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Fairly assessing unfairness: an exploration of gender disparities in informal entrepreneurship among academics in business schools

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Abstract: Assessing gender disparities in science commercialisation has been in the centre of the unresolved debates on the inadequacies of the methods used to compare female and male academics. Drawing from the literature on non–IP-based academic entrepreneurship and gender disparities in science, this study used the "pair-matched" technique to isolate 406 female and male academics in business schools (203 of each gender from a sample of 729 academics) who share common characteristics regarding academic position, subdisciplinary affiliation, and experience. The study confirms that a comparison of female and noncomparable male academics could lead to an unfair judgement of female academics' performance. However, the results show that even compared to comparable men, women are less involved in remunerated consultations, generate a smaller proportion of their revenue from consultations and are less engaged in the creation of consultancy companies. In addition, the study allows us to quantify a leaky pipeline of both genders involved in informal academic entrepreneurship and to identify four paths, from progressive to nonprogressive. Most female academics follow a progressive entrepreneurial path but often struggle to move from nonremunerated to remunerated entrepreneurial engagements. The study concludes with implications for university administrators on knowledge transfer and gender inequality.

1. Introduction

"The way of progress [is] neither swift nor easy," said Marie Curie, the first woman to win a Nobel Prize and the only academic to be awarded a prize in two scientific disciplines (Ethridge 2016). In regard to academic entrepreneurship, it is "neither swift nor easy" for female academics to commercialise their research (Sinell et al. 2018). Several studies have shown that female academics may disclose fewer inventions to their universities (Colyvas et al. 2012) and are less likely to patent (Whittington and Whittington 2011; Dohse et al. 2017), to engage in industry consulting activities (Corley and Gaughan 2005; Besley et al. 2018), and even to create spinoffs than their male counterparts (Martin et al. 2015; Kochenkova et al. 2015). These differences are unlikely to be related to biological characteristics but rather are notably attributed to socially constructed gender-based unique barriers in the female entrepreneurship path (Malmström et al. 2017). Indeed, for decades, scholars have identified that female academics may be systematically excluded from commercial opportunities (Cole 1981; Murray and Graham 2007; Sohar et al. 2018).

While the literature on academic entrepreneurship is dynamic and mature (Secundo et al. 2020; Neves and Brito 2020; Hayter et al. 2018), only a disparate and modest stream of research examines female faculty participation in commercially oriented activities. Particularly, these studies have not investigated the stage of entrepreneurial career at which female academics struggle the most (Di Paola 2020; Parker et al. 2017; Ebersberger and Pirhofer 2011; Halilem 2010). Additionally, paradoxically, studies on the biased context of female academics have unfairly assessed the implications for academic entrepreneurship, using methods with limited potential and questionable relevance for comparison with male academics (Marginson 2016; Lincoln et al. 2012; Sá et al. 2020). This is often because, while women represent almost half of the faculty in several disciplines (Slate and Harris 2010), most of the studies that compare men and women have focused on technologically oriented disciplines and formal commercialisation of science, where the representation of women is significantly lower (Hill et al. 2010; de Melo-Martín 2013; Blume-Kohout 2014). These studies have led to exaggerated assessments of gender gaps between female and male academics (Marginson 2016; Lincoln et al. 2012; Tartari and Salter 2015). Against this backdrop, by drawing from the literature on non–IP-based academic entrepreneurship and on gender disparities in science, the purpose of this study is to fairly compare the entrepreneurial careers of female and male academics by focusing on disciplines and forms of entrepreneurial activities that women seem to engage in.

By using the "pair-matched" technique to isolate 406 female and male academics in business schools (BSs)[1] (203 of each gender from a sample of 729 academics) who share common characteristics regarding academic position, subdisciplinary affiliation, and experience, the study makes an original contribution to the academic entrepreneurship literature. Whereas the literature has discussed the gender gap in academic entrepreneurship in general (Colyvas et al. 2012; Whittington and Whittington 2011; Dohse et al. 2017; Corley and Gaughan 2005), the balanced analysis conducted in this paper has identified the specific type of entrepreneurial activities, and the stage at which female entrepreneurs in non-STEM disciplines struggle the most with their entrepreneurial careers. The study finds that a comparison of female and noncomparable male academics may lead to an unfair judgement of female academics' publication performance that progresses to entrepreneurial engagement. However, it is evident that even compared to

[1] an understudied discipline in academic entrepreneurship compared to the often-discussed STEM disciplines

comparable men, women are less likely to be involved in remunerated consultations, to generate a greater proportion of their revenue from consultations and to engage in the creation of consultancy companies. By quantifying a leaky pipeline of both female and male academics involved in entrepreneurial engagement, the study revealed that most women follow a progressive path in their entrepreneurial journey, but a majority of them struggle to move from nonremunerated to remunerated entrepreneurial engagements. Hence, the study's findings on the gender gap, even after a fair judgement, offer important implications for university administration in terms of the ways to support the progression of female academics in entrepreneurial careers in BSs.

After the literature review, we will present the methodology and descriptive results regarding gender disparities. We will then present the informal entrepreneurship paths of female and male academics. The article ends with concluding remarks on promising research opportunities and policy efforts for female academic entrepreneurship.

2. The Literature Review

Most of the studies on female academic entrepreneurship are confronted with a series of difficulties related to 1) the quantification of the gender gap and 2) a biased orientation on technologically oriented disciplines. This literature review, after an initial conceptualisation of the gender gap in science, will document each of these difficulties before introducing the theoretical foundations of the study of female academic entrepreneurship.

2.1. Explaining the Gender Gap

The explanation of the gender gap in the broader literature has often focused on demand-side and supply-side perspectives (Ding et al. 2013). Even though the purpose of this study is not to explore the reasons for the gender gap, outlining the key explanations discussed in the general literature will offer a conceptual background as well as a rationale for the need to understand the gender gap of entrepreneurial engagements by academics in BSs.

The demand-side perspective, developed in sociology and social psychology, argues that women have limited opportunities to gain access to certain job types. The supply-side perspective, developed in the field of economics, argues that the differences in the preferences of men and women lead to different choices that, in turn, lead to gender gaps in labour markets. Whereas the demand-side argument outlines systemic biases (Gorman and Kmec 2009), the supply-side argument is vested in individual-level choices (Bertrand and Hallock 2001). The key arguments in relation to the demand side of the gender gap, thus, involve socially constructed cultural beliefs that act as disadvantages for women, including the lack of competency, ability to perform (Ridgeway 2001), fitness (Lyness and Heilman 2006), and in-group membership (Stuart and Ding 2006) by females in relation to certain roles/tasks/jobs. In contrast, the key arguments for the gender gap based on the supply side are the greater family responsibilities of women working full time (Jacobs and Winslow 2004) and the lack of interest by women in conducting research with industry relevance (Ding et al. 2013).

Even though barriers to women's involvement in science could be rooted in institutional and national cultural beliefs, a bibliometric analysis from Larivière et al. (2013) shows that gendered disparities in science are a global phenomenon. For example, on a global scale, among the 5,483,841 research papers analysed, female academics account for fewer than 30% of authorship, are twice as represented as the first author and are even less cited than male academics. While the US and Canada present high degrees of male dominance, along with Japan and Qatar, South American and Eastern European countries demonstrate even greater gender parity (Larivière et al. 2013). However, Larivière et al. (2013: 213) observed that age could play "perhaps even the major role" in explaining gender differences in science, as seniority bears the imprint of previous generations' barriers to the progression of women. Thus, this underscores the need for more accurate methods to assess gender disparities that take into account the possible stratification among academics.

2.2. Unfairly Assessing the Unfairness: Quantifying the Gap

For decades, scholars have pointed out gender disparities in science and its commercialisation (Larivière et al. 2013; Jadidi et al. 2018; Whittington and Smith-Doerr 2005). These disparities have been illustrated as a gender gap of entrepreneurship (Corley and Gaughan 2005; Besley et al. 2018a; Sugimoto et al. 2015) in terms of invention disclosure (Colyvas et al. 2012), patenting (Whittington and Whittington 2011; Dohse et al. 2017), consultation (Corley and Gaughan 2005), and spinoff creation (Martin et al. 2015; Kochenkova et al. 2015). However, prevalent approaches in this literature have somehow ignored important markers of stratification that greatly limit the comparison of two populations of academics with different characteristics (Marginson 2016; Lincoln et al. 2012; Tartari and Salter 2015). In other words, while exploring the unfairness of female academics' trajectory in institutional contexts, some studies have unfairly compared females with noncomparable male academics (Sá et al. 2020).

This is particularly the case when scholars have compared samples of minorities of female academics with larger groups of their male counterparts, for whom general demographics, career advancement or distribution among disciplines/departments are different (Tartari and Salter 2015). For instance, Whittington and Smith-Doerr (2008) compared a sample of

308 female academics (32%) with 654 male academics, Ding et al. (2006) compared a sample of 903 female academics (21%) with a group of 3,324 male academics, Colyvas et al. (2012) compared a sample of 161 female academics (14%) with 927 male academics, while Thursby and Thursby (2005) compared a sample of 360 female academics (8%) with a group of 4,140 male academics. Thursby and Thursby (2005) observed that women in their sample tended to be younger than men and affiliated with departments with lower academic rankings. In the same vein, Hunter and Leahey (2010) found that the women in their sample were significantly younger and had been in their careers a significantly shorter period of time. Therefore, to overcome the unbalanced nature of the two populations, scholars have controlled their analyses for a range of personal characteristics associated with academic entrepreneurship (Abreu and Grinevich 2017; Ding et al. 2006). However, as was pointed out by Tartari and Salter (2015), the unbalanced nature cannot be solved fully by the introduction of control variables. Consequently, to isolate female and male academics with similar characteristics, other attempts, such as Sá et al.'s (2020), compared female and elite male academics who hold research chairs. While their study contributes to the understanding of gender differences, empirical evidence has shown that elite/top academics are not representative of other members of the academic community (Li et al. 2019; Abramo et al. 2019a, 2019b).

