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Spain... A Start-Up Nation?

How to Generate Successful Entrepreneurship and Innovation Ecosystems



NAO VICTORIA CROSSING THE STRAIT OF MAGELLAN. Guillermo Muñoz Vera

Oil on canvas mounted on panel. 150 x 225 cm [2015]

Video summary



Ignacio de la Torre, Ph. D.
idelatorre@arcanopartners.com

Leopoldo Torralba
ltorralba@arcanopartners.com

Joaquín Rivera
jrivera@arcanopartners.com

Diego Mejía
dmejia@arcanopartners.com

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www.arcanopartners.com

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About ‘Spain... A Start-Up Nation?’

‘Spain...A Start-Up Nation?’ is the result of a comprehensive research work on the entrepreneurial ecosystem in Spain. It aims to identify the main factors shaping successful entrepreneurial and innovative ecosystems around the globe, and analyse whether they can be adapted to the Spain landscape. With these factors as a starting point, we realise a meticulous study of the situation in Spain, highlighting both positives and negatives. We conclude by spotting potential areas for improvement, as well as a series of implementable measures that may contribute to place Spain at the forefront of entrepreneurship and innovation.

About the authors

- **Ignacio de la Torre** has been a partner of Arcano since 2008. He has more than 20 years’ experience in capital markets, having worked for Arcano, UBS and Deutsche Bank. He authored the series of reports titled ‘The Case for Spain’, which first anticipated the change in the Spanish economic cycle back in 2012. He holds a MBA from INSEAD, a BA in Economics from ICADE, as well as a BA in Law and a PhD in History from UNED. Ignacio has been lecturing economy in the IE Business School since 2003. He is the author of five books. In 2019, he won the Asprima-Sima award, and in 2009, the Everis prize jointly with Leopoldo Torralba.
- **Leopoldo Torralba** joined Arcano in 2015. He is a macroeconomic and market research analyst, deputy to Ignacio de la Torre. Previously, he worked as an equity research analyst (financial sector) at Ahorro Corporación Financiera, and as member of the Strategic Planning and Management Control division of Grupo Ahorro Corporación. Since 2008, he is an associate professor of finance (banking finance) at IE Business School. He holds a Master’s Degree as Professional European Financial Analyst from IEAF, an MBA from IE Business School, and a BA in Economy from the University of Zaragoza. He is the joint author of a book, with Ignacio de la Torre, for which they won the Everis prize in 2009.
- **Joaquín Rivera** joined Arcano in 2016. Alongside Ignacio de la Torre and Leopoldo Torralba, he is an economist and market analyst for Arcano Economic Research. Joaquín graduated from Madrid’s Universidad Carlos III with a degree in Economics and has previously worked as an analyst for Puenty Investors Community.
- **Diego Mejía** has been working for Arcano since 2018 as a market and macro research analyst. He holds an International Business Degree by the German Karlshochschule International University. Prior to joining Arcano, Diego worked as an analyst at Carlton Group.

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Table of contents

| | |
|--|----|
| Report Brief..... | 4 |
| Executive summary..... | 5 |
| 1. Introduction and historical background..... | 6 |
| 2. Determinants of entrepreneurship, success stories and their correlation with prosperity | 8 |
| 2.1. Successful start-up ecosystems | 8 |
| 2.2. Key factors to succeed in the development of innovation and start-up ecosystems | 12 |
| 2.3. Productivity, entrepreneurship and Venture Capital | 23 |
| 3. Entrepreneurship and innovation in Spain..... | 27 |
| 3.1. Success stories..... | 27 |
| 3.2. A snapshot of the current state of affairs in Spain | 28 |
| 3.3. The issue of financing innovation in Spain: the equity gap | 37 |
| 3.4. A snapshot of the current state of affairs in Spain: conclusions | 38 |
| 4. Recommendations..... | 40 |
| 4.1. Ideas for improving access to financing for start-ups..... | 40 |
| 4.2. Ideas to boost innovative knowledge in Spain | 43 |
| 4.3. Ideas to improve the entrepreneurial culture..... | 44 |
| 4.4. Ideas to improve the business environment and regulatory framework..... | 46 |
| 5. Conclusion..... | 49 |
| Bibliography | 51 |

Report Brief

At a critical moment of development for the Spanish ecosystems of innovation and entrepreneurship, we publish this in-depth study of how Spain fares in a variety of quantifiable determinants of successful entrepreneurship ecosystems, analysing the challenges and opportunities that lay ahead.

In short, while Spanish ecosystems clearly lag behind those of comparable economies, we believe this is a crucial inflection point, as the solid steps taken in the past several years begin to bear fruit. Spain has several innate advantages that make it an interesting destination for foreign investment, especially at this moment of great opportunity within the nascent ecosystems of innovation and entrepreneurship.

For instance:

- Spain's high-quality, low-cost of life and warm climate give it an edge when it comes to attracting foreign talent (Barcelona ranks among the top 5 European cities entrepreneurs wish to live in)
- The cost of labour in Spain is far below that of comparable European countries, and the employer productivity margin, greater. For reference, the average programmer's salary in Madrid is less than a third than in Silicon Valley or Israel. Spain also outputs large numbers of qualified workers (111,800 programmers in Madrid alone, ranking 6th among European cities)
- Total VC investment in Spain is growing at a CAGR of +20%

We believe that a few key reforms can catapult the success of Spain's local ecosystems, including:

- Removal of daily liquidity requirements for pension funds and insurers, allowing them to invest a certain percentage of assets in Venture Capital
- Distinguishing the fiscal treatment of stock options between established companies and start-ups
- Promoting a broad cultural shift that entails publically supporting success cases and changing attitudes towards success and failure
- Regulatory simplification and a homogenization of the domestic market
- Improving the effectiveness of public and private R&D spending

Structured in three sections, we begin with an analysis of successful examples of entrepreneurship ecosystems and the drivers of their prosperity, followed by an objective review of Spain's local and national ecosystems according to a series of widely accepted and quantifiable determinants of entrepreneurship, and end with a series of comprehensive recommendations for the development of a strong ecosystem for disruptive innovation, something we believe is of utmost national importance given the implications of innovation on productivity and therefore national prosperity.

