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Artículos científicos

Empresas de base científica universitarias: configuraciones según el género del emprendedor

University scientific-based firms: configurations according to gender of the entrepreneur

Empresas universitárias de base científica: configurações segundo o gênero do empreendedor

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Resumen

En la literatura científica son escasos los estudios que han explorado las posibles interacciones entre los factores explicativos de la creación de empresas de base científica (Berbegal-Mirabent *et al.*, 2015) y aborden las diferencias en la creación de este tipo de empresas de acuerdo al género del emprendedor (Sinell *et al.*, 2018); de hecho, la mayor parte de las investigaciones sobre la creación de empresas de base científica y origen universitario se han enfocado en el efecto de variables aisladas para explicar su emergencia y en uno o dos niveles de análisis. Por eso, se ha planteado la siguiente interrogante: ¿en qué se diferencian las configuraciones causales de empresas de base científica de acuerdo con el género del emprendedor? El objetivo es identificar diferencias causales en la creación de empresas de base científica de acuerdo con el género del emprendedor y tomando en consideración variables de análisis de los niveles macro, meso y micro. El estudio comprende empresas apoyadas por incubadoras y aceleradoras ubicadas en distintas ciudades de México. Se analizaron 185 empresas universitarias dentro de las cuales no todas son de base científica; en cada empresa se obtuvo la respuesta del emprendedor del negocio. La información fue recopilada a través de una encuesta en línea y procesada a través del análisis cualitativo comparativo para conjuntos difusos. Como resultado se encontró que ninguna variable por sí sola es condición suficiente para generar empresas de base científica/tecnológica, independientemente del género de los emprendedores, ya que todas las configuraciones causales que alcanzaron la consistencia mínima de 0.80 estuvieron compuestas por más de una variable. Cuando se analizan los datos de las *spin-offs* generadas por hombres emerge solo una configuración suficiente en la que es necesaria la presencia de grado de estudios, área de conocimientos, experiencia en investigación, un marco normativo que permita al investigador la obtención de regalías por la propiedad intelectual generada en la institución y un equipo de fundadores. Cuando se realiza el análisis solo para el género femenino se identificó que es necesaria la presencia de grado de estudios, área de conocimientos, experiencia en investigación, experiencia en la industria, un marco normativo que permita la obtención de regalías de la propiedad intelectual generada en la institución, cultura emprendedora y financiamiento externo. En ambos casos las configuraciones alcanzan el mínimo de 0.80. Se concluye que las mujeres suplen al equipo fundador, necesario para los hombres, con experiencia en industria, cultura emprendedora y financiamiento externo, mientras que coinciden en grado de estudios, área de conocimientos, experiencia en I+D y la presencia de una normatividad que asegure la participación de los académicos en las regalías

generada por la institución de donde emerge la empresa. Cabe resaltar que en ninguna de las configuraciones aparece como necesaria la presencia de oficinas de transferencia tecnológica.

Palabras clave: Análisis comparativo cualitativo, emprendimiento por género, empresa de base científica, niveles de análisis, transferencia de conocimientos.

Abstract

In the scientific literature, there are few studies that have explored the possible interactions between the explanatory factors of the creation of science-based companies (Berbegal-Mirabent, Ribeiro-Soriano, and Sánchez García, 2015) and addressed the differences in the creation of this type of company according to the gender of the entrepreneur (Sinell, Mueller-Wieland and Muschner, 2018); Most of the research on the creation of science-based companies of university origin has focused on the effect of isolated variables to explain their emergence and at one or two levels of analysis, in this sense, it seeks to answer: how do they differ the causal configurations of science-based companies according to the gender of the entrepreneur? The objective is to identify causal differences in the creation of science-based companies according to the gender of the entrepreneur, taking into account analysis variables at the macro, meso and micro levels. The study includes companies supported by incubators and accelerators located in different cities in Mexico. 185 university companies were analyzed, not all of which are scientifically based. The information was collected through an online survey and processed through comparative qualitative analysis for fuzzy sets. As a result, it was found that no variable by itself is a sufficient condition to generate science/technology-based companies regardless of the gender of the entrepreneurs, since all the causal configurations that reached the minimum consistency of 0.80 were made up of more than one variable. When the data on spin-offs generated by men is analyzed, only a sufficient configuration emerges in which the presence of a degree of study, area of knowledge, experience in research, a regulatory framework that allows the researcher to obtain royalties for the intellectual property generated in the institution and a team of founders. When the analysis is carried out only for the female gender, it was identified that the presence of a degree of studies, area of knowledge, experience in research, experience in the industry, a regulatory framework that allows obtaining royalties from the intellectual property generated in the institution, entrepreneurial culture and external financing, in both

cases the configurations reach the minimum of 0.80. It is concluded that women replace the founding team, necessary for men, with experience in industry, entrepreneurial culture and external financing while they coincide in degree of studies, area of knowledge, experience in R&D and the presence of regulations that ensure the participation of academics in the royalties generated by the institution from which the company emerges. It is noteworthy that in none of the configurations does the presence of technology transfer offices appear necessary.