However, comparative studies in medicine have a long history of strategies to deal with unbalanced groups of respondents/patients (Sinclair et al. 2011; Roick et al. 2007). One of the most powerful strategies to increase the comparability of independent groups of respondents is called the "pair-matched" technique (Sahai and Khurshid 1996; Zhang et al. 2014; Wang et al. 2018; Zimmermann et al. 2020). In this technique, any subject from an intervention group is matched with another subject in a control group who shares pertinent common characteristics before the comparison of the studied phenomenon/intervention (Bowling and Ebrahim 2005). This technique has already been mobilised 1) to study female differences with comparable male patients in medicine (Zhao 2018; Nieves et al. 2005; Abe et al. 2021; Eifert et al. 2014) and 2) in gender studies in social sciences (Carnes et al. 2015). However, no identified study has hitherto deployed this technique to study female/male academic differences, despite the proven possibility of contributing to a fair assessment of the gender gap in academic research and entrepreneurship.

2.3. Emphasising the Underrepresentation: Studying Technology Fields

Most studies on gender disparities in the commercialisation of academic research have been based on technology-oriented disciplines (Wheadon and Duval-Couetil 2019). Scholars have studied gender disparities in engineering fields (Blume-Kohout 2014), in medicine (Colyvas et al. 2012), in the life sciences (Ding et al. 2013), or more generally in the so-called science, technology, engineering, and mathematics (STEM) fields (Sohar et al. 2018; Blume-Kohout 2014; Sinell et al. 2018). Indeed, STEM fields are important sources of innovation and technology (Kuschel et al. 2020; Beede et al. 2011; Bianchi and Giorcelli 2020). Moreover, as pointed out by Halilem et al. (2011), researchers in the natural sciences and engineering are those with the most diversified portfolio of entrepreneurship outcomes, which makes them interesting cases to study formal commercialisation.

However, an emphasis on these disciplines when studying gender disparities is problematic for at least two reasons. First, women represent fewer than half of the faculty in several disciplines (Chronister et al. 1997; Slate and Harris 2010); however, their presence is especially low in engineering and some technology fields (Tartari and Salter 2015). In some STEM disciplines, women's representation in the nontenured track in the US could be as low as 17% and 8% in the tenured track (Hill et al. 2010), while in the UK, women's representation could be as low as 5% of professors (Tartari and Salter, 2015). An emphasis on these disciplines where women are underrepresented could thus exacerbate the unbalanced nature of female-male academics' demographics.

Second, among nontechnology disciplines, where women are more numerous, the study of some research fields also presents interesting insights for academic entrepreneurship and innovation development. For instance, academics in business-oriented fields are important actors in local, regional, and national systems of innovation (Etzkowitz et al. 2018; Chaminade et al. 2018). BS professors have not only emphasised entrepreneurship education (Atkinson 2014) but have also fostered academic entrepreneurship in other research fields (Hayter et al. 2018). For example, a study by Goethner and Wyrwich (2019) showed that the knowledge flows between BS and life science researchers represent important sources of science-based and technology-oriented business ideas. Moreover, faculty in BSs could be as involved in entrepreneurship as those in technology fields (Amara et al. 2016). However, while researchers in technology rely more on IP-based entrepreneurship (Halilem et al. 2017), BS researchers are more oriented towards knowledge-based commercialisation, such as consultancy services (Wright et al. 2009). In this regard, a study by Amara et al. (2016) showed that BS researchers offer a wide range of value-adding services and expert advice to companies. Academic entrepreneurship in the field of business contributes either to the development of companies' customer value propositions, their market segment positioning, or their revenue-generating mechanisms.

Consequently, most studies on gender disparities in academic entrepreneurship have focused on 1) technology-oriented disciplines, such as engineering and health sciences (Rosser 2018; Wang and Degol 2017; Carrigan et al. 2017), and on 2) the IP-based commercialisation of science through patenting (de Melo-Martín 2013), licensing (Colyvas et al. 2012), or spin-off creations (Rosa and Dawson 2006). Nevertheless, scholars have called for more research on nontechnological fields (Alonso-Galicia et al. 2015) and on non IP-based commercialisation of science as little is known about the gender disparities in the informal commercialisation of science (Tartari and Salter 2015). Thus, exploring gender disparities in non-STEM disciplines where women are more represented will contribute to advancing knowledge of female/male academics' differences in relation to their informal academic entrepreneurship.

2.4. Theorising the leaking pipeline: Understanding informal female academic entrepreneurship

The study of female academic entrepreneurship is at the confluence of two unmet conceptualisations of science commercialisation and of the implications of females in science.

First, a recurring view of science commercialisation refers to academic entrepreneurship as a dynamic process composed of a series of events (Friedman and Silberman 2003), which has been well documented in the case of the formal commercialisation of science (Wood 2011; Grimaldi et al. 2011; Abreu and Grinevich 2013; Siegel and Wright 2015). For instance, the process generally starts with the discovery, by faculty, of an invention with commercialisation potential (Wood 2011). It will then typically involve its disclosure to the institutional technology transfer office (TTO), which is generally involved in the rest of the process up until commercialisation and beyond (Daniel and Alves 2020). While universities could retain revenue from the commercialisation of IP-based inventions, such revenue is generally less obvious in relation to other forms of entrepreneurial engagements involved in knowledge transfer/exchange (Halilem et al. 2017). Consequently, the other forms of commercialisation of academic knowledge are generally considered less interesting for the TTO to be involved in (Grimaldi et al. 2011). This is problematic because informal commercialisation, such as consultancy services, represents significant channels of diffusion of scientific knowledge (Perkmann and Walsh 2007) and could be extremely effective in commercialising knowledge to industry (Mody 2006). Moreover, more female academics are involved in informal commercialisation of science than in formal commercialisation (Perkmann et al. 2013; D'este and Perkmann 2011). While informal academic entrepreneurship has been studied for decades (Perkmann et al. 2013), the literature is still fragmented, and little is known about the dynamics of its processes (Wood 2011; Perkmann et al. 2021). However, it can be observed that it is embedded in a larger process of knowledge transfer with industry (Azagra-Caro et al. 2017). Academics engaging in informal entrepreneurship could follow a path where at each step, they will increase (Parker et al. 2017; Amara et al. 2013; Geuna and Muscio 2009) 1) their proximity to industrial agents, from sporadic to contractual consulting engagements that involve recurring interactions (Vick and Robertson 2018), 2) the revenue generated from the interactions from nonremunerated to remunerated activities (Pinheiro et al. 2016), and 3) the risk associated with the entrepreneurial process, from sporadic commercial activities to the creation of a consulting spin-off company (Schaeffer et al. 2020; Rajaeian et al. 2018).

Second, the literature on the underrepresentation of women in science often refers to the metaphor of the "leaky pipeline" (Polkowska 2013; Clark Blickenstaff 2005; Goulden et al. 2011). While this metaphor was originally used to illustrate the shortage of candidates, both male and female, in scientific careers (Berryman 1983), in recent decades, it has mostly been used to describe women's trajectories in science (Arnett 2015; Morganson et al. 2010; Sassler et al. 2017). Females are said to "leak" in their career path by privileging other career orientations (Jones et al. 2016; Lindholm 2004) or by failing in the process (Ginther and Kahn 2004; D'Amico et al. 2011). While the former group of reasons resides in personal and gendered priorities (Vβzquez-Cupeiro and Elston 2006), the latter suggests that women are held back by a variety of barriers linked to their personal characteristics and to their context (Parker et al. 2017). Consequently, at each stage on their path, the flow of women diminishes from students in secondary school through university degrees onto jobs in science, such as professors, then in tenured track positions (Reed et al. 2011). However, in an extensive literature review, Polkowska (2013) added another stage to this process of women's integration into science: commercialisation. The entrepreneurial stage could be seen as a culmination of the scientific career of those who have achieved scientific accomplishments and who start down a path to commercialise their knowledge and results (Polkowska 2013). In the same vein, Demiralp et al. (2018) hypothesise that the leaky pipeline theory may hold an implication for women's involvement in science commercialisation. Consequently, by integrating the theories of informal academic entrepreneurship and of the leaking female pipeline, it is possible to expect that 1) female academics from BSs, involved in informal commercialisation, will progressively increase their proximity to industrial agents, the revenue generated, and the risk associated with their commercial activities, and 2) at each step of the path, a progressively smaller number of women will be observed. By building on the critiques of previous gender studies' strategies of comparison and on these derivations from the literature (see Table 1 for a summary of selected studies), this paper intends to further our understanding of specific paths that may be involved in the leaky pipeline of female business school academics in entrepreneurial activities.

Studied variables	Studied population for comparison	Comparison strategies	References
Patenting behaviour	• 308 female (32%) with 654 male academics • Disciplines: life sciences	• Control variables (years since PhD, disciplines, etc.)	(Whittington and Smith-Doerr 2008)
Patent behaviour	• 903 female (21%) with 3324 male academics • Disciplines: life sciences	• Control variables (productivity, networks, etc.)	(Ding et al. 2006)
Disclosure of inventions	• 360 female (8%) with 4140 male academics • Disciplines: science and engineering	• Control variables (age, sub-disciplines, etc.)	(Thursby and Thursby 2005)
Commercialisation behaviour	• 161 female (14%) with 927 male academics • Disciplines: medical school research	• Control variables (rank, work settings, etc.)	(Colyvas et al. 2012)
Research productivity	• 55 female (37%) with 95 male academics • Disciplines: linguistics and sociology	• Study of fields with a higher representation of women	(Hunter and Leahey 2010)
Research productivity and recognition	• Matched samples of 165 female (17%) and 778 elite male academics who hold a research chair • Disciplines: science and engineering	• Matched samples of elite scientists	(Sá et al. 2020)
Research productivity and recognition Commercialisation behaviour	• Pair matched of 203 female academics and 203 comparable male academics (same subdisciplines, academic positions, and experience) • Disciplines: 7 BS subdisciplines of (Management, HRM, Finance, Marketing, Information Management, Operational Research, and Economics)	• Study of fields with a higher representation of women • Study of entrepreneurship process with a higher representation of women • Pair matched of 203 female academics and 203 comparable male academics • Empirical exploration of a leaking pipeline of informal academic entrepreneurship	Our study

Table 1: Summary of selected studies on gender disparities in science

3. Methodology

The studied population is composed of members of BSs in Canada who were identified from the websites of Canadian BSs affiliated with the Association of Universities and Colleges of Canada (AUCC). We excluded visiting professors and sessional instructors to identify a list of 3,134 regular faculty members at the ranks of assistant, associate, and full professors in 35 BSs. A stratified random sample of 1,286 scholars was extracted using criteria for representativeness (in terms of schools, seniority and BS subdisciplines). Then, a web-based survey, in combination with a telephone survey, was used to collect data between December 2009 and March 2010 from these faculty members based on principles suggested by Dillman (2000). This process resulted in 807 usable questionnaires for a response rate of 62%, from which we kept only faculty who held a PhD for a final sample of 729 academics (see Table 2 for a summary of the methodology). Among them, 27.8% (203 questionnaires) belonged to female academics who constituted the intervention group.