Executive summary

Spanish *nao* Victoria set sail from an Andalusian port now 500 years ago. Commanded by Juan Sebastián Elcano, it became the first ship in History to sail around the globe. It was a historic milestone, made possible through public-private initiative, supported by multi-source financing, and based on the breakthroughs in naval technology of previous decades,¹ many of which derived from military efforts. Although many years have passed, observing the blinding speed of innovation in the 20th and 21st centuries has led us to conclude that the drivers behind such a feat remain: abundant and specialised funding, human capital with an attitude and skills for entrepreneurship, and a knowledge ecosystem that is the breeding ground for research, promoting constant dialogue between the public and private sectors. This is how successful innovation and entrepreneurship ecosystems such as Silicon Valley function.

In the report we publish today, 'Spain... a Start-Up Nation?', we analyse the main factors behind the most successful entrepreneurship ecosystems around the globe. With these factors as a starting point, we realise a meticulous study of the situation in Spain, highlighting both positives (like its potential to attract capital and talent) and negatives (which are improving and pointing to a promising road ahead). Too often, the focus is erroneously on the latter.

Among the positives, we highlight a significant improvement in the past few years in several key determinants of successful entrepreneurship ecosystems. Financing, especially foreign (although also domestic, public and private), has grown dramatically. So has the number of scientific publications (associated with knowledge creation), and in terms of human capital, there has been a notable improvement in levels of expertise, making Spanish workers very competitive internationally (in Madrid, a programmer costs four times less than in Silicon Valley and half as much as in Berlin). This, in combination with Spain's other attractive structural features such as the generally low cost, high quality of living, has convinced many multinationals to set up innovation centres, Malaga's Parque Tecnológico de Andalucía (PTA) as an example, and has facilitated the attraction of local and international talent (Barcelona ranks as the third best city for attracting talent within Europe, and fifth globally).

Among the negatives, we note that we are still far from our European peers in key determinants of entrepreneurship, especially in regards to the total stock of Venture Capital (VC) investment (as a percentage of GDP), the creation and diffusion of knowledge (R&D and patent creation), and the existing entrepreneurial culture. Nevertheless, where there is room for improvement, there are likely to be opportunities. In the document, we identify a series of implementable measures that would accelerate the development of Spain's ecosystems of innovation and entrepreneurship. Undoubtedly, the path ahead has its obstacles, but across Spain, entrepreneurship ecosystems are taking root and the start-up scene is growing quickly. Besides, surpassing those obstacles is simply mind over matter.

In short, we consider that the current situation, especially with its future prospects, makes Spain's entrepreneurship environment very attractive for talent and investment, especially for VC. Spain proved 500 years ago that it can be an innovation powerhouse if operating within an adequate ecosystem that combines public-private initiative, available financing, knowledge creation, an entrepreneurial culture and a regulatory and taxation framework favourable for disruptive innovation. It can do it once again.

¹ In which Portuguese innovation played a critical role.

I. Introduction and historical background

In 2000, Andrew S. Grove, Intel's chief executive officer, announced to the investment community his company's multi-billion dollar plan to invest in e-commerce development. An analyst raised his hand and asked: "Sir, what is your expected ROI?" Andrew S. Grove retorted: "What's my ROI on e-commerce? Are you crazy? This is Columbus in the New World. What was his ROI?" A year later, Intel's share price was down over 50%.

Nonetheless, disruptive innovation and profitability are two concepts that don't necessarily conflict. For instance, some of the earliest examples of written word, dating back to around 3,400 B.C., are records of loans granted to the population by Sumerian temples to facilitate tax payment... back to the temples themselves!² The development of limited liability companies in 1st century B.C. Rome, key to the development of commerce in the Empire, was linked to the advent of lending (leading to the first banking crisis, under Emperor Tiberius' rule). In the Middle-Ages, shipping expeditions were largely financed by private initiative. The agreements established the rights and duties of financiers and navigators, who put their work and lives at risk in exchange for part of the proceeds (around 20%). In these early limited partnerships one can see the origins of both VC and its performance-based remuneration system known as carried interest.³ Military ventures were also decided on and financed through public-private schemes. A good example is the conquest of the island of Majorca by King James I of Aragon (1229), in which the distribution of goods among the Crown, the main military orders and the nobles had been contractually agreed upon beforehand.

The Catholic Monarchs financed Columbus' risky expedition to America in 1492,⁴ and reaped enormous rewards as it launched Spain, in less than one hundred years, into the position of world's first power by territorial extent. The first round-the-world expedition of Magellan-Elcano, which departed from the southern Spanish port of Sanlúcar de Barrameda on August 10th, 1519, was a Spanish venture financed by public-private initiative: the Crown and German bankers, the famed Fuggers among which. Despite the high human cost (700 casualties, including that of Magellan himself, commander of the expedition by order of the Crown of Castile), the proceeds from the cargo of spices on board the ship that managed to complete the circumnavigation in 1522 were exorbitant (35,000 ducats).⁵ According to the terms of the expedition, the Crown was entitled to 20% of the profits and the ship's commander, another 20%, however historian Edward Rosset tells in 'The Navigators' (1998) that Elcano was never paid what he was owed and entered a lifetime of litigation with the Crown.⁶

Other conquests, such as Mexico's by Cortés or Peru's by Pizarro, were also driven by private initiatives. Apart from the military and human considerations, both ventures stand out for their innovation (such as obtaining sulphur from volcanoes near today's Mexico City to assist in making gunpowder for the army, or floating artillery, which had pivotal role in the conquest of Tenochtitlan),⁷

² Goetzmann, (2017).

³ Carried interest is a share of the profits of an investment paid to the investment manager.