Keywords: Qualitative comparative analysis, entrepreneurship by gender, science-based company, levels of analysis, knowledge transfer.

Resumo

Na literatura científica, são poucos os estudos que exploraram as possíveis interações entre os fatores explicativos da criação de empresas de base científica (Berbegal-Mirabent et al., 2015) e abordam as diferenças na criação desse tipo de empresa de acordo com ao gênero do empreendedor (Sinell et al., 2018); De fato, a maior parte das pesquisas sobre a criação de empresas de base científica e universitária tem se concentrado no efeito de variáveis isoladas para explicar seu surgimento e em um ou dois níveis de análise. Diante disso, levantou-se a seguinte questão: como as configurações causais das empresas de base científica diferem de acordo com o gênero do empreendedor? O objetivo é identificar diferenças causais na criação de empresas de base científica de acordo com o gênero do empreendedor e levando em consideração variáveis de análise nos níveis macro, meso e micro. O estudo inclui empresas apoiadas por incubadoras e aceleradoras localizadas em diferentes cidades do México. Foram analisadas 185 empresas universitárias, nem todas com base científica; Em cada empresa, obteve-se a resposta do empresário empresarial. As informações foram coletadas por meio de uma pesquisa online e processadas por meio de análise qualitativa comparativa para conjuntos fuzzy. Como resultado, verificou-se que nenhuma variável por si só é condição suficiente para gerar empresas de base científica/tecnológica, independentemente do gênero dos empreendedores, pois todas as configurações causais que atingiram a consistência mínima de 0,80 foram compostas por mais do que uma variável. Quando se analisam os dados dos spin-offs gerados pelos homens, surge apenas uma configuração suficiente em que a presença de um grau de estudos, área de conhecimento, experiência em pesquisa, um marco regulatório que permita ao pesquisador obter royalties para a propriedade intelectual gerada

na instituição e uma equipe de fundadores. Quando a análise é realizada apenas para o gênero feminino, identificou-se que a presença de um grau de estudos, área de conhecimento, experiência em pesquisa, experiência na indústria, um marco regulatório que permite a obtenção de royalties da propriedade intelectual gerados na instituição, cultura empreendedora e financiamento externo. Em ambos os casos as configurações atingem o mínimo de 0,80. Conclui-se que as mulheres substituem a equipe fundadora, necessária para os homens, com experiência na indústria, cultura empreendedora e financiamento externo, ao mesmo tempo em que coincidem em grau de estudos, área de conhecimento, experiência em P&D e presença de regulamentações que assegurem a participação de acadêmicos nos royalties gerados pela instituição da qual a empresa surge. Note-se que em nenhuma das configurações parece necessária a presença de escritórios de transferência de tecnologia.

Palavras-chave: Análise comparativa qualitativa, empreendedorismo por gênero, empresa de base científica, níveis de análise, transferência de conhecimento.

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Introduction

The creation of *spin-offs*[1] it is a complex phenomenon influenced by factors that correspond to different levels of analysis (Caiazza, 2014; Djokovic and Souitaris, 2008). However, most of the research has focused on studying the isolated effects of one, two or more variables to explain their emergence (Fini et al., 2020; Jung and Kim: 2018) and at one or two levels of analysis. depending on the chosen theoretical approach. For example, Djokovic and Souitaris (2008) and O'Shea et al. (2008) carry out reviews of the literature in which they classify the investigations into one or two levels; subsequently, Markuerkiaga et al. (2016) insist that the phenomenon must be addressed in a more comprehensive way. In short, the studies that have explored the possible interactions between the explanatory factors and tackled the problem in a forceful way are scarce.

For this reason, a qualitative comparative analysis was carried out with the aim of identifying causal configurations in the creation of these companies according to the gender of the entrepreneurs. The variables that have been used in isolation to explain the phenomenon —and which are taken up in this study— are a) micro-level: the area of study, the degree of studies, the previous experience of the entrepreneur and the founding team; b)

[1] Se utilizará la palabra *spin-off* como sinónimo de empresa de base científica/tecnológica.

mesolevel: institutional intellectual property policy, technology transfer office services and promotion of entrepreneurial culture, and c) macrolevel: access to external financing, levels of analysis also studied by Hossinger et al. (2019).