Characteristics	Definition
Studied population	3,134 regular faculty members at the ranks of assistant, associate, and full professors in 35 BSs in Canada (small, medium and large universities)
Sampling method	A random sample of 1,286 scholars was extracted, using three criteria for representativeness: i) the school, ii) the seniority of the scholar as measured by his or her academic rank, and iii) his or her subdiscipline
Data collection	Through a web-based survey, in combination with a telephone survey, between December 2009 and March 2010
Response rate	807 usable questionnaires for a response rate of 62%, for a final sample of 729 academics who hold a PhD (203 female and 526 male academics)
Pair-matched technique	203 female academics (intervention group) randomly pair matched with 203 male academics (control group) who are affiliated with the same BS subdisciplines (Management, HRM, Finance, Marketing, Information Management, Operational Research, and Economics), hold the same academic position (assistant, associate, and full professor), and have a similar experience
Power analysis	According to a power analysis, 176 observations are required to control for a Type II error. Comparisons are based on 406 observations
Tests	Validation of the control group: descriptive statistics and T-test comparisons of the three characteristics (subdisciplines, position, and experience) Validation of the pair-matched technique: descriptive statistics, and t-tests comparison between the intervention group and the control group and the whole population of male academics
Statistical parameters	Confidence interval of 95%; T-test levels of significance (.10, .05, and .01) linked, respectively to the t values 1.65, 1.98, and 2.57.

Table 2: Summary of the Methodology

To make comparisons more accurate, we used the pair-matched technique (Bowling and Ebrahim 2005). This technique is based on the principle that closely matched subjects are more similar than unmatched subjects; thus, comparing responses with a number of pairs is more efficient than comparing the responses of groups of randomly identified subjects without any kind of stratification (Bowling and Ebrahim 2005). To use this technique (see Figure 1 for a graphic representation of the pair-matched process), we first selected the pertinent characteristics for pair matching female and male academics. Several systematic reviews of academic entrepreneurship have pointed out recurring characteristics of stratification (Bozeman et al. 2013; Neves and Brito 2020; Schmitz et al. 2017), namely, 1) the academic position, as each position comes with its own research, teaching, and administrative duties (Åstebro et al. 2012); 2) the sub-discipline of affiliation, as some research domains offer more potential for commercialisation than others (Abreu and Grinevich 2017); and 3) experience, as the number of years since PhD graduation is a proxy for academics' cumulative advantage (Amara et al. 2020).

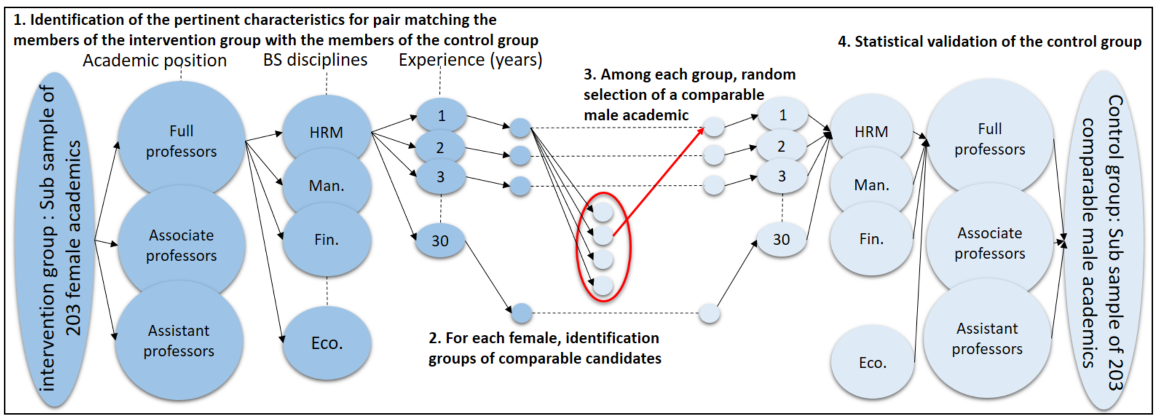


Figure 1: Application of the pair-matched technique

Second, for each of the 203 female academics, we identified 203 groups of male academics who hold the same academic position (assistant, associate, and full professor), are affiliated with the same BS subdisciplines (HRM, Management, Finance, Marketing, Information Management, Operational Research, and Economics), and have the same experience[2] (in terms of the number of years since PhD graduation). Third, using the random tool of SPSS,

[2] In relation to the experience, in order to increase the pool of comparable males for each female academic, we considered a range of one year before and after the PhD. One can hypothesise that in such a short period of time, the accumulated advantage is limited, allowing the comparison (Curran et al. 2020). For example, regarding research, an average increase of the h-index per year is of only 0.6 (Swihart et al. 2018).

we randomly selected, for each of the 203 female academics, a comparable male who shares the same characteristics in terms of disciplines, career advancement, and seniority (each male could only be selected once).

Before carrying out the comparisons, we conducted a power analysis for difference-of-means tests to control for the possibility of failing to reject a false null hypothesis or committing a Type II error (Lipsey 1990; Portney and Watkins 2008). The statistical program G-power 3.1.9.2 (Faul et al. 2009) was used to ensure that we had an appropriate number of valid cases for statistical analyses to be performed and to detect a true effect when it existed. Using the significance level of 0.05, to detect the small effect size of 0.05, the minimum sample size required to perform the difference of means tests was determined to be 176 (see Appendix 1). Considering that comparisons between the intervention and control groups are based on 406 observations, it was very unlikely that an effect would be detected if one existed. Then, fourth, to empirically validate the control group (comparable men), we relied on T-test comparisons of the three characteristics (subdisciplines, positions, and experience) between the intervention (female) and controlled (male) groups. Finally, to empirically validate the method, we also tested differences between the intervention group and the whole population of male academics, as has usually been done in the literature (Colyvas et al. 2012; Thursby and Thursby 2005; Whittington and Smith-Doerr 2008; Ding et al. 2006). We assess the significant differences between male and female academics using descriptive statistics and t-tests on research (the number of publications and the number of citations in Web of Science); and on informal entrepreneurship paths (binary variable of nonremunerated consulting, remunerated consulting and creation of a consulting company). Patents were not considered as BS faculty are generally not involved in patenting (Amara et al. 2016; Wright et al. 2009). This was then followed up by a statistical exploration of the leaky pipeline phenomenon of academics (Arnett 2015; Morganson et al. 2010; Sassler et al. 2017) in a progressive path of entrepreneurship moving from 1) no knowledge transfer activities to 2) involvement in nonremunerated consultation and then to 3) involvement in remunerated consultation leading to 4) the creation of a consulting company. We analysed the linear progression from nonengagement to consultancy company formation and the progression by skipping some of the middle steps as well as nonprogression.

4. Results

4.1. Descriptive results

Descriptive statistics offered an initial preliminary understanding of the suitability of using ‘paired comparison’. Regarding academic position and the subdisciplines of affiliation, Table 3 shows that the intervention (females) and control (comparable males) groups share the same distributions. However, the distributions of the intervention group (females) differ greatly from the whole population of male academics. This difference is discussed to further justify the appropriateness of deriving a comparable sample rather than simply comparing two groups. For example, the most represented academic position among women is associate professor (43%), while it is full professor for the whole population of male academics (39%). Moreover, more female academics were represented in the category of assistant professor (29%) than male academics (22%). Regarding the subdisciplines of affiliation, we can derive the same conclusions. The intervention and control groups share the same distributions of affiliations between BS disciplines. However, regarding the comparison with the entire population of males, we can observe slight differences, as women are more represented in management (41.3%), HRM (20.2%), and marketing (15.7%) compared to the whole population of males, who are more represented in management (35%), marketing (14.1%), HRM (13.3%), and finance (11.4%).

Pertinent characteristics	Categories	Intervention group (female)		Control group (comparable males)		Whole population of males	
		Number	Percentage	Number	Percentage	Number	Percentage
Academic position	Full professor	57	28.1	57	28.1	205	39.0
	Associate professor	88	43.3	88	43.3	202	38.4
	Assistant professor	58	28.6	58	28.6	119	22.6
	Total	203	100	203	100	526	100
Subdiscipline of affiliation	Management	84	41.3	84	41.3	187	35
	HRM	41	20.2	41	20.2	70	13.3
	Finance	12	6	12	6	60	11.4
	Marketing	32	15.7	32	15.7	74	14.1
	Information M.	16	7.9	16	7.9	48	9.1
	Operational Research	8	4	8	4	39	7.4
	Economics	10	4.9	10	4.9	48	9.1
	Total	203	100	203	100	526	100
Experience by academic position	Mean	11.3		11.3 (-0.89)		15.9(6.32)***	
	Full professor	18.42		18.31 (0.942)		25.06(4.98)***	
	Associate professor	12.64		12.36(-2.93)		14.15(1.519)*	
	Assistant professor	5.89		6.18(0.362)		7.59(1.734)*	

***<:01; **<:05; *p<:1

Table 3: Descriptive statistics and comparison between female and male academics

Finally, the same conclusion is obtained when comparing the experience of the groups (number of years since PhD graduation). While the difference in academics' experience between the intervention and control groups was statistically nonsignificant, the difference with the experience of the whole population of males was significant (P value of 0.000). In other words, while the comparability between the intervention and control groups is confirmed on the three characteristics, it is not empirically validated for the whole population of males. Furthermore, when we crossed the data between experience and academic position, the intervention and control groups presented nonsignificant differences for assistants (5.9 years and 6.18 years), associates (12.64 years and 12.36 years), and full professors (18.42 years and 18.31 years). However, in each of these categories, the average years of experience of males from the whole population is increasingly higher, from 1.5 years to 6.6 years (7.59 years, 14.15 years, and 25.06 years, respectively) and differences are statistically significant (P value of 0.1 to 0.01). These results offer another empirical confirmation of the several concerns highlighted in the literature (Marginson 2016; Lincoln et al. 2012; Tartari and Salter 2015) regarding the limitations of the recurring method of comparison between female academics and an entire population of noncomparable male academics.

