female enterprise are: (a) cooperative societies and partnerships set up to an extent not less than 60% by women; (b) limited companies whose shares are owned by no less than two-thirds of women and whose administrative bodies are constituted for at least two-thirds by women sole proprietorships run by women; (c) individual companies run by women.

ASOs is a dummy variable equal to 1 if the company is an ASO. Their interaction allows for determining whether female entrepreneurs in ASOs establish companies with different performances compared to female entrepreneurs in other kinds of business contexts.

The control variables are the same adopted for the matching procedure. Details on the variable's name, description, and source are provided in Table 2.

4 Results

Table 3 reports the descriptive statistics before the matching, where the average values differ significantly between the two types of companies, namely ASOs and the control sample of other innovative start-ups. While the two groups show similarities in the distribution over the country and in the leverage, where no statistical difference is evident, several differences support the need for a matching approach before running any regression analyses. In particular, ASOs are more frequently HTKIS, are smaller, and are more profitable.

[6] The organization failure $\_t$ can happen in many forms, including dissolution, bankruptcy, merger, or reorganization (Kalleberg & Leicht, 1991), but the available data do not allow the distinction between these different processes, so they are analyzed together as "failed," which means out of the activities at a certain year. In the sample, the companies survive at least 2 years until a maximum of 13.

Table 4 reports the same values after the propensity score matching was performed, showing that the statistical differences are not significant.

Table 5 exhibits the results of the OLS regressions. Model 1 shows that women-led firms grow less than men-led firms (coefficient = −0.325, p-value < 5%), confirming our hypothesis 1. Referring to the treatment (being an ASO), instead, there is no statistically significant difference in growth rate between ASOs and innovative start-ups (coefficient = 0.461, p-value > 10%). However, in model 2, when we estimate the growth of women-led ASOs with respect to women-led non-ASOs, we observe a positive coefficient for the interaction term (coefficient = 0.893, p-value < 5%). This result supports our hypothesis 3 in that it confirms that women-led ASOs grow more than other women-led companies. With reference to previous studies, this may be explained by the fact that academic affiliation provides resources to overcome obstacles to female academic entrepreneurship. Among controls, in both models we find that HTKIS grow more than their low-tech counterparts, suggesting that these firms are more prone to exploit business opportunities and to grow (Civera et al., 2020). Firm size is negatively related to growth performance, confirming that big companies are less growth-intense businesses (Fernández-López et al., 2019). Finally, leverage is positively related to growth as it represents a source of financing and investment for companies, which traditionally rely on debt more than on equity (Vohora et al., 2004). Interestingly, context controls play no significant role in determining growth rates.

Table 6 exhibits the results of the Cox regression on survival time. In model 1, we find that women-led firms are more likely to survive (i.e., less likely to fail) than men-led firms (coefficient = −0.528, p-value < 5%), supporting our hypothesis 2, based on extant studies denoting the lower growth-orientation of female entrepreneurs (Davis & Shaver, 2012; Shinnar et al., 2012). Referring to the treatment (being an ASO), we find that ASOs are less likely to survive than innovative start-ups (coefficient = 0.985, p-value < 10%), which is in line with the literature on ASOs' poorer economic (Mathisen & Rasmussen, 2019; Wennberg et al., 2011). This is even more true when considering the comparison between women-led ASOs and other women-led firms (interaction coefficient = 1.836–0.664, p-value < 5%). This result supports our hypothesis 4