The guiding question was the following: how do the causal configurations of science-based companies differ according to the gender of the entrepreneur, taking into account the macro, meso and micro levels? The questionnaire for the collection of information consisted of 23 items distributed in four sections. This was designed in Google Forms and sent by email to directors of business incubators and accelerators located in different cities in Mexico, who in turn forwarded it to the entrepreneurs who at that time had some relationship with each institution.

The article is divided into seven main sections. In this the introduction to the subject is presented, in the second the theoretical and conceptual framework on which the research is based, in the third the methodological aspects, in the fourth the results, later the discussion, in the fifth and in the sixth the conclusions. most relevant and, finally, contributions to future lines of research are included.

Theoretical and conceptual framework

Science/technology-based companies are considered to be those derived from scientific research carried out in public or private institutions that have an innovation protected by some form of intellectual property (patent, industrial design, layout design of integrated circuits and copyrights). author for the case of software) (Wright, et al., 2008). These are generally founded by academics or students who are involved in the development of the research from which the intellectual property that is intended to be commercialized derives, although they can also be created by entrepreneurs external to the institution and the team that carried out the investigation. research from which the intellectual property or the product being marketed was derived.

There are companies derived from research that do not have intellectual property; however, it is more difficult to verify that their products or processes are derived from the application of new knowledge that allows them to maintain a competitive advantage in the market. Instead, the registration of intellectual property is a way to identify the application of new knowledge and the right to its exclusive exploitation on a temporary basis, which allows these companies to protect themselves from competition and avoid paying royalties if that knowledge is registered by another national or foreign company. This last aspect is of

great relevance for countries with persistent negative balances in their technological balance, as is the case of Mexico, which in 2016 its payments abroad for patents, licenses, know-how and non-patented inventions represented 129 times the value of their income, according to data from the National Institute of Statistics and Geography (INEGI, 2017).

To comprehensively address the creation of this type of company, variables from the macro, meso and micro levels of analysis were included in accordance with the classification made by Djokovik and Souitaris (2008) and O'Shea et al. (2008). Based on this classification, the following lines describe the evidence found regarding the influence of certain variables on the creation of spin-offs, variables that have been used in isolation to explain the phenomenon and, therefore, have obtained contradictory results. . For example, in the case of technology transfer offices, Berbegal-Mirabent et al. (2015) point out that the transfer offices had positive effects on the generation of spin-offs, while Rodeiro Pazos et al. (2012) point out that transfer offices had no effect on the generation of spin-offs in the case of Spanish public universities. Other studies have found contradictory results in variables such as previous experience (Li and Dutta, 2018; Schleinkofer and Schmude, 2013).

In the following sections, the various findings regarding each of the variables involved are explained in more detail. The selected variables are those that have been commonly used to explain the phenomenon a) micro-level: the area, degree of studies, previous experience of the entrepreneur and if he is part of a founding team; b) mesolevel: institutional intellectual property policy, technology transfer office and promotion of entrepreneurial culture, and c) macrolevel: access to financing (table 1).

Table 1. Variables that empirically influence the creation of spin-offs

Niveles	Corrientes	Variables
Macro	Influencia ambiental externa	a) Mercado financiero o acceso al financiamiento.
Meso	Determinantes institucionales y organizacionales	b) Oficina de transferencia tecnológica.
		c) Política de propiedad intelectual.
		d) Fomento de cultura emprendedora.
Micro	Atributos o características individuales	e) Nivel de estudios.
		f) Área de estudios.
		g) Experiencia.
		h) Equipo fundador.

Source: Own elaboration based on a) Avdeitchikova (2009), Bozkaya and De la Potterie (2008), Korpysa (2019) b) Berbegal-Mirabent *et al*. (2015), Debackere (2010), Fini *et al*., (2017) c) Hyejin y Byung-Keun (2018), Lach y Schankerman (2003), Muscio *et al*. (2016), d) Benavides-Sánchez *et al*. (2021), Markuerkiaga *et al*. (2016), Sánchez (2011), e) Åstebro *et al*. (2012), Barbini *et al*. (2021), Colombo y Delmastro (2002), Kanellos (2013) f) Barbini *et al*. (2021), D'Este y Patel (2005), García (2014), Rodeiro Pazos *et al*. (2012), g) Li y Dutta (2018), Rasmussen y Borch, (2010).

In the following paragraphs, based on an analysis of the literature, the variables for each level that have been empirically found to influence the creation of spin-offs.