4.2. Assessing the Gender Gap

We assessed the gender gaps between the intervention group and the other two groups (control and the whole population, see Table 4). Especially in relation to academics in BSs, publications and their academic impact (as reflected by citations) are considered to offer knowledge that could be commercialised (Abreu and Grinevich 2017). When we compared the intervention group with the whole population of male academics, we found that, on average, women produce 66% of males' scientific production and have been cited 64% of males' citations. These results are in line with previous results from the literature, as Hunter and Leahey (2010) found that women's scientific production accounts for 60% of males' cumulative articles, while Odic and Wojcik (2020) found that female academics have, on average, 68% of males' articles published in 125 highest impact journals in psychology.

However, when compared with the control group, the differences are reduced to 78% and 77% of comparable males' scientific production and citations, respectively. Considering the importance of research as a base for several forms of commercialisation (Abreu and Grinevich 2017), the findings indicate that the comparison of female academics with the whole population of male academics offers an unfair judgement on female activities. Moreover, when we crossed the data between research and academic position, we found that the differences between females and comparable males tend to be higher at the beginning of the career and to decrease drastically over the career stages, as women account for 50% of comparable male assistant professors' publications, 76% for associate professors, and 89% for full professors).

Variables		Intervention group (females)	Control group (comparable males)	Whole population	Comparable gender gap (percentage)	Usual gender gap
Published Articles (nb.)		3.04	3.86 (NS)	4.60***	78	66
Citations (nb.)		21.74	28.01 (NS)	32.74**	77	64
Consulting		41%	54.18***	54.6***	75.9	75
Creation of a consulting company		25.6%	33%**	34%**	77	75
Revenue generated from consulting activities	Less than 10%	69%	59%	55%	117%	125%
	Between 10 and 20%	27%	20%	27%	135%	100%
	More than 20%	5%	21%	18%	24%	28%

***<:01; **<:05; *p<:1

Table 4: Assessment of the Gender Gaps

Regarding the involvement of female academics in consulting activities and in the creation of a consulting company, the percentage of women involved in these two entrepreneurship channels is 41% (compared to 54.18% for comparable men and 54.6% for the whole population of men) and 25.6% (compared to 33% and 34%, respectively). In all cases, differences are significant (P value ranging from 0.05 to 0.01). Finally, we found significant differences between the remunerated female academics (41%, 83 females) and the two other groups (54.18%, 110 comparable males and 54.6%, 287 males). The proportion of female academics and comparable male academics who generate less than 10% of their revenue from consulting activities is higher (69% and 59%, respectively) than in the case of the whole population of males (55%). However, while the proportion of female academics who derive between 10% and 20% of their revenue from consulting activities is close to the whole population of males (27% in both cases), comparable male academics are less numerous (20%). Finally, only 5% of female academics derive more than 20% of their revenue from consulting, while the proportion is higher in the case of comparable male academics and the whole population of male academics (21% and 18%, respectively). These results show that even compared to comparable men, women are less likely to be involved in remunerated consultation and to derive a higher proportion of their revenue from these activities. In line with previous results that show that women interact less often with industry and are less likely to generate revenue (Perkmann et al. 2013; Tartari and Salter 2015), this study quantifies the disparities. As the results show that the comparison is fairer between the intervention (women) and control (comparable men) groups, in the rest of the study, the identification of the leaky pipeline will be made with these two groups.

4.3. Identifying the Leaky Pipeline

We compared the proportion of female and comparable male academics regarding the 4 steps of the informal entrepreneurship process (see Figure 2). First, the proportion of academics not involved in any form of knowledge transfer is higher for females (28.6%) than for males (23.6%). Regarding the leaky pipeline, the flow of academics, both female and male, diminishes by slightly more (for females) and less (for males) of a quarter. Then, the proportions of female and comparable male academics involved in nonremunerated consultation were similar (54.7% and 53.2%, respectively). However, while the pipeline is leaky for women, as 41.3% are involved in remunerated consultation, this is not the case for males, as 55.6% are involved in this commercial channel. The proportion is even higher than in the case of nonremunerated consultation, implying that for some male academics, the process is not progressive.

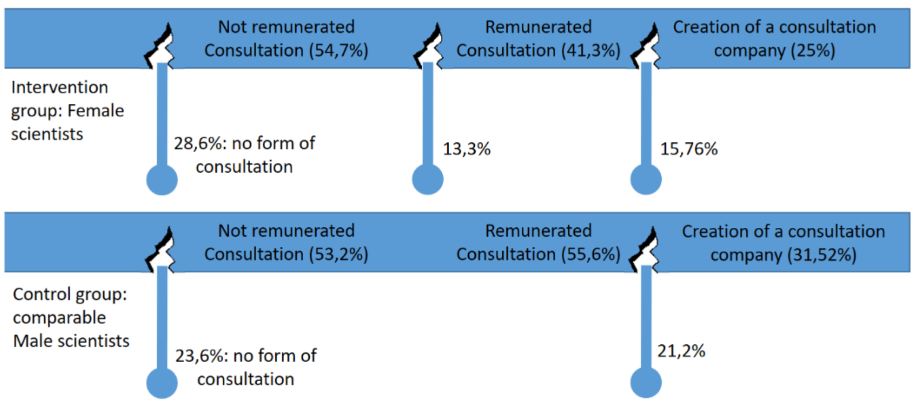


Figure 2: Assessing gender differences in the informal entrepreneurship path

Finally, the pipeline is leaking for both genders regarding the creation of a consulting company (25% and 31.52%, respectively). When assessing the gender gaps, the involvement of women and men in nonremunerated consultations was similar (54.7% versus 53.2%). However, the proportion of women accounts for 74% of the proportion of men involved in remunerated consultation and 79% for the creation of a consultancy. These results could be explained by gendered choices to value nonremunerated over remunerated consultations (i.e., supply-side perspective) or by barriers/lack of opportunities (i.e., demand-side perspectives), which hinder women from progressing to the remunerated form of consultation.

Figure 3 shows that most of the female (65.4%) and male academics (72.4%) follow incremental entrepreneurial processes: progressive path 1, which starts with nonremunerated consulting (50.2% for females and 53.2 for males), then remunerated consulting services with companies (27.1% and 36%), and ending with the creation of a consulting company (14,3% and 21,7%); ,and the deferred progressive path 2, which starts with remunerated consulting services with companies (14.3% and 19.2%), ending in the creation of a consulting company (4.4% and 6%).

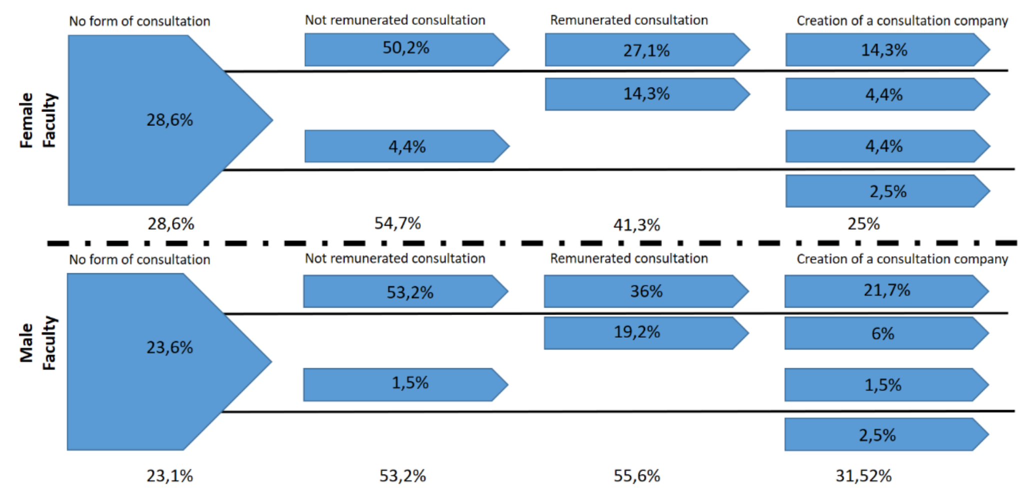


Figure 3: Identifying the paths of informal entrepreneurship

However, some female (6.9%) and male (4%) academic entrepreneurs are involved in (3) nonprogressive paths, where academics engage in nonremunerated consulting services (4.4% and 1.5%) to jump on the creation of a consulting company (4.4% and 1.5%) and where they create a consulting company without any involvement in other forms of consultation (2.5% and 2.5%). The identification of progressive and nonprogressive paths of academic entrepreneurship resonates with a debate over the academic process of science commercialisation (Yusof and Jain 2010). For example, while some conceptualisations have described academic entrepreneurship as a progression through a sequence of stages

(Micozzi 2020; Wood 2011; Rasmussen 2011), others have emphasised its nonincremental nature as a nonlinear iterative process (Benning and Flatten 2020; Vohora et al. 2004). These results show not only that both paths exist but also that the progressive path is the most recurring among both genders.

5. Concluding remarks

5.1. Important results

While scholars have identified for decades that female academics may be systematically excluded from commercial opportunities (Cole 1981; Murray and Graham 2007; Sohar et al. 2018), how to assess gender disparities in science have been at the centre of unresolved ongoing debates (Marginson 2016; Lincoln et al. 2012; Nygaard and Bahgat 2018). Studies on academic entrepreneurship have confronted a series of difficulties related to using methods with limited potential for comparison between female and male academics (Marginson 2016; Lincoln et al. 2012; Sá et al. 2020) or emphasising technologically oriented disciplines and the formal commercialisation of science, where women are even more underrepresented (de Melo-Martín 2013; Blume-Kohout 2014). Drawing from the literature on informal academic entrepreneurship and gender disparities in sciences, this study proposed mobilising the “pair matched,” a method inspired by methodological designs in medicine, to isolate female and male academics who share common characteristics on discipline affiliation, academic position, and experience. These results offer empirical confirmation of several concerns (Marginson 2016; Lincoln et al. 2012; Tartari and Salter 2015) regarding the limitations of the recurring method of comparison between female academics and an entire population of noncomparable male academics. Additionally, the results show that the assessment of the research gender gap between female academics and the whole population of male academics exacerbates the differences. Indeed, while the scientific production of women accounts for 66% of the whole population of males, it increases to 78% when compared with comparable men. The results confirm that a comparison with the whole population of males, as has been done several times in the literature (Whittington and Smith-Doerr 2008; Colyvas et al. 2012; Thursby and Thursby 2005; Ding et al. 2006), could thus lead to an unfair judgement of female activities. Moreover, the findings suggest that differences between female and comparable male academics tend to be higher at the beginning of the career and to decrease drastically over the career stages (ranging from 50% for assistant professors to 89% for full professors). Consequently, instead of addressing the gender gap in science as a static phenomenon, future research could explore the evolution of the gender gap through the stages of the career and identify the unique barriers at each step.