⁴ The discovery of America was preceded by great Portuguese and Spanish naval innovations, from the development of cogs and carracks to the important advances in cartography of the 15th century, fruit of the objective of carrying out a series of conquests on the Africa coast. It is often erroneously believed that Columbus' "Santa María" was a caravel, but it was actually a larger ship known as a carrack. The caravel fell in disuse by the early 16th century while the fruits of Spanish innovation evolved the carrack into the galleon, a warship with the cargo capacity of a carrack and the manoeuvrability of a caravel. Without a doubt, this innovation was key to the dominance of the global Spanish Empire in the XVI century.

⁵ Calzada, (2012).

⁶ Perhaps an early example of public organisms dis-incentivising future private initiative.

⁷ Hanson, (2002).

and for the huge revenues they procured for their financiers and military leaders. Obviously though, the act of financing innovation is a highly risky venture. Other expeditions, such as the search for El Dorado or the Fountain of Youth, failed.⁸ Even in the 16th century, it is interesting to observe the close link that exists between: i) the attitude towards taking risks (such as sailing westbound in 1492 when the general belief was that nothing lied beyond the Pillars of Hercules,⁹ or embarking on the conquest of unknown empires such as the Aztec or the Inca with very limited troops),¹⁰ ii) collaboration between the public and private sectors, and iii) innovation, both civil and military. For example, the innovative use of weaponry by the Spanish General Gonzalo Fernández de Córdoba, known as 'el Gran Capitán' revolutionised 16th century warfare, and the introduction of the galleon around 1519 explains the European domination of the seas until the 20th century.

As we will see, the relationship between risk-taking, public and private collaboration, and the role of military and civil innovation was at the core of the technological disruption undergone by the United States and Israel in the 20th and 21st centuries, respectively. However, ecosystems of dynamic innovation do not necessarily guarantee success. As the historian Hugh Thomas¹¹ points out, the innovative Spain of the 16th century ended up closing in on itself for complex, and in a way, understandable reasons, given the religious atmosphere of the time. Although the 17th century was a time of cultural flourishing (Cervantes, Góngora, Calderón or Lope), the country's self-imposed enclosure translated to shrinking innovation. By the end of the 18th century, doctoral theses discussing 'the sex of angels' were being registered by the Faculty of Theology of the University of Salamanca, a downfall described in the 19th century by renowned Spanish philosopher Miguel de Unamuno: "Let them invent!"

Given that humans share 99% of DNA with each other (and a high percentage with chimpanzees), the anthropological thesis that some humans have a more entrepreneurial and innovative mind than others doesn't quite hold water and Unamuno's exclamation therefore, is at odds with the biological evidence. Innovation depends on the ecosystem that facilitates and finances it. Spanish investigators are behind innovations such as the submarine (1888), the cable car (1907), the portable X-ray machine (1909), or the gyroplane – precursor to the helicopter – (1920). But the list could be larger. The purpose of this study is to detect which factors are behind the successful emergence of these ecosystems so we can then analyse what Spain as a country is doing better or worse, and conclude with a roadmap to position the country amongst the most innovative.

The fourth industrial revolution is in full swing. The OECD estimates that 14% of existing jobs are at a high risk of automation, and 32% could undergo radical transformations. In Spain specifically, the percentage of jobs at high-risk of automation rises to 22%. Generating innovation ecosystems reduces this key vulnerability. Therefore, there is much at stake in returning this national enterprise of innovation to success.

⁸ Calzada, (2012).

⁹ However, the notion that even Columbus thought the Earth was flat is not actually correct. The Greeks already suspected that the Earth was round simply because of how ships progressively disappeared over the horizon, such that the highest part (the sails) could still be seen even when lower parts (the hull) could not. Eratosthenes (3rd century B.C.), knowing that a stick would not cast shade at noon on the summer solstice in Aswan, made the test in Memphis, proving that there was a certain angle of shade. He thought that the only explanation was a spherical Earth. He paid a man to walk and measure the distance between both locations and, using a rule of three between the angle, the distance and the 360 degrees of roundness, he accurately calculated the circumference of the Earth. In the Middle-Ages, most scholars admitted that the Earth was round, but it was a widespread belief among the less educated swaths of population that there was nothing beyond the Pillars of Hercules.

¹⁰ Pizarro and Cortés embarked on their expeditions with barely 169 and 500 men, respectively.

¹¹ *La Guerra Civil Española* (2018).

2. Determinants of entrepreneurship, success stories and their correlation with prosperity

2.1. Successful start-up ecosystems

Entrepreneurial ecosystems have proliferated since the 20th century. In general, they are associated with clusters of knowledge and innovation, relationships between academia, governments and the private sector and, consequently, the creation of new businesses and well-paid jobs. This mix has great political appeal, so many governments have embarked on the development of entrepreneurial ecosystems: Silicon Valley (US), Boston-Cambridge (US), Israel (especially in Tel Aviv and Be'er Sheva), Zhongguancun (China), London, Berlin, Stockholm... In Spain, Madrid, Barcelona, Valencia and Málaga are noteworthy, among others. The leadership of the US is evident in the number of 'unicorns' or technological start-ups with valuations in excess of one billion dollars. Of the 346 that currently exist, the US has 172, China 91, the United Kingdom 17, India 16, and Germany and Korea, 8. The rest of the countries have five or less and Spain only has one¹² (Figures 1 and 2). Innovative countries, such as Israel or Japan, curiously have hardly any representatives.¹³

Figure 1. Number of unicorns as of May 2019

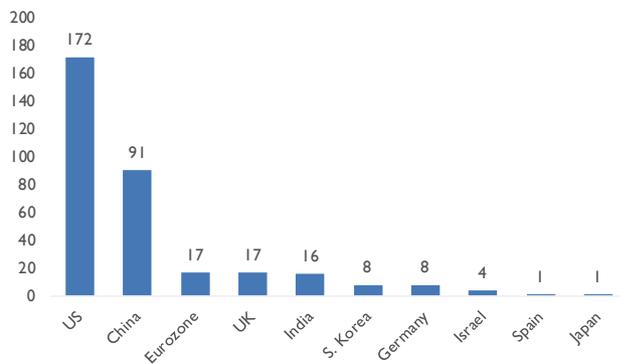
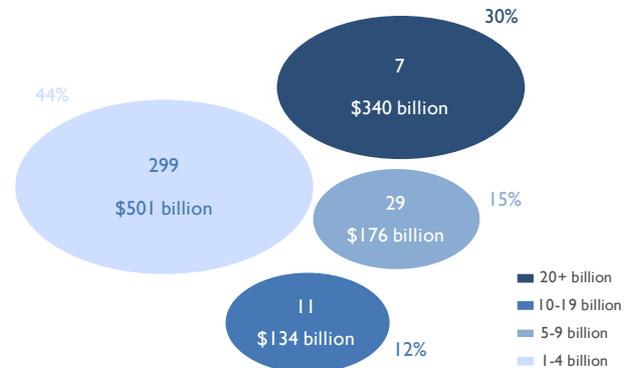


Figure 2. Unicorns by valuation (in dollars)



Note: Due to rounding, percentages do not add up precisely to 100 in Figure 2.