Macro level: access to financing

Newly created technology-based companies have certain characteristics that cause financing problems, including little or no information and asymmetric information, risk and uncertainty, the time needed to obtain returns and the absence of tangible assets (Avdeitchikova, 2009; Bozkaya and De La Potterie, 2008). Due to the above, seed capital financing schemes are considered essential in the early stages of the company, since it has been shown that the willingness of scientists to start university companies decreases as institutional restrictions to access external financing increase (Korpysa, 2019). This means that a greater presence of venture capital funds and angel investors encourages the emergence of spin-offs. Faced with this situation, strategies have been developed such as the European

Seed Capital Fund Pilot Scheme (1988-95) (Murray, 1998), NASDAQ and NASDAQ Europe for the provision of capital for spin-offs (Djokovic and Souitaris, 2008).

Other initiatives have consisted of government contributions through subsidies, the participation of entrepreneurs in venture capital funds that invest in the early stages of the company, and obtaining seed capital from angel investors (Colombo et al. , 2013; Meuleman and De Maeseneire, 2012). However, in countries such as Mexico, access to external financing, especially for new companies, remains very restricted. In a recent study, only 23% of university-based technology-based start-ups obtained resources from sources other than friends and family in the pre-commercial stage (García et al., 2020).

In this sense, it is expected to find the presence of external financing (other than friends and family) as a necessary condition in the formation of spin-offs, although not in all sufficient configurations.

Mesolevel: policies and institutional support structures

The protection of intellectual property is a key factor for the creation of technology-based companies, as evidenced in the scientific literature on the subject. This type of registration makes it easier for universities to market the goods and services derived from the process of generating and applying knowledge of their human capital, as has happened in the United States and Canada (Landry et al., 2007), in Japan (Kodama, 2008) and Europe (Debackere, 2010; Fini et al., 2017).

The incentive of any commercialization process is to obtain profits, which is why the intellectual property policy defined by universities generally implies the participation of the inventor and various areas of the same university in the income derived from the licenses issued. Various studies have identified that the greater participation of academics and researchers in the income derived from the commercialization of their inventions positively influences the creation of technology-based companies (Lach and Schankerman, 2003; Muscio et al., 2016). Likewise, patent registration has a positive and significant effect on the probability that universities create spin-offs (Hyejin and Byung-Keun, 2018).

Therefore, it is expected to find the presence of intellectual property policies for the participation of researchers in obtaining royalties as a necessary condition in the creation of spin-offs and the greater the participation, the greater the influence of this factor.

Regarding technology transfer offices, the role they play in the creation of spin-offs has been studied by Fini et al. (2017) in Italy, Norway and the United Kingdom. The services provided by technology transfer offices allow student and academic entrepreneurs to obtain from resources to training through consulting processes for the protection of intellectual property (Fuster et al., 2019; Rasmussen and Borch, 2010). In this way, various universities have initiatives that contribute to the formation of EBT-Us and implement their technology transfer offices, including Geogia Tech (Rothaermel and Thursby, 2005) and the Catholic University of Louvain, in Belgium (Debackere , 2010). Also in Mexico and Spain, there are studies that indicate that the support and services provided by the experts who are part of the OTTs foster a growing participation of entrepreneurs in the creation of spin-offs (Berbegal-Mirabent et al., 2015; Red de Technology Transfer Offices, 2016, 2018). However, some studies such as the one by Rodeiro et al. (2012) point out that transfer offices had no effect on the generation of spin-offs in the case of Spanish public universities. Due to the above, it is expected to find OTT services as a necessary condition in some, but not in all, sufficient configurations in the creation of spin-offs.

In relation to the promotion of an entrepreneurial culture, it can be emphasized that the commercialization of technological developments derived from research requires resources and entrepreneurial skills, so that educational institutions, in addition to encouraging the production of marketable goods and services derived from of the investigative processes also require to be oriented towards entrepreneurship (Scuotto et al., 2020). In Colombia, Benavides-Sánchez et al. (2021) state the need for universities to have entrepreneurship centers if they seek to promote the creation of EBT. For this, it is important to consider the identification of potential entrepreneurs (López Puga and García García, 2011), who are subsequently creditors to participate in support programs for the promotion of entrepreneurial culture, since in the literature on the subject studies are identified in which the creation of EBT is related to the entrepreneurial culture (Caiazza, 2014; Markuerkiaga *et al*., 2016).

In this sense, it is expected to find that the presence of entrepreneurship education is a necessary condition in some of the sufficient configurations in the creation of spin-offs.

Micro level: the characteristics of entrepreneurs

The academic degree becomes relevant in recent investigations, since a positive relationship has been found between postgraduate studies and the creation of science-based companies (Barbini et al., 2020). However, in the literature on the subject, it is identified that the studies that relate the creation of technology-based companies with the academic degree of entrepreneurs are scarce and heterogeneous. In fact, some analyze this relationship before the intention to undertake (Fritsch and Krabel, 2012), while others carry out the analysis once the company has started (Åstebro et al., 2012; Colombo and Delmastro, 2002; Kanellos, 2013).