Regarding informal entrepreneurship, the results show that even compared to comparable men, fewer women are involved in remunerated consultation (41.3% versus 55.6%) and fewer derive a higher proportion of their revenue from these activities (only 5% of women derive more than 20% of their revenue from consultation compared with 21% for comparable men). Regarding the leaky pipeline, the results show that the number of both female and male academics decreases during the process but at different stages. The number of female academics decreases at each stage, from nonremunerated consultation to the creation of a consulting company. However, the number of males is constant from nonremunerated to remunerated consultation and then decreases during the stage of the creation of a consulting company. Future research could specifically explore the barriers that hinder women and men from progressing in their paths to isolate those factors that relate only to women, only to men, and to both genders. Moreover, while the progressive paths of informal entrepreneurship concern the majority of professors, either female or male, some of them are also involved in nonprogressive paths, where they leapfrog from nonremunerated consultation to the creation of a consulting company and to the creation of a consulting company without any involvement in another form of consultation. Future qualitative research could explore how some academic entrepreneurs could reach such advanced stages of commercialisation without any previous attempts.

5.2. Contributions

This paper, by addressing the gap in our knowledge of a fair assessment of entrepreneurial engagements by female academics in BS subdisciplines in comparison to their male counterparts, makes three original contributions to the academic entrepreneurship literature.

First, by applying the "pair-matched" method to assess differences between female and male academics for the first time, this study contributes methodologically to the literature on gender comparison by evaluating the unfairness of a noncontextualised analysis. Indeed, as the pertinence of the method is empirically validated, the study offers a more accurate comparison between female and comparable male academics. The findings of the "pair-matched" method suggest that a comparison of female and noncomparable male academics could lead to a biased judgement of female academics' performance in terms of publications that are used as the knowledge base to progress to entrepreneurial engagement. However, it is evident that even compared to comparable men, women are less likely to be involved in remunerated consultation, to generate a higher proportion of their revenue from consulting services or to engage in the creation of consultancy companies. Accordingly, this method offers a more accurate and detailed understanding of the types of activities in which female academics struggle compared to their ‘more comparable’ male counterparts.

Second, while the leaky pipeline theory holds implications for female academic entrepreneurship (Demiralp et al. 2018; Polkowska 2013), it has essentially been mobilised to identify the decreasing number of women at different periods of their lives, namely, from secondary school through university and on to the creation of a company (Martin et al. 2015). However, this theory has never been mobilised to study the leaking phenomenon in the different steps of an entrepreneurial path, which, thus, constitutes an empirical contribution. More specifically, by quantifying a leaky pipeline of both female and male academics involved in entrepreneurial paths, the study revealed that most women follow a progressive path in their entrepreneurial journey, but a majority of them struggle to move from nonremunerated to remunerated entrepreneurial engagement.

Third, regarding informal academic entrepreneurship, this study contributes to the debate over the progressive/nonprogressive processes of academic entrepreneurship by empirically identifying both types of processes and quantifying their prevalence. Indeed, the results show that incremental processes are still recurring among BS academics engaging in entrepreneurship, both female and male. Moreover, while studies on female academic entrepreneurs have been dominated by technological science areas, this study offers new insights into the entrepreneurial path in nontechnological, knowledge-intensive areas, moving from publications to nonremunerated consultancy, then to remunerated consultancy and finally to consultancy company creation, including a very small minority skipping some steps. Thus, the findings add value to the academic entrepreneurship literature (Colyvas et al. 2012; Whittington and Whittington 2011; Dohse et al. 2017; Besley et al. 2018a) by identifying the specific type of entrepreneurial activities and the stage of the entrepreneurial career of female entrepreneurs in non-STEM disciplines.

5.3. Limitations

This study offers the first empirical use of the "pair-matched" technique in gender studies in the case of academics. However, it is not without limitations. Based on several systematic reviews and previous studies (Bozeman et al. 2013; Neves and Brito 2020; Schmitz et al. 2017; Åstebro et al. 2012; Abreu and Grinevich 2017; Haeussler and Colyvas 2011), we identified important recurring markers of stratification, namely, academic positions, subdisciplines of affiliation, and finally experience. Other markers could also be added to this list, such as the institutional settings that hinder or create opportunities for academic entrepreneurship (Fischer et al. 2019). However, despite the nonnegligible effect of the institutional environment, a study by Halilem et al. (2011) based on a multilevel analysis of involvement in various activities concluded that the explanation of academics' behaviour is still a matter of individual differences. To increase the pool of comparable men for each woman, we considered a range of one year before and after completion of the PhD. Dealing with larger samples, future research could consider selecting only comparable men who graduated the same year. Indeed, while the evolution of the cumulative advantage is limited over a period of one year (Curran et al. 2020), it still exists (Swihart et al. 2018). Despite the limitations, this study shows that the pair-matched technique is proven to be an effective method for disparity analysis between the member of a potentially discriminated group and pair matched comparable members of a category of reference. Thus, by building on the "pair-matched" technique for data collection and analysis, the study opens the door to further development of more robust analyses and predictive models, for example, on the barriers and facilitators to overcoming gender disparities in science. Furthermore, the method could also be useful for the identification of disparities regarding other underrepresented academic groups, such as members of minorities or Black, Indigenous, and People of Colour (BIPOC, Kulp et al. 2021), whose literature suffers from the same limitations on the comparison of populations with an unbalanced nature (Madsen et al. 2017).

5.4.Practical/Social Implications

Enlarging the university footprint over society through knowledge transfer and tackling gender inequality in science are of increasing importance in the agendas of policy-makers and university administrators. However, those two objects of policy and of institutional management are linked in a timely fashion and are also intertwined. On the one hand, consultancy services represent significant channels of diffusion of scientific knowledge (Perkmann and Walsh 2007) and could be extremely effective in commercialising knowledge to industry (Mody 2006). In the case of BSs, Amara et al. (2016) have shown that academics offer a wide range of value-adding services and expert advice to companies ranging from customer value propositions to revenue-generating mechanisms. On the other hand, the use of a more accurate method for comparison, the pair-matched method, shows that the research productivity gap between female and male academics exists but is not as large as usually found in the literature (from 66%, see Hunter and Leahey 2010, to 78%, our results). Moreover, the results show that the productivity gap decreases drastically over the career stages (ranging from 50% for assistant professors to 89% for full professors). Thus, the gender mix policy should address the barriers that female academics face at the beginning of their career to reduce their negative impact over time. Moreover, as our study shows, while the proportions of female and comparable male academics involved in nonremunerated consultations are similar, fewer women are involved in remunerated consultations. Previous studies have shown that female academics tend to engage in commercially oriented activities when they can fully separate themselves from their academic duties, such as when they are on academic leave or when they quit their academic career (Fox and Xiao 2013). Thus, as most women follow a progressive path in their entrepreneurial journey, supporting female academics to bridge the gap between nonremunerated and remunerated consultation would both serve to increase knowledge transfer from universities and to reduce gender inequality. Failure to understand the female faculty's involvement in entrepreneurship would result either in the underutilisation of women's human capital or in a "leaking" of women, "at the culmination of their academic career" (Polkowska 2013), where they are already underrepresented.

Bibliography

Abe, T., Bell, Z.W., Wong, V., Spitz, R.W., Yamada, Y., Song, J.S., Loenneke, J.P., 2021. Skeletal muscle size distribution in large-sized male and female athletes, American Journal of Human Biology, 33, e23473. https://doi.org/10.1002/ajhb.23473

Abramo, G., D'Angelo, C.A., Di Costa, F., 2019a. The collaboration behavior of top scientists, Scientometrics, 118, 215-32. https://doi.org/10.1007/s11192-018-2970-9

———, 2019b. A gender analysis of top scientists' collaboration behavior: Evidence from italy, Scientometrics, 120, 405-18. https://doi.org/10.1007/s11192-019-03136-6

Abreu, M., Grinevich, V., 2013. The nature of academic entrepreneurship in the uk: Widening the focus on entrepreneurial activities, Research Policy, 42, 408-22. https://doi.org/10.1016/j.respol.2012.10.005

———, 2017. Gender patterns in academic entrepreneurship, The Journal of Technology Transfer, 42, 763-94. https://doi.org/10.1007/s10961-016-9543-y

Alonso-Galicia, P.E., Fernández-Pérez, V., Rodríguez-Ariza, L., Fuentes-Fuentes, M.d.M., 2015. Entrepreneurial cognitions in academia: Exploring gender differences, Journal of Managerial Psychology, 30, 630-44. https://doi.org/10.1108/JMP-08-2013-0262

Amara, N., Halilem, N., Traoré, N., 2016. Adding value to companies' value chain: Role of business schools scholars, Journal of Business Research, 69, 1661-68. https://doi.org/10.1016/j.jbusres.2015.10.035

Amara, N., Landry, R., Halilem, N., 2013. Faculty consulting in natural sciences and engineering: Between formal and informal knowledge transfer, Higher Education, 65, 359-84. https://doi.org/10.1007/s10734-012-9549-9

Amara, N., Rhaiem, M., Halilem, N., 2020. Assessing the research efficiency of canadian scholars in the management field: Evidence from the dea and fsqca, Journal of Business Research, 115, 296-306. https://doi.org/10.1016/j.jbusres.2019.10.059

Arnett, D.K., 2015. Plugging the leaking pipeline: Why men have a stake in the recruitment and retention of women in cardiovascular medicine and research, Circulation: Cardiovascular Quality and Outcomes, 8, S63-S64. https://doi.org/10.1161/CIRCOUTCOMES.115.001757

Åstebro, T., Bazzazian, N., Braguinsky, S., 2012. Startups by recent university graduates and their faculty: Implications for university entrepreneurship policy, Research Policy, 41, 663-77. https://doi.org/10.1016/j.respol.2012.01.004

Atkinson, R.D., 2014. Understanding the us national innovation system, ITIF, June. https://doi.org/10.2139/ssrn.3079822

Azagra-Caro, J.M., Barberá-Tomás, D., Edwards-Schachter, M., Tur, E.M., 2017. Dynamic interactions between university-industry knowledge transfer channels: A case study of the most highly cited academic patent, Research Policy, 46, 463-74. https://doi.org/10.1016/j.respol.2016.11.011

Beede, D.N., Julian, T.A., Langdon, D., McKittrick, G., Khan, B., Doms, M.E., 2011. Women in stem: A gender gap to innovation, Economics and Statistics Administration Issue Brief. https://doi.org/10.2139/ssrn.1964782

Benning, L., Flatten, T.C., 2020. How do new technology ventures grow? A theory of planned behaviour based assessment of inorganic growth, International Journal of Globalisation and Small Business, 11, 88-113. https://doi.org/10.1504/IJGSB.2020.109171

Berryman, S., 1983. Who will do science? Trends, and their causes in minority and female representation among holders of advanced degrees in science and mathematics. Rockefeller Foundation, New York.