Source: CB Insights, Arcano Economic Research

When first approaching the analysis of start-up ecosystems one must start by separating the grain from the chaff and trying to simplify the multiple factors associated with the generation of an ecosystem. In our opinion, the four clearest success stories are: Silicon Valley, Cambridge-Boston, Israel and Zhongguancun.

Silicon Valley

The development of this ecosystem, considered by many as the world's leading tech hub, is closely linked to Stanford University. Stanford was founded in the 19th century with a generous donation

¹² Cabify. Curiously enough, important political players have tried to make Cabify lose its unicorn status by passing new regulations that forced the company to pull out of some Spanish cities, instead of maintaining the legal framework that made possible the emergence of this Spanish start-up. Ironically, politicians who claim to want to foster entrepreneurship often do the opposite.

¹³ In the case of Israel, Mobileye, a start-up which makes technology for autonomous driving, was acquired by Intel in 2017 for 15 billion dollars; and Waze, the navigation app, by Google in 2013 for 1 billion dollars. The problem in Japan seems to be the lack of international ambition of its start-ups.

from railroad tycoon Leland Stanford after his only child died of typhoid. The University experienced a remarkable development during the first half of the 20th century. During World War II, the US military decided to move important research units from the East Coast to the West, and Stanford was an ideal place for military and academic collaboration. Stanford inaugurated an industrial park in 1950 that housed delegations of companies whose personnel were mainly dedicated to research, so that they could continue training in the University in advanced subjects and, later, apply that knowledge in the laboratories of their own firms. This association helped break the traditional divorce between academic research and business innovation. Among the companies that set up there are well-known names such as IBM, GE, Kodak and Hewlett-Packard.

This breakthrough is relevant to understand the emergence of the first semiconductor company, Fairchild Semiconductors,¹⁴ within this ecosystem in 1959. With its invention of the chip, Fairchild Semiconductors consolidated the technological leadership of the US, off-shooting companies like Intel. Fairchild also changed financial history, as it was the first VC-funded company. Venture capital (VC) was a type of technology-oriented financing (in the form of equity) birthed in the Stanford ecosystem in the wake of the Small Business Investment Act of 1958. The VC industry, therefore, preceded Private Equity (PE), whose first deal, Orkin, took place in 1964. The success of the Stanford model was such that, by 1967, employment in the technology sector had soared from less than 1,000 to more than 10,000 workers¹⁵ and 38 similar science parks had been developed from Palo Alto to San José, forming the base of the ecosystem herein described.¹⁶

Finally, it is interesting to note how the crisis of the 1970s had an impact on the West Coast job market for recent graduates in engineering (embodied by the motto: 'either self-employed or unemployed'). Iconic firms like Apple and Microsoft were born at that time. Through the 21st century, well-known companies like Google, Netflix and Facebook developed in the West Coast ecosystem. In 2018 alone, Silicon Valley produced 32 new unicorns.¹⁷ The GDP per capita of the area amounts to 128,000 dollars, more than double that of the US and four times that of Spain. It is the metropolitan area with the highest GDP growth in the nation (8%).¹⁸

Cambridge – Boston

The industrial development of the North East US led to the building of large capital cities during the 19th century. The foundation of the Massachusetts Institute of Technology (MIT) was key in the genesis of the fourth industrial revolution, with important new innovations such as machine learning, the cornerstone of artificial intelligence.

As with Silicon Valley, the Cambridge ecosystem could not have unfolded without public-private collaboration, especially the early military collaborations. During the World War II, teams of researchers and engineers from different sectors were trained to work on different military research projects, promoted by the National Defense Research Committee (NDRC).¹⁹ It was the seed of what became the military research institute, ARPA, known since 1972 as DARPA. ARPA's space programs were transferred to NASA in 1960. The Internet emerges within DARPA and MIT from a series of works by MIT researcher Joseph Licklider in 1962, which would later be applied to the

¹⁴ Other companies founded at this time by Stanford students include Hewlett Packard and Varian Associates.

¹⁵ Nicholas, (2019).

¹⁶ Findlay, (1992).

¹⁷ Creating unicorns also has its risk though, since many start-ups put their focus on breakneck growth when they may not actually be mature enough to develop at such a pace. [Link](#).

¹⁸ Bureau of Economic Analysis, (2017).

¹⁹ Wildes and Lindgren, (1985).

military computer network by Lawrence Roberts, also a MIT researcher. In 1966, Roberts was transferred to DARPA, where a year later, he would develop project 'Arpanet', origin of the current Internet.²⁰ DARPA research has also led to key innovations, such as GPS and touch screens.

The results obtained by the Cambridge ecosystem are also staggering. More than 30,200 founded companies are still active, providing 4.6 million jobs and billing more than three trillion dollars in aggregate turnover.²¹

Israel

The state of Israel, founded in 1948, had major adversities to face. Several wars with its neighbours between 1948 and 1973, a scarcity of natural resources, and a series of misguided state policies had stagnated the country's economy by the late 1980s. Israel's image was associated with conflict and violence, and the uprisings (intifadas) of its Palestinian population. The situation changed drastically during the 1990s, when the vision of then Prime Minister, and later president, Simon Peres, of turning Israel into a nation of start-up companies began to permeate society. Multinational corporations had already detected the research potential of the Israeli educational system,²² which produces engineers, physicists and mathematicians with military training²³ with some firms opening research and development (R&D) centres in Israel as early as the 1950s (IBM and Intel in the 1970s), but this grew exponentially at the end of the 1990s, reaching 380 centres today. Yigal Erlich, who was back then Chief Scientist of Israel's Ministry of Industry and Trade, established the financial framework (Yozma Program), creating a fertile ground for the industry that finances innovation to emerge, one of the essential determinants of a successful ecosystem.