In the studies carried out once the technology-based company started, it has been identified that entrepreneurship in Italy is mostly associated with postgraduate academic levels (Colombo and Delmastro, 2002). In Greece, 86% of technology-based entrepreneurs have higher education (Kanellos, 2013). However, an analysis of entrepreneurial intention among researchers found that those without a doctorate show greater interest in entrepreneurship than those with this academic degree (Åstebro et al., 2012; Fritsch and Krabel, 2012). According to this, we would expect to find postgraduate studies as a necessary condition in some of the configurations sufficient for the creation of spin-offs.

On the other hand, regarding the study area variable, a recent investigation found a solid relationship between the educational field and the R&D intensity of entrepreneurial projects: engineering and life sciences students tend to form companies with greater technological intensity than those in the business and humanities area (Barbini et al., 2020). In the same way, Shane (2002) and O'Shea et al., (2005) point out that most of the spin-offs are generated in the health sciences or biomedicine, as well as chemistry and within from the areas of electrical and electronic engineering (D'Este and Patel, 2005). Universities with academic programs in engineering and life sciences have a greater propensity to create science-based companies (Rodeiro et al., 2012).

Based on the above, it is expected to find that engineering and life sciences studies are a necessary condition in any of the sufficient configurations.

Looking at prior experience, Li and Dutta (2018) found that the founding team industry positively affected the creation of new high-tech businesses in a sample of 446 start-ups in the United States. This relationship between the experience of technology-based entrepreneurs in the industry and the creation of their businesses has been supported by evidence by various authors. For example, Colombo and Delmastro (2002) point out that

more than 90% of the technology-based entrepreneurs who created new companies had previous experience, and 71% of them in high-tech industries. A similar situation was found by Kodama (2008) in Japan, where companies were created by unemployed people who previously worked in the electrical and electronics industry. Likewise, experience in the industry is also a factor that favors the commercialization of inventions derived from knowledge (Rasmussen and Borch, 2010). However, in Germany no evidence was found of the influence of previous experience in the creation of *spin-offs* (Schleinkofer y Schmude, 2013).

Therefore, it is possible to expect that in different contexts, previous experience is a necessary condition in some of the sufficient configurations in the formation of spin-offs.

In relation to the founding team, starting a new business as a team is considered different from doing it alone. Working in this way essentially depends on individual and personal capacity to deal with contingencies, while team members coordinate their work, pool efforts, share knowledge and information, and develop mutual competencies, effectively constituting a superior entity that transcends to individual members. According to Santos et al. (2019), when two or more people dynamically interact and create interdependent relationships with the common goal of starting new businesses, their individual capabilities can be increased, refined, enhanced, and reinforced as a team competition. This means that starting a venture with the help of a founding team is more likely than doing it alone, since the team complements knowledge, financial resources and the network of contacts to access different types of financing (Rasmussen and Borch, 2010).

As Li and Dutta (2018) point out, the existing literature on the influence of the founding team has tended to emphasize the role and impact of the team on a variety of company outcomes, such as survival, growth, performance, and other outcomes. organizational challenges despite the early call for the role of founding teams in business creation.

In summary, this study contributes to resolving this important gap, so it is expected that the presence of a founding team in one of the configurations sufficient for the creation of spin-offs is a necessary condition.

Methodology

Qualitative comparative analysis (QCA) was used in its fuzzy-set qualitative comparative analysis (fsQCA) variant for two reasons: a) it is assumed that the creation of spin-offs is a social phenomenon complex and as such there is no single way to reach the same result, and b) in Mexico it is a rare phenomenon because it was not until 2015 that a regulatory framework was established that allows and encourages the creation of companies based on property intellectual generated from scientific research carried out in educational institutions and public research centers. The QCA is ideal for small and intermediate samples or populations (up to 50 cases) (Ragin, 2000), although it can also be applied to large samples. Unlike traditional quantitative analysis techniques, the comparative method assumes complex causality and focuses on asymmetric relationships that detect configurations that allow a specific result (Schneider and Wagemann, 2012), that is, different combinations of the same variables or factors. can lead to the same result, in this case, the emergence of scientific/technologically based companies of academic origin. A configuration is the combination of variables or factors that are minimally necessary and/or sufficient to cause a specific result. Configurations consist of positive, negative or absent conditions (Berbegal-Mirabent et al., 2015). The compared method can also identify conditions that lead to the absence of the result (in this case it is only used to detect the cases of presence).

The fsQCA is appropriate for variables that can take different degrees of set membership with values ranging from 0 to 1. Fuzzy sets explicitly require that the definition of set membership values be based on three qualitative anchors: full set membership (1), full non-membership (0), and indifference (0.5) (Schneider y Wagemann, 2012).