Bertrand, M., Hallock, K.F., 2001. The gender gap in top corporate jobs, ILR Review, 55, 3-21. https://doi.org/10.1177/001979390105500101

Besley, J.C., Dudo, A., Yuan, S., Lawrence, F., 2018. Understanding scientists' willingness to engage, Science Communication, 40, 559-90. https://doi.org/10.1177/1075547018786561

Bianchi, N., Giorcelli, M., 2020. Scientific education and innovation: From technical diplomas to university stem degrees, Journal of the European Economic Association, 18, 2608-46. https://doi.org/10.1093/jeea/jvz049

Blume-Kohout, M., 2014. Understanding the gender gap in stem fields entrepreneurship, US Small Business Administration Office of Advocacy Report. https://doi.org/10.2139/ssrn.2506835

Bowling, A., Ebrahim, S., 2005. Handbook of health research methods: Investigation, measurement and analysis. Open University Press - McGraw-Hill Education New York.

Bozeman, B., Fay, D., Slade, C.P., 2013. Research collaboration in universities and academic entrepreneurship: The-state-of-the-art, The Journal of Technology Transfer, 38, 1-67. https://doi.org/10.1007/s10961-012-9281-8

Carnes, M., Devine, P.G., Manwell, L.B., Byars-Winston, A., Fine, E., Ford, C.E., Forscher, P., Isaac, C., Kaatz, A., Magua, W., 2015. Effect of an intervention to break the gender bias habit for faculty at one institution: A cluster randomized, controlled trial, Academic medicine: journal of the Association of American Medical Colleges, 90, 221. https://doi.org/10.1097/ACM.0000000000000552

Carrigan, C., O'Leary, K., Riskin, E., Yen, J., O'Donnell, M., 2017. On-ramping: Following women scientists and engineers through their transition from nonacademic to faculty careers, The Journal of Technology Transfer, 42, 98-115. https://doi.org/10.1007/s10961-015-9460-5

Chaminade, C., Lundvall, B.-Å., Haneef, S., 2018. Advanced introduction to national innovation systems. Edward Elgar Publishing.

Chronister, J.L., Gansneder, B.M., Harper, E., Baldwin, R.G., 1997. Full-time non-tenure-track faculty: Gender differences, NEA Higher Education Research Center Update, 3, n5.

Clark Blickenstaff, J., 2005. Women and science careers: Leaky pipeline or gender filter?, Gender and Education, 17, 369-86. https://doi.org/10.1080/09540250500145072

Cole, J.R., 1981. Views: Women in science: Despite many recent advances, women are still less likely than men to be promoted to high academic rank, and few have full citizenship in the informal scientific community, American Scientist, 69, 385-91.

Colyvas, J.A., Snellman, K., Bercovitz, J., Feldman, M., 2012. Disentangling effort and performance: A renewed look at gender differences in commercializing medical school research, The Journal of Technology Transfer, 37, 478-89. https://doi.org/10.1007/s10961-011-9235-6

Corley, E., Gaughan, M., 2005. Scientists' participation in university research centers: What are the gender differences?, The Journal of Technology Transfer, 30, 371-81.

Curran, M., Bloom, Q., Brint, S., 2020. Does cluster hiring enhance faculty research output, collaborations, and impact? Results from a national study of us research universities, Minerva, 58, 585-605. https://doi.org/10.1007/s11024-020-09408-3

D'Amico, R., Vermigli, P., Canetto, S.S., 2011. Publication productivity and career advancement by female and male psychology faculty: The case of italy, Journal of Diversity in Higher Education, 4, 175.

D'este, P., Perkmann, M., 2011. Why do academics engage with industry? The entrepreneurial university and individual motivations, The Journal of Technology Transfer, 36, 316-39. https://doi.org/Why do academics engage with industry? The entrepreneurial university and individual motivations

Daniel, A.D., Alves, L., 2020. University-industry technology transfer: The commercialization of university's patents, Knowledge Management Research & Practice, 18, 276-96. https://doi.org/University-industry technology transfer: The commercialization of university's patents de Melo-Martín, I., 2013. Patenting and the gender gap: Should women be encouraged to patent more?, Science and engineering ethics, 19, 491-504. https://doi.org/10.1007/s11948-011-9344-5

Demiralp, B., Morrison, L.T., Zayed, S., 2018. On the commercialization path: Entrepreneurship and intellectual property outputs among women in stem, Technology & Innovation, 19, 707-26.

Di Paola, N., 2020. Pathways to academic entrepreneurship: The determinants of female scholars' entrepreneurial intentions, The Journal of Technology Transfer, 1-25. https://doi.org/10.1007/s10961-020-09824-3

Dillman, D.A., 2000. Mail and internet surveys: The tailored design method. John Wiley, New York.

Ding, W., Murray, F., Stuart, T.E., 2006. Gender differences in patenting in the academic life sciences, Science, 313, 665-67. https://doi.org/10.1126/science.1124832

———, 2013. From bench to board: Gender differences in university scientists' participation in corporate scientific advisory boards, Academy of Management Journal, 56, 1443-64. https://doi.org/10.5465/amj.2011.0020

Dohse, D., Goel, R.K., Nelson, M.A., 2017. Female owners versus female managers: Who is better at introducing innovations?, The Journal of Technology Transfer, 1-20.

Ebersberger, B., Pirhofer, C., 2011. Gender, management education and the willingness for academic entrepreneurship, Applied Economics Letters, 18, 841-44. https://doi.org/10.1080/13504851.2010.503931

Eifert, S., Guethoff, S., Kaczmarek, I., Beiras-Fernandez, A., Seeland, U., Gulbins, H., Seeburger, J., Deutsch, O., Jungwirth, B., Katsari, E., 2014. Applying the gender lens to risk factors and outcome after adult cardiac surgery, Visceral Medicine, 30, 99-106. https://doi.org/10.1159/000362344

Ethridge, M.M., 2016. Marie curie: Radioactivity pioneer and the first woman to win a nobel prize. Cavendish Square Publishing, LLC.

Etzkowitz, H., Germain-Alamartine, E., Keel, J., Kumar, C., Smith, K.N., Albats, E., 2018. Entrepreneurial university dynamics: Structured ambivalence, relative deprivation and institution-formation in the stanford innovation system, Technological Forecasting and Social Change, 141, 159-71. https://doi.org/10.1016/j.techfore.2018.10.019

Faul, F., Erdfelder, E., Buchner, A., Lang, A.-G., 2009. Statistical power analyses using g* power 3.1: Tests for correlation and regression analyses, Behavior Research Methods, 41, 1149–60. https://doi.org/10.3758/BRM.41.4.1149

Fischer, B.B., de Moraes, G.H.S.M., Schaeffer, P.R., 2019. Universities' institutional settings and academic entrepreneurship: Notes from a developing country, Technological Forecasting and Social Change, 147, 243-52. https://doi.org/10.1016/j.techfore.2019.07.009

Fox, M.F., Xiao, W., 2013. Perceived chances for promotion among women associate professors in computing: Individual, departmental, and entrepreneurial factors, The Journal of Technology Transfer, 38, 135-52.

Friedman, J., Silberman, J., 2003. University technology transfer: Do incentives, management, and location matter?, The Journal of Technology Transfer, 28, 17-30. https://doi.org/10.1023/A:1021674618658

Geuna, A., Muscio, A., 2009. The governance of university knowledge transfer: A critical review of the literature, Minerva, 47, 93-114. https://doi.org/10.1007/s11024-009-9118-2

Ginther, D.K., Kahn, S., 2004. Women in economics: Moving up or falling off the academic career ladder?, Journal of Economic perspectives, 18, 193-214. https://doi.org/10.1257/0895330042162386

Goethner, M., Wyrwich, M., 2019. Cross-faculty proximity and academic entrepreneurship: The role of business schools, The Journal of Technology Transfer, 1-47. https://doi.org/10.1007/s10961-019-09725-0

Gorman, E.H., Kmec, J.A., 2009. Hierarchical rank and women's organizational mobility: Glass ceilings in corporate law firms, American Journal of Sociology, 114, 1428-74.

Goulden, M., Mason, M.A., Frasch, K., 2011. Keeping women in the science pipeline, The ANNALS of the American Academy of Political and Social Science, 638, 141-62. https://doi.org/10.1177/0002716211416925

Grimaldi, R., Kenney, M., Siegel, D.S., Wright, M., 2011. 30 years after bayh–dole: Reassessing academic entrepreneurship, Research Policy, 40, 1045-57. https://doi.org/10.1016/j.respol.2011.04.005

Haeussler, C., Colyvas, J.A., 2011. Breaking the ivory tower: Academic entrepreneurship in the life sciences in uk and germany, Research Policy, 40, 41-54. https://doi.org/10.1016/j.respol.2010.09.012

Halilem, N., 2010. Inside the triple helix: An integrative conceptual framework of the academic researcher's activities, a systematic review, Journal of Research Administration, 41, 23-50.