Table 2 Variables used in the empirical analysis

Variable	Definition	Source
Dependent variables		
Growth	Compound annual growth rate of total assets over 3 years after establishment of the spinoff	AIDA
Failure	Dummy variable equal to 1 if ASO has failed, up to the end of 2018	Spinoff Italia
Survival time	For failed spinoffs, the time from start-up until failure	Spinoff Italia
Main variable		
Women-led firm	Dummy variable is equal to 1 if the firm is a female enterprise, according to the official definition, and zero elsewise. The Italian official definition of female enterprise is provided by Law 215 (February 25, 1992)	AIDA, Linkedin, official websites
Group dummy		
ASO	Dummy variable is equal to 1 if the firm is an academic spinoff and 0 otherwise	Spinoff Italia, AIDA
Firm-level control variables (propensity score matching)		
HTKIS	Dummy variable is equal to 1 if the firm belongs to a manufacturing industry classified as high-tech according to their technological intensity (R&D expenditure/value added), or to a service industry classified as knowledge-intensive services and less knowledge-intensive services, based on their share of tertiary educated persons (Eurostat, 2009), 0 otherwise	Spinoff Italia/Registry of Innovative Firms/ Eurostat
Total assets	Balance-sheet value of total asset (K€). Natural logarithms are used in the regressions	AIDA
Leverage	Firm's debt-to-equity ratio (%)	AIDA
EBITDA ratio	Ratio between earnings before interest, taxes, depreciation and amortization (K€), and total assets	AIDA
Context-level control variables (propensity score matching)		
GDP	Gross domestic product at regional level. The variable is per region per year (M€)	ISTAT
R&D expenditure	Percentage of regional expenditure dedicated to research and development over regional GDP. The variable is per region, per year	ISTAT
Graduation gender difference	Gender difference (female—male) in the 25-year-old graduation rate (% of 25-year-old population with a bachelor's degree, or higher tertiary education certificate)	ISTAT
Macroregions	Set of dummy variables equal to 1 if the firm is located in northeast Italy, in the center, in the south, or the insular Italy, according to NUTS-1 classification. northwest is the reference case	Spinoff Italia/Registry of Innovative Firms

Notes: All the variables are considered at the year of the foundation of the firm. ISTAT is the Italian National Statistical Institute. Firm-level control variables are measured per year and per firm; context-level control variables are measured per region (or macro-region) per year

Table 3 Descriptive statistics before matching

Variable	ASOs (*a*)	Innovative start-ups (*b*)	Differences (*b* − *a*)
Firm-level control variables			
HTKIS (dummy)	0.93	0.79	−0.14***
Total assets (K€)	73,471.55	169,447.50	95,975.92**
Leverage (ratio)	0.34	1.01	0.67
EBITDA ratio (%)	5.83%	−1.62%	−7.45**
Context-level control variables			
GDP (€)	139,733.50	182,483.40	42,749.90***
R&D expenditure (%)	1.30	1.02	−0.28***
Graduation gender difference (%)	12.42	12.80	0.38
Northwest (dummy)	0.32	0.32	0.00
Northeast (dummy)	0.24	0.22	−0.02
Center (dummy)	0.22	0.21	−0.01
South (dummy)	0.16	0.19	0.03
Islands (dummy)	0.06	0.06	0.00
No. obs	420	7644	

The table reports the descriptive statistics for the sample of 420 ASOs and 7644 innovative firms, observed between 2006 and 2019. The third column reports the means' differences (***, **, and * identify significance at less than 1%, 5%, and 10% level, respectively, of *T*-tests on the statistical significance of differences)

Table 4 Descriptive statistics after the matching

Variable	ASOs (*b*)	Innovative start-ups (*a*)	Differences (*b* − *a*)
HTKIS (%)	0.92	0.92	0.00
Total asset (K€)	82,340.24	77,420.67	−4919.57
Leverage (%)	0.42	0.05	−0.37
EBITDA ratio (%)	4.32%	3.25%	−1.07%
GDP (M€)	144,850.40	141,844.20	−3006.20
R&D expenditure (%)	1.27	1.27	0.00
Gender graduation difference	11.88	11.92	0.04
Northwest	0.28	0.27	−0.01
Northeast (%)	0.25	0.26	0.01
Center (%)	0.24	0.20	−0.04
South (%)	0.18	0.20	0.02
Islands (%)	0.05	0.07	0.02
No. obs	293	293	

Sample of 293 academic spinoffs and 293 matched innovative start-ups, as resulting from the propensity score matching. The table shows the descriptive statistics (means) for the matched sample of spinoffs and start-ups. The third column reports the means' differences. No difference is statistically significant at less than 10%

and may provide empirical evidence of the empowerment of female academic entrepreneurs compared to female nonacademic counterparts. Among controls, firm size and regional GDP are related to high survival rates as big companies and prosperous contexts are characterized by economic stability (Rodeiro-Pazos et al., 2021). By contrast, we do not find any significant effect on other local features.