Israel pioneered Technology Transfer Offices (TTOs), which sought to connect academic innovations with a commercial application. When a patent is issued, the university's TTO oversees identifying companies from around the world that may be interested in negotiating a use agreement by paying royalties, financing future university projects and economically rewarding the researchers. Today, the country has a TTO in each of its nine research universities. In addition, Israel has a Chief Scientist Office (CSO),²⁴ an independent authority with the legislative power to set innovation policy. These bold government efforts, supported by the R&D Law of 1984, laid the foundation for Israel's start-up revolution.

Finally, the development of local entrepreneurial hubs that physically connect University (especially engineering departments) with the Military, the VC industry, start-ups and the R&D subsidiaries of multinationals changed the Israeli production model and earned it the name 'The Start-Up Nation'. SMS, medical imaging nano-cameras, and the LIDAR 'eyes' of autonomous cars are all Israeli inventions, many of them developed jointly by military and university researchers. The figures of

²⁰ The goal of this project was to decentralise communications in the event of a potential Cold War attack, since all US communications were concentrated in Chicago.

²¹ Roberts et al., (2015).

²² All Be'er Sheva University students must take at least one course on entrepreneurship.

²³ At present 30,000 soldiers serve in military units specialised in IT and cybersecurity at Be'er Sheva.

²⁴ Currently known as Israel Innovation Authority, it sponsors incubator programmes (Tnuf, Incubators Incentive Program...) aimed at supporting early stage companies. In 2018, these programmes poured some 114 million dollars into 213 start-ups. It also funds accelerator programmes (R&D or Pilot Funds, among others), whose goal is to help start-ups reach the sustainable growth stage. In 2018, these programmes provided 146 million dollars to more than 190 companies. The Israel Innovation Authority offers programmes designed to foster entrepreneurial culture as well as the knowledge and the skills demanded by society (Coding Bootcamp, Take Back the Tech...), as well as R&D initiatives designed to have an impact on some of the world's most critical problems (Grand Challenges, EzerTech...). One of the principles that guides the Authority is continued co-investment with the private sector.

Israel's transformation speak for themselves: one start-up²⁵ for every 1,350 inhabitants, compared to the European average of one for every 20,000.²⁶ Activity concentrates in three hubs: Tel Aviv, Haifa and Be'er Sheva. A strong industry of financing innovation has developed, and at present, Israel boasts more than 250 VC funds, half of which are Corporate Venture Capital firms²⁷ (CVCs). There are 23 start-up incubators and 75 business accelerators.²⁸

Zhongguancun

As we have seen, China counts 91 unicorns, the result of another national research effort. As in the previous examples, the role of the government has been key in the development of the ecosystem. It has implemented many programmes to promote the high-tech industry, notably the Torch Programme and the National High Technology Research or Development Programme, which have encouraged the emergence of 130 highly technological areas, including Zhongguancun, the so-called 'Chinese Silicon Valley'. This entrepreneurial hub houses 300 corporate multinational R&D centres, where more than 10,000 foreigners work aside the local population. There is also a close connection between the hub and two important universities, Tsinghua and Beijing.

A book²⁹ by Kai-Fu Lee, former president of Google China, identifies some of the factors that enabled the country's sudden technological dominance, highlighting two. First, China's lack of traditional infrastructure made digital a more practical and cost-effective solution for companies and people, as exemplified by the country's use of digital payments. Second, the number of Chinese users connected to the Internet (more than the US and Europe combined) is fantastic input for the development of artificial intelligence.³⁰ Analysing China's entrepreneurial culture, 15% of the active population expects to launch a new business in the next three years. Although it may sound low, it is actually well above the US (12%), the UK (7%) and Spain (6%).³¹ This entrepreneurial mindset can also be quantified by surveys on the fear of failure: 41.7% of the Chinese describe themselves as unafraid, compared to 36.2% of Spaniards and 37.7% of Britons. Academically, in terms of number of researchers per million inhabitants, while the US has 4,256 or Japan, 5,305, China has only 1,235, leaving margin for improvement.³² Furthermore, even though it holds more than twice as many domestic patents (326,970) as the US (150,949) or Japan (156,844), their rate of international recognition³³ is really low (25,576), again compared to the US (134,558) and Japan (129,069).³⁴ Finally, the WEF³⁵ places China in 27th position out of 140 in the Global Competitiveness Index, in which Spain ranks 34th.

Chinese government is making bold moves, and recently announced that it had earmarked 1.8 trillion dollars for public funding of innovative business ventures through 2025.³⁶ Star, an exclusive

²⁵ The definition of a start-up can be subjective. For the European Start-up Monitor developed by the European Start-up Network, a start-up is a company younger than ten years old, featuring innovative technologies or business models, growing at a significant and rapid pace.

²⁶ PWC, (2019).

²⁷ CVCs are a tool used by large cap companies to invest in private business ventures.

²⁸ Incubators provide the required tools to make business ideas come to fruition. Whereas accelerators 'speed up' or drive the growth of already existing businesses by providing capital and/or mentoring.

²⁹ *AI Superpowers: China, Silicon Valley and the New World Order*, Houghton Mifflin Harcourt, (2018).

³⁰ Wolf, M. (April 16th, 2019). [China battles the US in the artificial intelligence arms race](#). *Financial Times*.

³¹ Data collected by GEM from each individual country.

³² Its quality is relative, since according to the H Index (an author-level metric calculated by counting the number of publications for which an author has been cited by other authors), China is ranked 13th. The US, UK and Germany occupy the first positions and Spain the 11th.