Halilem, N., Amara, N., Landry, R., 2011. Is the academic ivory tower becoming a managed structure? A nested analysis of the variance in activities of researchers from natural sciences and engineering in canada, Scientometrics, 86, 431-48. https://doi.org/10.1007/s11192-010-0278-5

Halilem, N., Amara, N., Olmos-Peñuela, J., Mohiuddin, M., 2017. "To own, or not to own?" a multilevel analysis of intellectual property right policies' on academic entrepreneurship, Research Policy, 46, 1479-89. https://doi.org/10.1016/j.respol.2017.07.002

Hayter, C.S., Nelson, A.J., Zayed, S., O'Connor, A.C., 2018. Conceptualizing academic entrepreneurship ecosystems: A review, analysis and extension of the literature, The Journal of Technology Transfer, 43, 1039-82. https://doi.org/10.1007/s10961-018-9657-5

Hill, C., Corbett, C., St Rose, A., 2010. Why so few? Women in science, technology, engineering, and mathematics. American Association of University Women, Boston, US.

Hunter, L.A., Leahey, E., 2010. Parenting and research productivity: New evidence and methods, Social studies of science, 40, 433-51. https://doi.org/10.1177/0306312709358472

Jacobs, J.A., Winslow, S.E., 2004. The academic life course, time pressures and gender inequality, Community, Work & Family, 7, 143-61. https://doi.org/10.1080/1366880042000245443

Jadidi, M., Karimi, F., Lietz, H., Wagner, C., 2018. Gender disparities in science? Dropout, productivity, collaborations and success of male and female computer scientists, Advances in Complex Systems, 21, 1750011. https://doi.org/10.1142/S0219525917500114

Jones, R.D., Griffith, K.A., Ubel, P.A., Stewart, A., Jagsi, R., 2016. A mixed-methods investigation of the motivations, goals, and aspirations of male and female academic medical faculty, Academic medicine, 91, 1089-97. https://doi.org/10.1097/ACM.0000000000001244

Kochenkova, A., Giuri, P., Grimaldi, R., Munari, F., 2015. The effect of university-level support policies on female participation in academic patenting, Druid15, 15-17.

Kulp, A.M., Pascale, A.B., Wolf-Wendel, L., 2021. Clear as mud: Promotion clarity by gender and bipoc status across the associate professor lifespan, Innovative Higher Education, 1-22. https://doi.org/10.1007/s10755-021-09565-7

Kuschel, K., Ettl, K., Díaz-García, C., Alsos, G.A., 2020. Stemming the gender gap in stem entrepreneurship–insights into women's entrepreneurship in science, technology, engineering and mathematics, International Entrepreneurship and Management Journal, 1-15. https://doi.org/10.1007/s11365-020-00642-5

Larivière, V., Ni, C., Gingras, Y., Cronin, B., Sugimoto, C.R., 2013. Bibliometrics: Global gender disparities in science, Nature News, 504, 211. https://doi.org/10.1038/504211a

Li, W., Aste, T., Caccioli, F., Livan, G., 2019. Early coauthorship with top scientists predicts success in academic careers, Nature communications, 10, 1-9. https://doi.org/10.1038/s41467-019-13130-4

Lincoln, A.E., Pincus, S., Koster, J.B., Leboy, P.S., 2012. The matilda effect in science: Awards and prizes in the us, 1990s and 2000s, Social studies of science, 42, 307-20. https://doi.org/10.1177/0306312711435830

Lindholm, J.A., 2004. Pathways to the professoriate: The role of self, others, and environment in shaping academic career aspirations, The Journal of Higher Education, 75, 603-35. https://doi.org/10.1080/00221546.2004.11773579

Lipsey, M., 1990. Design sensitivity: Statistical power for experimental research. Vol. 19. SAGE Publications Ltd., CA, USA.

Lyness, K.S., Heilman, M.E., 2006. When fit is fundamental: Performance evaluations and promotions of upper-level female and male managers, Journal of Applied Psychology, 91, 777. https://doi.org/10.1037/0021-9010.91.4.777

Madsen, T.E., Linden, J.A., Rounds, K., Hsieh, Y.H., Lopez, B.L., Boatright, D., Garg, N., Heron, S.L., Jameson, A., Kass, D., 2017. Current status of gender and racial/ethnic disparities among academic emergency medicine physicians, Academic Emergency Medicine, 24, 1182-92. https://doi.org/10.1111/acem.13269

Malmström, M., Johansson, J., Wincent, J., 2017. Gender stereotypes and venture support decisions: How governmental venture capitalists socially construct entrepreneurs' potential, Entrepreneurship Theory and Practice, 41, 833-60.

Marginson, S., 2016. 'Global stratification in higher education.' in, *Higher education, stratification, and workforce development* (Springer).

Martin, L., Wright, L., Beaven, Z., Matlay, H., 2015. An unusual job for a woman? Female entrepreneurs in scientific, engineering and technology sectors,

International Journal of Entrepreneurial Behavior & Research, 21, 539-56. https://doi.org/10.1108/IJEBR-08-2011-0095
Micozzi, A., 2020. The entrepreneurial dynamics in italy: A focus on academic spin-offs. Springer Nature, Cham, Switzerland.
Mody, C.C., 2006. Corporations, universities, and instrumental communities: Commercializing probe microscopy, 1981-1996, Technology and culture, 47, 56-80. https://doi.org/10.1353/tech.2006.0085
Morganson, V.J., Jones, M.P., Major, D.A., 2010. Understanding women's underrepresentation in science, technology, engineering, and mathematics: The role of social coping, The Career Development Quarterly, 59, 169-79. https://doi.org/10.1002/j.2161-0045.2010.tb00060.x
Murray, F., Graham, L., 2007. Buying science and selling science: Gender differences in the market for commercial science, Industrial and Corporate Change, 16, 657-89. https://doi.org/10.1093/icc/dtm021
Neves, S., Brito, C., 2020. Academic entrepreneurship intentions: A systematic literature review, Journal of Management Development. https://doi.org/10.1108/JMD-11-2019-0451
Nieves, J.W., Formica, C., Ruffing, J., Zion, M., Garrett, P., Lindsay, R., Cosman, F., 2005. Males have larger skeletal size and bone mass than females, despite comparable body size, Journal of Bone and Mineral Research, 20, 529-35. https://doi.org/10.1359/JBMR.041005
Nygaard, L.P., Bahgat, K., 2018. What's in a number? How (and why) measuring research productivity in different ways changes the gender gap, Journal of English for Academic Purposes, 32, 67-79. https://doi.org/10.1016/j.jeap.2018.03.009
Odic, D., Wojcik, E.H., 2020. The publication gender gap in psychology, American Psychologist, 75, 92. https://doi.org/10.1037/amp0000480
Parker, M., Hayter, C.S., Lynch, L., Mohammed, R., 2017. 'Barriers to academic entrepreneurship among women: A review of the constituent literatures.' in, *Gender and entrepreneurial activity* (Edward Elgar Publishing).
Perkmann, M., Salandra, R., Tartari, V., McKelvey, M., Hughes, A., 2021. Academic engagement: A review of the literature 2011-2019, Research Policy, 50, 1-20. https://doi.org/10.1016/j.respol.2020.104114
Perkmann, M., Tartari, V., McKelvey, M., Autio, E., Broström, A., D'Este, P., Fini, R., Geuna, A., Grimaldi, R., Hughes, A., 2013. Academic engagement and commercialisation: A review of the literature on university–industry relations, Research Policy, 42, 423-42. https://doi.org/10.1016/j.respol.2012.09.007
Perkmann, M., Walsh, K., 2007. University–industry relationships and open innovation: Towards a research agenda, International journal of management reviews, 9, 259-80. https://doi.org/10.1111/j.1468-2370.2007.00225.x
Pinheiro, R., Normann, R., Johnsen, H.C.G., 2016. External engagement and the academic heartland: The case of a regionally-embedded university, Science and Public Policy, 43, 787-97. https://doi.org/10.1093/scipol/scw020
Polkowska, D., 2013. Women scientists in the leaking pipeline: Barriers to the commercialisation of scientific knowledge by women, Journal of technology management & innovation, 8, 156-65. https://doi.org/10.4067/S0718-27242013000200013

Portney, L., Watkins, M., 2008. Foundations of clinical research: Applications to practice. Prentice Hall, Upper Saddle River.

Rajaeian, M.M., Cater-Steel, A., Lane, M., 2018. Determinants of effective knowledge transfer from academic researchers to industry practitioners, Journal of engineering and technology management, 47, 37-52. https://doi.org/10.1016/j.jengtecman.2017.12.003

Rasmussen, E., 2011. Understanding academic entrepreneurship: Exploring the emergence of university spin-off ventures using process theories, International Small Business Journal, 29, 448-71. https://doi.org/10.1177/0266242610385395

Reed, D.A., Enders, F., Lindor, R., McClees, M., Lindor, K.D., 2011. Gender differences in academic productivity and leadership appointments of physicians throughout academic careers, Academic medicine, 86, 43-47. https://doi.org/10.1097/ACM.0b013e3181ff9ff2

Ridgeway, C., 2001. Gender, status, and leadership, Journal of social issues, 57, 637-55. https://doi.org/10.1111/0022-4537.00233

Roick, C., Heider, D., Bebbington, P.E., Angermeyer, M.C., Azorin, J.-M., Brugha, T.S., Kilian, R., Johnson, S., Toumi, M., Kornfeld, Å., 2007. Burden on caregivers of people with schizophrenia: Comparison between germany and britain, The British Journal of Psychiatry, 190, 333-38. https://doi.org/10.1192/bjp.bp.106.025353

Rosa, P., Dawson, A., 2006. Gender and the commercialization of university science: Academic founders of spinout companies, Entrepreneurship and Regional Development, 18, 341-66. https://doi.org/10.1080/08985620600680059

Rosser, S.V., 2018. Breaking into the lab: Engineering progress for women in science and technology, International Journal of Gender, Science and Technology, 10, 213-32.