The QCA has several steps. The first is to build the comparative table or data matrix: the number of rows is determined by the number of cases available and the number of columns by the number of independent and dependent variables (Pérez-Liñán, 2010). The second step is to build the truth table: this data matrix has 2^k rows, where k is the number of explanatory variables. Each row reflects a specific combination of attributes (both those that were empirically observed and those that were not) and each column represents a condition (presence or absence of the attribute). The third step is to reduce the number of rows in the truth table, which is done through a process of logical minimization. Using Boolean algebra, this process returns a set of combinations of causal conditions (each one is minimally sufficient to produce the result) (Berbegal-Mirabent et al., 2015). Line reduction depends on two criteria: coverage and consistency. Coverage is analogous to the coefficient of

determination in statistical analysis (Woodside, 2013, cited by Berbegal-Mirabent et al., 2015) and indicates the proportion of total positive cases that each causal combination manages to explain. Consistency is analogous to correlation in statistical analysis and indicates the proportion of cases in each row that have the outcome of interest. According to Ragin (2000), when the index is equal to or greater than 0.80, the causal configuration emerges as a sufficient condition. The second and third steps to carry out the analysis were performed using the fsQCA 3.0 software that uses the minimization algorithm Quine-McCluskey (Ragin y Davey, 2016).

185 responses were analyzed, of which only 25 are spin-off, that is, positive and negative cases were selected, which allowed observing variation in the dependent variable creation of spin-off (table 2) with the aim of avoiding bias. of selection (Pérez-Liñán, 2010). The field work was carried out with a questionnaire as an instrument to obtain information, applied to the entrepreneurs electronically through mail previously sent to the directors of business incubators and accelerators that attended them. The application was made during the months of August and September 2020 and 2021.

The questionnaire is made up of 23 items grouped into four sections[2]: the first collects individual characteristics of the entrepreneur (micro level), the second on the product and the institutional and organizational determinants (meso level: university environment), the third on access to financing (macro level: influence of the external environment) and the last collects characteristics of the business. Items 11, 3, 4, 5, 7, 20, 17, 14, 18 and 19 were used to measure the variables creation of spin-off (SpO), degree of studies (GradoEst), area of knowledge (AreaCono), research and development experience (ExpID), industry experience (ExpInd), founding team (EquiFund), technology transfer office services (ServiOTT), participation in intellectual property royalties (RegaliPI), promotion of entrepreneurial culture (CultEmpr) and access to financing (Financ), respectively (table 2). Items 1 and 2 collect demographic data, item 6 is complementary to 7, items 8, 9 and 10 were used to identify if the product was innovative, item 12 identifies the type of institution in which the study was carried out. research from which the innovation was derived, items 13 and 15 identify whether any of the founders was involved in the research from which the intellectual property that is marketed was derived, item 16 identifies the technological area of the

[2] El instrumento completo se puede consultar a través de correo electrónico del autor de correspondencia.

innovation, items 21 , 22 and 23 compile age of the company, number of employees and incubator of origin. The operationalization of the variables is shown in table 2.

Table 2. Variable Definition

Condiciones		Código	Descripción
Resultado*(variable dependiente)	Creación de spin-off	SpO	¿El producto que ofrece la empresa se derivó de la investigación científica/tecnológica realizada en la universidad o centro de investigación? (1 = sí; 0 = no).
Condiciones antecedentes* (variables independientes)	Atributos o características individuales	GradoEst	Máximo grado de estudios (1 = maestría o doctorado; 0.75 = licenciatura; 0.5 = media superior; 0 = menor a media superior.
		AreaCono	Escriba el área de conocimiento de su máximo nivel de estudios (1 = ingenierías o ciencias de la vida; 0.5 = ciencias sociales/negocios; 0 = otra).
		ExpID	¿En alguno de los puestos que ha desempeñado realizó actividades de investigación y desarrollo? (anterior a la creación de su empresa) (1= sí; 0 = no).
		ExpInd	¿Alguna de las empresas donde laboró pertenece al sector industrial? (anterior a la creación de su empresa) (1 = tecnológico alto; 0.75 = medio alto; 0.5 = medio bajo; 0.25 = bajo; 0 = no) **
		EquiFund	Indique el número de emprendedores que fundaron la empresa (1 = más de uno; 0 = uno).
	Determinantes institucionales y organizacionales	ServiOTT	¿Recibió servicios de apoyo por una OTT para la creación de su empresa? (1= sí; 0 = no).
		RegaliPI	¿Los ingresos generados por la propiedad intelectual explotada son cedidos en alguna medida a

			los inventores en su universidad? (1 = 50 a 70 %; 0.75 = 35 a 49 %; 0.5 = 1 a 34 %; 0 = no) ***
		CultEmpr	Tomó cursos o capacitación en creación o gestión de empresas anterior al inicio de su emprendimiento (1= sí; 0 = no).
	Influencia ambiental externa	Financ	Recibió financiamiento distinto al de familiares y amigos en la etapa de formación de la empresa (antes del inicio de producción y ventas): plan de negocios, estudios de mercado, prototipos o diseño de producto, pruebas del producto. (1 = sí; 0 = no)