³³ Please refer to section 2.2.5 of this report.

³⁴ WIPO Statistics. 2017 data.

³⁵ World Economic Forum.

³⁶ [China's state-owned venture capital fund battle to make an impact](#) (2018). Emily Feng, *Financial Times*.

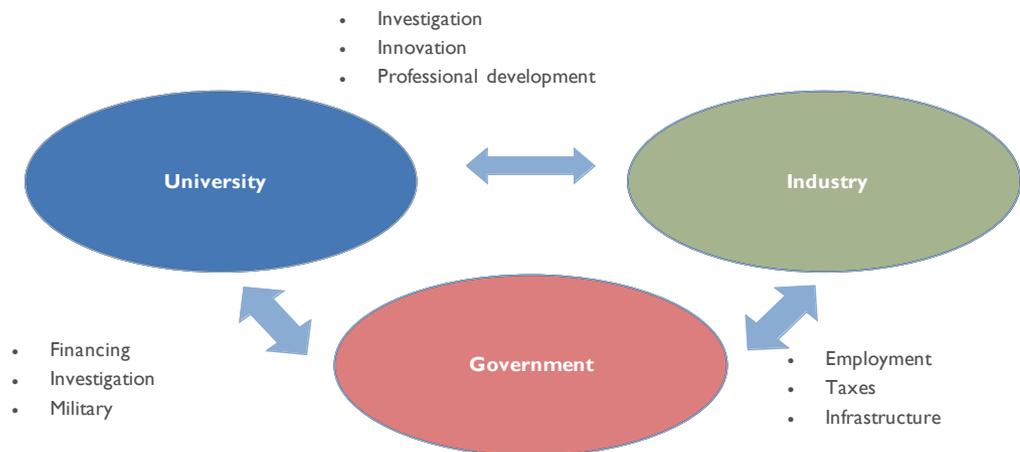
market for the tech sector to be listed on the Shanghai Stock Exchange, is likely to encourage investment in innovative national companies, enabling them to seek necessary funding. This market is, however, more exposed to retail investors (than say, the more institutional NASDAQ), which can make it more volatile.

The great challenge for the Chinese ecosystem is whether, given the high degree of involvement of the public sector, it will be able to deliver to same extent as innovation ecosystems with a more reasonable balance between public and private sectors, since the predominance of the former in research usually results in lower productivity.³⁷ It has been pointed out, however, that implementation may be easier in non-democratic systems (not innovation, which has been traditionally associated to free societies) since the State can disregard red tape and speed up technological implementation (the deployment of Chinese 5G networks, as an example). Finally, it is unclear to what point the forced technology transfers by Western companies, in exchange for access to the Chinese market, are responsible for the development of innovation in China. A post-trade war New World may give us an answer.

2.2. Key factors to succeed in the development of innovation and start-up ecosystems

So much has been written about the factors associated with the success of start-up ecosystems that the analysis can become tangled. Paramount though, as the book 'The Triple Helix'³⁸ describes in detail, is the triad of interaction formed by university-industry-government (Figure 3).

Figure 3. Triple Helix Innovation Model



Source: Arcano Economic Research

³⁷ Cheng et al., (2018).

³⁸ Etzkowitz and Zhou, (2018).

From the complex, we have reduced a simple but in-depth analysis of what we conclude are the most important determinants of entrepreneurial ecosystems:

- **Financing** throughout the entire chain, from business angels (BA) to VC to public markets.³⁹
- **Favourable frameworks**, regulatory, institutional and fiscal.⁴⁰
- **Human capital** or entrepreneurs, with the confidence to push new ideas (risking failure for a shot at social recognition), but also the necessary skills to execute them.⁴¹
- **Proximity of key stakeholders**, being academia, VC funds, corporate R&D centres, start-ups, and governments.
- **Creation and dissemination of knowledge**, measured not only by patent generation, but also by their practical application, which implies development and internationalisation.
- **Free access to markets**.

Let's analyse them in detail.

2.2.1. Financing

Even if an ecosystem manages to generate innovation, it will not prosper unless it is backed by a financial system that can turn those innovations into viable businesses. If we find a common link between innovation and entrepreneurship ecosystems, it is precisely that they are supported by a healthy and plentiful financial system. The most important message here is that financing is essential throughout all stages of a company's life. If public power, well-intentioned but mistakenly, promotes microclimates in only one of these stages, the entire ecosystem will never take off.

First: financing through equity, not debt

Innovation and entrepreneurship are risky activities. They are often associated with intangible assets that are not eligible as collateral for loans. Therefore, the generally preferred financing tool for development-heavy pre-revenue companies has been either equity or non-refundable public subsidies (the State expects to obtain an ROI in the form of new jobs).⁴² In general, loan-backed innovation and R&D does not deliver so much. In Spain, only half of the public aid available for R&D is disposed of, and it may be partly because they are often hybrid instruments closer to debt than to equity.

Second: financing the entire value chain from the earliest stage, avoiding 'equity gaps'

VC has an undeniable role in financing innovation,⁴³ but it is not the only player. Many start-ups are first bankrolled by their founder or by what is colloquially known as FFF (Family, Friends and Fools). If the company succeeds in the early stage, it will seek the support of private investors, sometimes business angels (BA), who can also finance companies from the very beginning. Here enters the concept of 'entrepreneurial recycling', whereby founders of successful start-ups, after selling their companies, reinvest part of the profits in new start-ups. These tend to be significant investments, not just for their volume but also for the experience and credibility associated with

³⁹ Lee et al., (2015); Wilson, (2015); Coutu, (2014); European Commission, (2014a); Gorodnichenko et al., (2013); OECD, (2013); Allman et al., (2011).

⁴⁰ Lilischkis et al., (2013); Bravo-Biosca et al., (2013); Ahmand y Hoffman, (2008). Some studies of entrepreneurship include the infrastructure as its own determinant, we have included it within this point.

⁴¹ Coutu, (2014); Allman et al., (2011); Forfás, (2014).

⁴² Germany follows this model and has been able to produce successful growth companies.