Table 7 reports our robustness tests, where we replace our main response variable, women-led firm,

Table 5 Growth analysis output

Variables	(1)	(2)
Women-led firm	−0.325**	−0.497**
	(0.147)	(0.226)
ASO	0.461	0.310
	(0.349)	(0.257)
Women-led firm × ASO	-	0.893**
		(0.417)
HTKIS	0.643***	0.770***
	(0.048)	(0.108)
Total Assets	−1.013*	−1.042*
	(0.528)	(0.588)
Leverage	0.466***	0.592***
	(0.197)	(0.209)
EBITDA ratio	2.821	3.084
	(3.218)	(3.065)
GDP	−0.837	−1.023
	(0.725)	(0.668)
R&D expenditure	−0.112	−0.101
	(1.046)	(2.102)
Gender graduation difference	0.133	0.120
	(0.115)	(0.104)
Macroregion dummies	Yes	Yes
Constant	2.104	1.616
	(1.678)	(1.361)
Observations	586	586
R-squared	0.136	0.144

The table shows the results of the OLS regression with the compound annual growth rate with respect to 3-year performance in terms of revenues as dependent variables. In model (1), the response variable (women-led firm) is included. In model (2), the response variable (women-led firm) interacted with the dummy variable identifying the treated group (ASOs), such that the interaction term measures the difference-in-difference effect. The values in parentheses are robust standard errors. *** indicate significance at the 1%, ** at the 5%, and * at the 10% levels, respectively

Table 6 Survival analysis output

Variables	(1)	(2)
Women-led firm	−0.528**	−0.664**
	(0.280)	(0.336)
ASO	0.985*	0.767*
	(0.528)	(0.409)
Women-led firm × ASO	-	1.836**
		(0.889)
HTKIS	0.013	0.006
	(0.014)	(0.005)
Total assets	−0.336**	−0.288**
	(0.120)	(0.140)
Leverage	0.331	0.241
	(0.229)	(0.183)
EBITDA ratio	−0.252	−0.159
	(0.210)	(0.141)
GDP	−0.073**	−0.078**
	(0.029)	(0.031)
R&D expenditure	0.097	0.118
	(0.093)	(0.116)
Gender graduation difference	0.072	0.064
	(0.064)	(0.044)
Macro-region dummies	Yes	Yes
Observations	586	586

The table shows the results of the Cox regression on survival time. In model (1), the response variable (women-led firm) is included. In model (2), the response variable (women-led firm) interacted with the dummy variable identifying the treated group (ASOs), such that the interaction term measures the difference-in-difference effect. The values in parentheses are robust standard errors. *** indicate significance at the 1%, ** at the 5%, and * at the 10% levels, respectively

with measures of absolute and relative presence and women in the entrepreneurial team. In all cases, both when we consider the percentage (Table 7, models 1 and 3) and the number of women within the entrepreneurial team (Table 7, models 2 and 4), the results supporting our hypotheses hold.

5 Discussion and conclusions

As aforementioned, the feminist theories generally agree that women-led businesses are characterized by lower growth but higher survival rate than their men-led counterparts because of differences in both resource endowment and preferences (Davis & Shaver, 2012; Rodríguez-Gulías et al., 2018; Sinell et al., 2018). In this paper, we argue that university affiliation makes women-led firms outperform women-led counterparts in terms of growth rate. We argue, on the basis of extant studies on the topic, that university affiliation provides women with resource endowments necessary for the growth of the company (Rodríguez-Gulías et al., 2017), but it also offers exposure to specific entrepreneurial skills and competencies, entrepreneurial role model, and entrepreneurship-supportive infrastructures that empower female academic entrepreneurs and make them more prone to create growth-oriented