* All independent and dependent variables take values between 0 and 1: values above 0.5 mean presence of the variable of interest, and values equal to or less than 0.5 mean absence of the variable. For the dependent variable, values greater than 0.5 mean that the company is science-based according to the definition presented in the theoretical framework; For independent variables, these values mean that the variable was present in the creation of the science-based company or that it is a necessary condition.

**The values of the answers were assigned according to the technological level of the industry, according to the OECD classification, where the entrepreneur worked prior to starting his company, from 0.25 to 1 and 0 for those who had no experience in the industry.

***The values of the answers were assigned taking into account the level of participation that the researchers have in the royalties of the intellectual property; the greater the participation, the higher the value, with a limit of 70% in accordance with the Law of Science and Technology in Mexico. (Congreso de la Unión, 2015).

Results

Once the information was collected and the data matrix was built, the results shown in Table 3 were obtained, in which it can be seen that only 14% of the companies surveyed derived from scientific research carried out in an educational institution. superior or research center. It also highlights that only 14% of the companies revealed having been formed in an institution with an established regulation on intellectual property that allows researchers to participate in the royalties derived from the intellectual property that is marketed through the

company. Also noteworthy is the small number of companies that managed to access external financing (19%) and the low participation of entrepreneurs with postgraduate studies (25%).

Table 3. Frequencies observed in the dependent and independent variables

		Valores de membresía observados para cada variable					
	Variables	1	0.75	0.5	0.25	0	Total de observaciones
Nivel de análisis	SpO	14 %				86 %	185
Micro	GradoEst	25 %	62 %	13 %		0 %	185
	AreaCono	33 %		57 %		10 %	185
	ExpID	64 %				36 %	185
	ExpInd	12 %	11 %	3 %	19 %	54 %	185
	EquiFund	65 %				35 %	185
Meso	RegaliPI	2 %	4 %	9 %	0 %	86 %	185
	ServiOTT	35 %				65 %	185
	CultEmpr	63 %				37 %	185
Macro	Financ	19 %				81 %	185

Source: Own elaboration based on the software fsQCA 3.0 (Ragin y Davey, 2016)

After the construction of the data matrix, steps two and three of the comparative qualitative analysis were carried out, which are detailed in the methodological section, through the fsQCA software (Ragin and Davey, 2016). This was done, on one occasion, excluding spin-offs created by women and, on another occasion, excluding those started by men. Tables 4 and 5 show the causal configurations that can generate the creation of a spin-off by gender of the entrepreneur. According to the intermediate solution, neither variable by itself is a sufficient condition. When the data on spin-offs generated by men is analyzed, only a sufficient configuration emerges in which the presence of degree of studies, area of knowledge, experience in research, regulatory framework that allows the participation of researchers in royalties is necessary. of the intellectual property generated in the institution and a team of founders.

Table 4. Models that predict spin-off creation in Mexico by gender: men

	Cobertura bruta	Cobertura única	Consistencia
GradoEst*AreaCono*ExpID*RegaliPI*~ServiOTT*EquiFund	0.194444	0.125	1
GradoEst*AreaCono*ExpID*RegaliPI*CultEmpr*Financ*EquiFund	0.097222	0.027777	0.538462
GradoEst*AreaCono*ExpID*ExpInd*RegaliPI*ServiOTT*CultEmpr*Financ	0. 041666	0.041666	0.75
Cobertura de la solución: 0.263889			
Cobertura de consistencia: 0.76			

Model: EBT-U = f (GradoEst, AreaCono, ExpID, ExpInd, EquiFund, ServiOTT, RegaliPI, CultEmpr, Financ)

Algorithm: Quine-McCluskey

Source: Own elaboration based on the software fsQCA 3.0 (Ragin y Davey, 2016)

On the other hand, when men are excluded from the analysis, the presence of a degree of study, area of knowledge, experience in research, experience in the industry, regulatory framework that allows the participation of researchers in the royalties of the intellectual property generated is necessary. in the institution, entrepreneurial culture and external financing. In none of the configurations with the minimum consistency of 0.80 does the presence of OTT appear as necessary. The consistency of the configuration for the case of women was 0.83 and a coverage of 18%, while for men a consistency of 1 with coverage of 19%. The intermediate solution presents more configurations in each case, although with consistencies lower than the minimum established.