⁴³ Bravo-Biosca, (2010).

being a second-generation entrepreneur. Some countries promote this concept through capital gains tax exemptions for reinvestments in new start-ups.⁴⁴ In our opinion, part of Spain's financing deficit is due precisely to the lack of recycling capital, which seems logical given the lack of a favourable fiscal framework.

After BAs, companies usually finance their growth through funding rounds with the VC industry. But policy proposals that attempt to mimic other ecosystems often erroneously focus on the former stage in a company's life, perhaps because it is more politically glamorous, or because individuals are generally more trusted than institutions. This is a mistake. Generating a BA ecosystem without fostering VC means that companies that succeed in this first step do not get financing when they grow, so FFFs and BAs cannot exit their investment, and the ecosystem eventually collapses. The lack of financing at the growth stage of a company is known as an 'equity gap' and it is one of the main reasons for the failure of entrepreneurship ecosystems. Spain clearly presents negative equity gaps, one of its areas of improvement.

Third: the importance of VC

As we have seen in the previous examples, the most successful innovation ecosystems go hand in hand with the development of the financial industry that makes them possible. Venture capitalists not only finance technology companies via equity,⁴⁵ but they get involved in the company's daily management to fuel growth and thus generate value, with a correlation of 79%.⁴⁶ In the US, a paradigm of entrepreneurship, the industry grew exponentially, and in 2000 there were ten times more VC companies than in 1980,⁴⁷ favoured by the regulatory change in 1979 that allowed pension funds and insurers to invest in this asset class. With 29.4 billion under management, Yale University's endowment has currently 19% of its assets invested in VC and 14% in PE – this endowment's investments in VC exceeds by far the total amount invested in Spain over the last ten years –.

Here is an up-to-date snapshot of the VC global industry: Total investment numbered 286 billion dollars in 2018 (a significant increase vs. 2017) over more than 15,800 deals (Figure 4), with the US and China leading the world. Both are responsible for two-thirds of total VC investment (US, 110 billion; China, 105 billion), as shown in Figure 5. Average size per deal varies, 18 million in the US and six million in Israel.

The key metric to analyse the VC penetration in a country – an essential parameter of entrepreneurship – is investment in VC per capita. In this case, Israel leads the ranking with 368 dollars per person, followed by the US with 250 dollars.⁴⁸ In China the number is 40, and Spain stands below the European average with 21 and 30 dollars per capita, respectively.

Another ratio to measure the importance of VC in the financing of a country's entrepreneurship ecosystem is the total invested amount as a percentage of GDP (although a city-by-city comparison would provide more comparable results). Here, the US and Israel come in first, with investments nearing 0.4% of GDP, whereas Spain falls short with barely 0.05%. The number of VC-funded start-ups per 1,000 residents is also a good gauge for measuring the relevance of VC per country.⁴⁹

⁴⁴ OECD, European Commission, (2014).

⁴⁵ There is a type of debt financing provided by VCs known as Venture Debt, which exists in proportion of approximately one dollar of venture debt for every seven dollars venture capital dollar invested and is a combination of debt and equity.

⁴⁶ Akcigit et al. (2019)

⁴⁷ Nicholas, (2019).

⁴⁸ Dealroom, (2017).

⁴⁹ OECD, (2017).

Once again, the US leads by a wide margin, with 21 VC-funded start-ups per 1,000 people against Spain, with just 3.⁵⁰ Other indicators used to calculate the density of VC are the number of active funds in a country (or city), capital raised per year, capital invested, the average size per round of financing and the number and volume of exits (either sales or initial public offerings).

Figure 4. Total global investment (billions of dollars) and number of global transactions

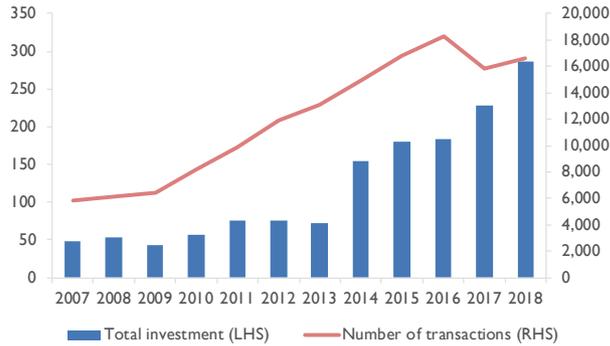
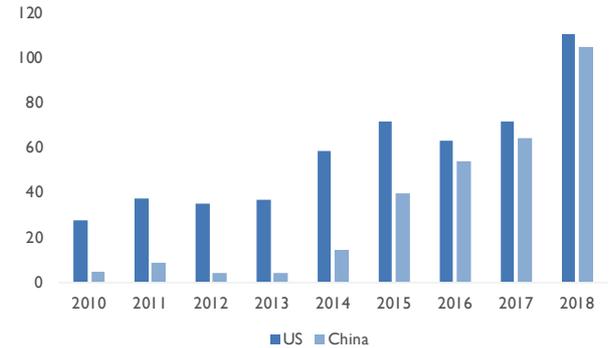


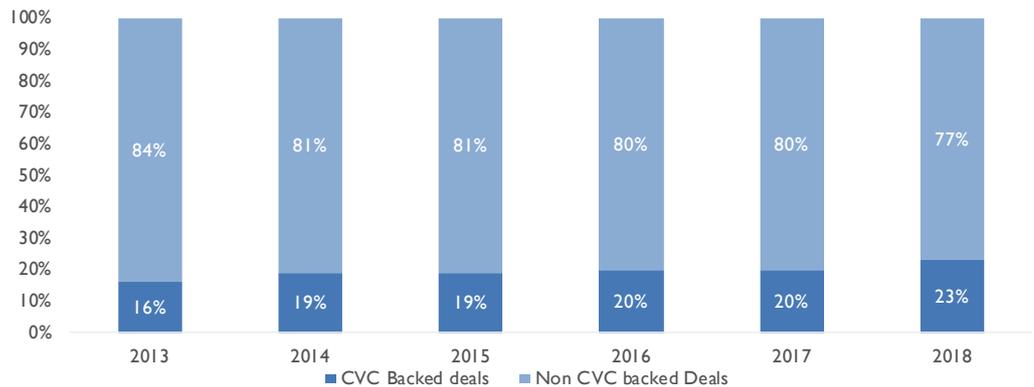
Figure 5. Total global investment in the US and China (billions of dollars)



Source: Prequin, Arcano Economic Research

A relevant form of VC is Corporate Venture Capital (CVC), essentially innovation investment arms of large companies whose goal is to gain knowledge and implement technologies that they have not been able to develop in-house (there is a negative correlation between company size and innovation as a result of the bureaucratic burden associated with larger corporations, as pointed out by Galbraith). Today, about a quarter of the VC industry is made up of CVC (Figure 6).