Sá, C., Cowley, S., Martinez, M., Kachynska, N., Sabzalieva, E., 2020. Gender gaps in research productivity and recognition among elite scientists in the us, canada, and south africa, PloS one, 15, e0240903. https://doi.org/10.1371/journal.pone.0240903

Sahai, H., Khurshid, A., 1996. Formulas and tables for the determination of sample sizes and power in clinical trials for testing differences in proportions for the matched pair design: A review, Fundamental & clinical pharmacology, 10, 554-63. https://doi.org/10.1111/j.1472-8206.1996.tb00614.x

Sassler, S., Glass, J., Levitte, Y., Michelmore, K.M., 2017. The missing women in stem? Assessing gender differentials in the factors associated with transition to first jobs, Social science research, 63, 192-208. https://doi.org/10.1016/j.ssresearch.2016.09.014

Schaeffer, V., Öcalan-Özel, S., Pénin, J., 2020. The complementarities between formal and informal channels of university–industry knowledge transfer: A longitudinal approach, The Journal of Technology Transfer, 45, 31-55. https://doi.org/10.1007/s10961-018-9674-4

Schmitz, A., Urbano, D., Dandolini, G.A., de Souza, J.A., Guerrero, M., 2017. Innovation and entrepreneurship in the academic setting: A systematic literature review, International Entrepreneurship and Management Journal, 13, 369-95. https://doi.org/10.1007/s11365-016-0401-z

Secundo, G., Rippa, P., Cerchione, R., 2020. Digital academic entrepreneurship: A structured literature review and avenue for a research agenda, Technological

Forecasting and Social Change, 157, 120118. https://doi.org/10.1016/j.techfore.2020.120118
Siegel, D.S., Wright, M., 2015. Academic entrepreneurship: Time for a rethink?, British Journal of Management, 26, 582-95. https://doi.org/10.1111/1467-8551.12116
Sinclair, J.M., Gray, A., Rivero-Arias, O., Saunders, K.E., Hawton, K., 2011. Healthcare and social services resource use and costs of self-harm patients, Social psychiatry and psychiatric epidemiology, 46, 263-71. https://doi.org/10.1007/s00127-010-0183-5
Sinell, A., Müller-Wieland, R., Muschner, A., 2018. Gender-specific constraints on academic entrepreneurship and engagement in knowledge and technology transfer, Technology Innovation Management Review, 8, 15-26.
Slate, J., Harris, A., 2010. Female faculty members at texas community colleges: Any changes since 2000?, Advancing Women in Leadership Journal, 30. https://doi.org/10.18738/awl.v30i0.292
Sohar, K., Mercier, N., Goble, L., Ghahramani, F., Loftin, B., 2018. Gender data gap: Baseline of us academic institutions, Technology & Innovation, 19, 671-83. https://doi.org/10.21300/19.4.2018.671
Stuart, T.E., Ding, W.W., 2006. The social structural determinants of academic entrepreneurship: An analysis of university scientists' participation in commercial ventures, American Journal of Sociology, 112, 97-144.
Sugimoto, C.R., Ni, C., West, J.D., Larivière, V., 2015. The academic advantage: Gender disparities in patenting, PloS one, 10, e0128000. https://doi.org/10.1371/journal.pone.0128000
Swihart, R.K., Sundaram, M., Kellner, K.F., Fei, S., 2018. Benchmarking scholarly performance by faculty in forestry and forest products, Journal of Forestry, 116, 320-27. https://doi.org/10.1093/jofore/fvx021
Tartari, V., Salter, A., 2015. The engagement gap: Exploring gender differences in university–industry collaboration activities, Research Policy, 44, 1176-91. https://doi.org/10.1016/j.respol.2015.01.014
Thursby, J.G., Thursby, M.C., 2005. Gender patterns of research and licensing activity of science and engineering faculty, The Journal of Technology Transfer, 30, 343-53. https://doi.org/10.1007/s10961-005-2580-6
Vick, T.E., Robertson, M., 2018. A systematic literature review of uk university–industry collaboration for knowledge transfer: A future research agenda, Science and Public Policy, 45, 579-90. https://doi.org/10.1093/scipol/scx086
Vohora, A., Wright, M., Lockett, A., 2004. Critical junctures in the development of university high-tech spinout companies, Research Policy, 33, 147-75. https://doi.org/10.1016/S0048-7333(03)00107-0
Vβzquez-Cupeiro, S., Elston, M.A., 2006. Gender and academic career trajectories in spain: From gendered passion to consecration in a sistema endogβmico?, Employee Relations, 28, 588-603. https://doi.org/10.1108/01425450610704515
Wang, M.-T., Degol, J.L., 2017. Gender gap in science, technology, engineering, and mathematics (stem): Current knowledge, implications for practice, policy, and future directions, Educational psychology review, 29, 119-40.
Wang, W., Liu, F., Hu, T., Wang, C., 2018. Matched-pair comparisons of minimally invasive esophagectomy versus open esophagectomy for resectable esophageal

cancer: A systematic review and meta-analysis protocol, Medicine, 97, e11447. https://doi.org/10.1097/MD.0000000000011447

Wheadon, M., Duval-Couetil, N., 2019. Token entrepreneurs: A review of gender, capital, and context in technology entrepreneurship, Entrepreneurship & Regional Development, 31, 308-36. https://doi.org/10.1080/08985626.2018.1551795

Whittington, K., Whittington, K.B., 2011. Gender, motherhood, and scientific work across employment sectors: Commercial patenting in academia and industry, Work and Occupations, 38, 417-56.

Whittington, K.B., Smith-Doerr, L., 2005. Gender and commercial science: Women's patenting in the life sciences, The Journal of Technology Transfer, 30, 355-70. https://doi.org/10.1007/s10961-005-2581-5

———, 2008. Women inventors in context: Disparities in patenting across academia and industry, Gender & Society, 22, 194-218. https://doi.org/10.1177/0891243207313928

Wood, M.S., 2011. A process model of academic entrepreneurship, Business Horizons, 54, 153-61. https://doi.org/10.1016/j.bushor.2010.11.004

Wright, M., Piva, E., Mosey, S., Lockett, A., 2009. Academic entrepreneurship and business schools, The Journal of Technology Transfer, 34, 560-87.

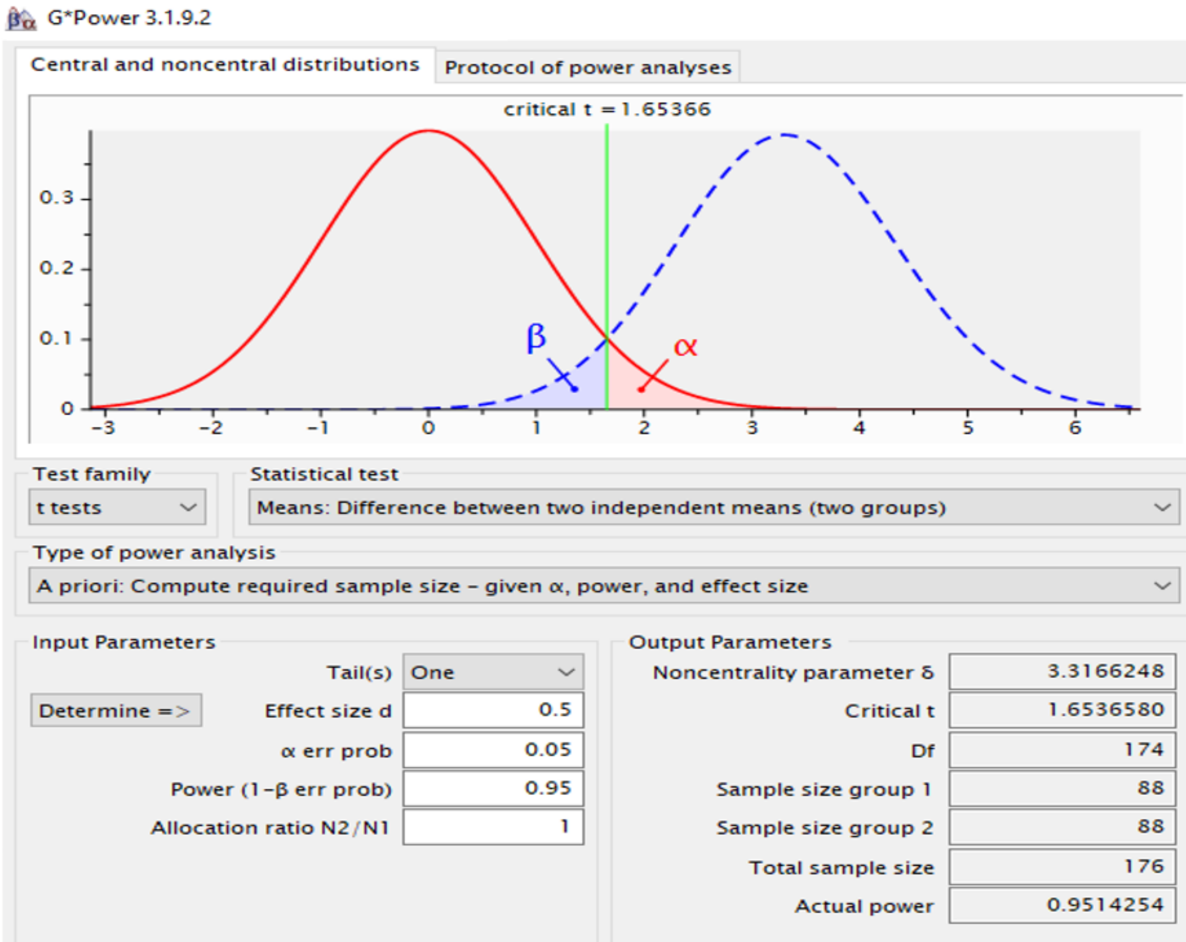
Yusof, M., Jain, K.K., 2010. Categories of university-level entrepreneurship: A literature survey, International Entrepreneurship and Management Journal, 6, 81-96. https://doi.org/10.1007/s11365-007-0072-x

Zhang, B., Zhu, F., Ma, X., Tian, Y., Cao, D., Luo, S., Xuan, Y., Liu, L., Wei, Y., 2014. Matched-pair comparisons of stereotactic body radiotherapy (sbrt) versus surgery for the treatment of early stage non-small cell lung cancer: A systematic review and meta-analysis, Radiotherapy and Oncology, 112, 250-55. https://doi.org/10.1016/j.radonc.2014.08.031

Zhao, Q., 2018. On sensitivity value of pair-matched observational studies, Journal of the American Statistical Association, 114, 713-22. https://doi.org/10.1080/01621459.2018.1429277

Zimmermann, F., Börtlein, J., Milinkovic, D.D., Balcarek, P., 2020. Patient-reported outcomes after revision surgery for failed medial patellofemoral ligament reconstruction: A matched-pair analysis including correction of predisposing factors, The American Journal of Sports Medicine, 48, 3566-72. https://doi.org/10.1177/0363546520966354

Appendix 1: Power analysis for difference of means test



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