Table 5. Models that predict spin-off creation in Mexico by gender: women

	Cobertura bruta	Cobertura única	Consistencia
GradoEst*AreaCono*ExpID*ExpInd*RegaliPI*CultEmpr*Financ	0.1785	0.1428	0.83
GradoEst*AreaCono*ExpID*ExpInd*RegaliPI*ServiOTT*EquiFund	0.2142	0.1785	0.75
Cobertura de la solución: 0.26			
Cobertura de consistencia: 0.76			

Model: EBT-U = f(GradoEst, AreaCono, ExpID, ExpInd, EquiFund, ServiOTT, RegaliPI, CultEmpr, Financ)

Algorithm: Quine-McCluskey

Source: own elaboration based on the software fsQCA 3.0, Ragin y Davey (2016)

Discussion

No variable used as an explanatory factor, by itself, is a sufficient condition to generate science/technology-based companies regardless of the gender of the entrepreneurs. When data on male-generated spin-offs are analyzed, only one sufficient configuration emerges. According to this configuration, it is preferable that the entrepreneurs have studies in the area of engineering or life sciences, postgraduate studies, experience in research, as well as that the academic institutions where the intellectual property that will be commercialized have a regulatory framework that allows the participation of researchers in royalties and that the greater this participation, the better results. In addition, the presence of a team of founders, that is, it is preferable that the new company is founded by several entrepreneurs.

On the other hand, when only women are included in the analysis, the presence of postgraduate studies, knowledge in engineering or life sciences, research experience, industry experience, a regulatory framework that allows the participation of researchers is necessary. in the royalties of the intellectual property generated in the institution, that the entrepreneurs have had some training on entrepreneurship and access to external financing other than family or friends.

In none of the configurations with a consistency of at least 0.80 does the presence of technology transfer offices appear necessary, which coincides with Rodeiro et al. (2012). This is presumably because the services offered by these types of offices are often also

provided by incubators, entrepreneurship programs and liaison offices, as well as entities designed to manage intellectual property within educational institutions. superior and research centers.

Although the study included companies supported by incubators and accelerators located in cities in 22 states of the country, including Mexico City, only volunteer subjects participated; however, the diversity of areas included and the size of the sample allow for a more complete picture of the phenomenon in Mexico. Although there is a considerable number of previous studies that have addressed the subject, this one is distinguished by the timeliness of the data, the inclusion of the different levels of micro, macro and meso analysis, the study population (Mexico) and the method of analysis. analysis (fsQCA), which allows obtaining important results with small samples and is sensitive to context effects. The latter means that the same variables can have different effects in different places; therefore, statistical analysis models that measure the net effects of the variables are inappropriate for explaining this phenomenon.

Unlike traditional quantitative analysis techniques, the comparative method assumes complex causality and focuses on asymmetric relationships that detect configurations that allow a specific result (Schneider and Wageman, 2012), that is, different combinations of the same variables or factors. can lead to the same result, in this case, the emergence of university-based technology-based companies. However, it is advisable to replicate the study with a more representative sample and to section the study by regions with different contexts to find different effects of the same variables.

Conclusions

Causal configurations were identified in the creation of these companies according to the gender of the entrepreneurs. Through the comparative qualitative analysis for fuzzy sets, it was found that women replace the founding team, necessary for men, with experience in industry, entrepreneurial culture and external financing, while they coincide in degree of studies, area of knowledge, experience in I +D and the presence of regulations that ensure the participation of academics in the royalties of the intellectual property generated by the institution from which the company emerges.

In addition, it should be noted that in none of the configurations does the presence of technology transfer offices appear necessary. With the above, the question that guided the study was answered: how do the causal configurations of spin-offs differ according to their

origin? The results obtained can contribute to redirect public policy for the development of science-based companies in Mexico.

Future lines of research

The study made it possible to derive various lines of research, for example, a subsequent analysis of the effects of technology transfer offices on science-based companies to explain the reasons why they do not represent a necessary condition for the creation of this type of company. .

Likewise, the entrepreneurial culture present in the causal configuration of the creation of EBT by women could be improved through programs to strengthen this culture, for which a previous study is required through which the level of culture is identified. enterprising; This can be comparative by area of knowledge to determine the aspects of the entrepreneurial culture that are present in women in the areas that are more likely to undertake and with the derived information, generate or propose actions to strengthen the cultural factors that have an effect. positive in technology-based entrepreneurship and train or design strategies that contribute to strengthening the entrepreneurial culture of women in the various areas of study.

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