Table 7 Robustness tests

Variables	(1)	(2)	(3)	(4)
% Female members	−0.376*		−1.839*	
	(0.197)		(1.088)	
# Female members		−0.064*		−0.702**
		(0.0.036)		(0.322)
ASO	0.166	0.239	1.572**	1.148*
	(0.852)	(0.256)	(0.770)	(0.599)
% Female members × ASO	−0.552**	-	−2.013**	-
	(0.277)		(0.853)	
# Female members × ASO	-	0.102**		1.528**
		(0.044)		(0.725)
HTKIS	0.114*	0.120*	0.640	0.533
	(0.056)	(0.061)	(0.617)	(0.463)
Total assets	−0.841*	−0.848*	−0.289**	−0.264**
	(0.481)	(0.495)	(0.120)	(0.118)
Leverage	0.434*	0.552**	0.352	0.301
	(0.235)	(0.262)	(0.289)	(0.196)
EBITDA ratio	2.514	2.683	−0.251	−0.190
	(2.942)	(3.062)	(0.195)	(0.156)
GDP	−0.697	−0.838	−0.056**	−0.070**
	(0.562)	(0.599)	(0.019)	(0.027)
R&D expenditure	−0.102	−0.084	0.074	0.099
	(0.960)	(0.933)	(0.066)	(0.092)
Gender graduation difference	0.122	0.112	0.064	0.061
	(0.105)	(0.100)	(0.052)	(0.044)
Macro-region dummies	Yes	Yes	Yes	Yes
Constant	1.651	1.559	-	-
	(1.412)	(1.336)		
Observations	586	586	586	586
R-squared	0.132	0.126	-	-

The table shows the results of the OLS regression with the compound annual growth rate with respect to 3-year performance in terms of revenues, as dependent variables (models 1 and 2), and results of the Cox regression, using the survival time and the dummy variable failure (models 3 and 4). In models 1 and 3, the Female presence variable is replaced by the percentage of female members in the board (% female), while in models 2 and 4 it is replaced by the number of women on the board (# female). The values in parentheses show the standard errors. *** indicate significance at the 1%, ** at the 5%, and * at the 10% levels

companies (Abbasianchavari & Moritz, 2021; Di Paola, 2020; Nanda & Sørensen, 2010). This paper contributes to different streams of literature. By highlighting the positive role of university affiliation in enhancing the performance of women-led firms, it contributes to the entrepreneurial ecosystem's studies devoted to investigating mechanisms to enhance economic growth and innovation through female entrepreneurship and through universities, respectively. Moreover, our study contributes to feminist theories by identifying university affiliation as a means to overcome women's discrimination (liberal feminist theories) and conciliate the idea that women may be associated with growth preferences (social feminist theories).

The outperformance of academic respect to nonacademic female entrepreneurs in terms of growth may imply the importance of supporting entrepreneurship

activities in university contexts, which may be enhanced by formulating policies and by involving practitioners and policymakers in the process. On the other way round, our results highlighted how women-led firms are penalized in contexts other than academia. Literature on entrepreneurial ecosystems suggests the need for a more comprehensive in supporting female entrepreneurship arising from the interaction of all their elements (see, for instance, Foss et al., 2019). Synergies between universities, institutions, and capital providers, together with targeted policies and a diffuse entrepreneurial culture, may serve the scope. Due to its beneficial role, universities may, for instance, be more involved as a partner in entrepreneurial initiatives at a more systemic level. For policymakers, an important implication is related to the fact that university affiliation helps women's empowerment and the generation of companies that are more oriented to growth and less oriented to survival. By supporting academic entrepreneurship, they may be aware of the typology of business they are incentivizing. Whether the final objective of policymakers is fostering high-growth companies, favoring entrepreneurship in the academic context may be a winning strategy. Vice versa, policymakers may aim to develop companies with alternative business models that care more about social and environmental sustainability issues; for example, boosting academic entrepreneurship may not be optimum.

Yet, as suggested by the literature (Di Paola, 2020; Piva & Rovelli, 2021), discrimination between male and female academics still persists. This suggests the existence of obstacles that prevent them from becoming entrepreneurs within the university context. Extant literature has identified as obstacles the lack of human and social capital and the reduced access to capital (Lauto et al., 2022; Neumeyer et al., 2019; Piva & Rovelli, 2021). To address the issue, it is crucial to develop entrepreneurship programs targeting specifically female academics. Entrepreneurship programs may consist of education and training to provide women with entrepreneurial and management skills that are fundamental for business establishment and performance. Moreover, entrepreneurship programs should involve successful entrepreneurs—academic peers and not—to offer mentorship and best practices to look at. Finally, entrepreneurship programs targeting women should help in improving their negotiation skills with financial institutions and other capital providers. However, it is undeniable that the root of the problem derives from women's underrepresentation in specific disciplines where ASOs are created, namely engineering and science, mathematics, and computing, both during studies and afterward during their careers (Di Paola, 2020; Micozzi et al., 2016). Moreover, the under-representation of women in senior and leadership positions (Foss & Gibson, 2015) makes their scientific work less visible (Abreu & Grinevich, 2017). In this regard, university managers may consider setting up some measures to improve women's participation within academia. The combined effect of career progression initiatives and entrepreneurship programs targeting women may contribute to overcoming difficult situations faced by women in academia.

As with any other piece of work, this study is not devoid of limitations, which are open for future research developments. First, we provide evidence of the beneficial role played by university affiliation, and we suppose that it is due to the empowerment of female academic entrepreneurs. Yet, future research may address the mechanisms through which university affiliation empowers female academic entrepreneurs. Overcoming risk aversion (Bönte & Piegeler, 2013; Gimenez-Jimenez et al., 2020) and improving self-efficacy (BarNir et al., 2011; Newman et al., 2019; Wilson et al., 2007) are some of the mechanisms suggested by previous literature on female entrepreneurship. Second, we adopt the definition of female enterprise without disentangling between women as founders, women as part of an entrepreneurial team, and women as part of the top management team. Although we consider the presence of women in the entrepreneurial team as a robustness test, investigating in depth the teams on the basis of academic spinoffs may shed additional light on the female academic entrepreneurship phenomenon. According to our study, we could expect a positive correlation between the presence of women in ASOs and their growth. However, considering the interactions between team members as well as their composition and characteristics is fundamental (Nikiforou et al., 2018). Extant studies have found mixed evidence about the beneficial or detrimental effect of team configuration on the performance of ASOs according to different characteristics like human capital, social capital, age, and gender (Bock et al., 2018; Knockaert et al., 2011; Visintin

& Pittino, 2014). Yet, including gendered differences in the entrepreneurial team configurations may contribute to understanding differences in decision-making and leadership styles and their impact on performance. An investigation as such may be done by either focusing on the context of ASOs only or comparing ASOs with other firms. Third, we resort to the social and liberal feminists to frame our study by basing on the extant literature on the topic (see Foss et al., 2019). Yet, in support of the post-structuralist theory, which requires scholars to analyze the impact of gendered institutions and ecosystems, Baughn et al., (2006) highlight the importance of studying women's entrepreneurship and entrepreneurship as a socially embedded phenomenon. They suggest that institutional and ecosystem theory might help understand hidden institutional constraints that could hinder women's entrepreneurship. Nonetheless, this approach is extremely complex to adopt from an empirical point of view as a dummy variable for indicating female-led businesses would be not enough. The degree of femininity and masculinity (Gupta et al., 2009) must be disentangled and measured and applied to different contexts. Starting from our study, future research may analyze female academic entrepreneurship through these lenses. Some other limitations due to the adoption of quantitative methods need to be acknowledged. In order to apply the definition of a female enterprise, a significant sample reduction occurred due to the matching with the AIDA database and online data collection by the hand of team data. The data collection by hand made also difficult to access additional individual-level control variables to proxy women's human capital, and social capital as well as their role in society and in the family. Finally, we are aware that some variables adopted may be misleading in the context of ASOs and innovative startups, although widely used. For example, EBITDA as a proxy of financial solidity may be inappropriate as these companies may be characterized by high R&D investments, which are no longer considered an expense in the profit and loss account and have become part of the fixed assets of the balance sheets (applying IFRS—IAS). We, therefore, acknowledge that EBITDA may be positive also for companies who do not cover R&D expenses with their revenues. We acknowledge this limitation of our analysis, which, along with the others above mentioned, leaves room for further research.

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