Figure 6. Weight of CVC investment on global VC investment



Source: CB Insights, Arcano Economic Research

So, what are the determinants of a successful VC industry? Public incentives were critical in the case of the US and Israel. In Silicon Valley, as previously mentioned, the US Small Business Investment Act of 1958 enabled the emergence of the modern VC industry by backing new tech companies with tax benefits⁵¹ and federal soft credits. There were many failures along the way,

⁵⁰ OECD, (2017).

⁵¹ In the 70s, the effective tax rate of capital gains from VC-participated companies was cut, giving a boost to the industry, as it was able to raise more institutional capital. In addition, the US Government became a key client of many VC firms, as

but companies like Intel were born under this program. In 1979, pension funds were given the green light to invest in VC, and the inflow of institutional capital energised the industry. In the long run, returns, while volatile, have been significant for the best managers, as proven by the comparison of average returns for the top quartile asset managers. However, returns are largely dependent on the skills of the professional (Figure 7).

Figure 7. **Average return of top quartile by asset class (%)**⁵²

| Asset | 5 years | 10 years | 15 years | 20 years | 25 years |
|-----------------------|---------|----------|----------|----------|----------|
| VC | 48 | 38 | 29 | 92 | 57 |
| PE | 25 | 22 | 27 | 31 | 31 |
| Real estate | 27 | 24 | 26 | 24 | 24 |
| Equities (large caps) | 12 | 7 | 5 | 8 | 10 |
| HY bonds | 5 | 6 | 7 | 6 | 8 |
| IG bonds | 4 | 5 | 5 | 5 | 6 |

Source: Cambridge Associates Global Venture Capital, Global Private Equity and Global Real Estate Benchmarks Returns Report.

Overall, academic research has shown how public policies have been key to the development of VC, especially the regulation of pension funds and the inverse correlation between the volume of VC-raised capital and the taxes on capital gains generated.⁵³

Fourth: The day after VC

Successful VC-funded companies turn to a market where the funds can exit the investment and return money to their participants. Traditionally, the stock exchange has been considered the best exit strategy at this late stage, and the establishment of Nasdaq, a tech market in 1971, contributed to turning this strategy into a mainstream trend. VC funds generally sold their companies when they reached valuations above 100 million dollars (Amazon was worth 438 million when it went public in 1997), and then retail and institutional investors participated in the creation (or destruction) of value (Amazon is worth almost one trillion dollars today). However, different accounting scandals⁵⁴ brought about regulatory changes that led to more stringent requirements to access and remain on the stock market. As a result, it is no longer the first option of choice for companies (Figure 8), who increasingly stay private by raising capital from PE firms or other private investors, and many even exit privately via a sale to a larger company. Versus 8,000 companies listed in the US in 1996, only 4,000 trade on the stock market today while the number of companies financed by PE firms has risen from 2,000 to 8,000. The public market may have been the main source of financing for large firms in the US back then, but today only about two thirds of financing flows from private capital markets, one third from the stock exchange (Figure 8). This is a trend shift which is particularly apparent in the technology sector.

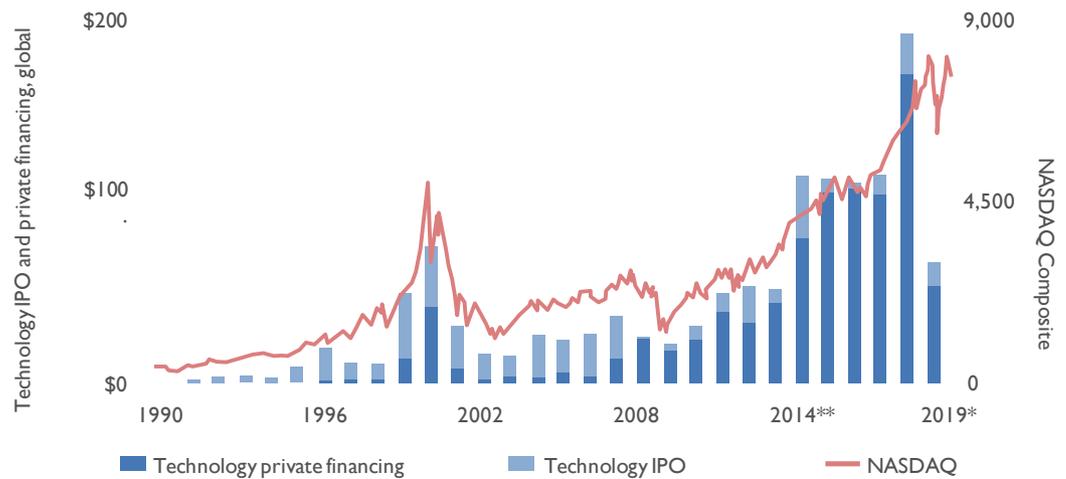
they helped transform military applications into civilian ones. Many of these inventions came from the US military research institute, DARPA, which was the origin of breakthrough innovations such as the internet, touchscreens and GPS.

⁵² PE asset class excludes VC. 5-, 10-, 15-, 20- and 25-year returns representative of average pooled IRR for years dating back to 2014. Top quartile returns for all asset classes shown. Large-cap equity proxy is Lipper aggregated US large-cap equity fund performance. High yield bond proxy is Lipper aggregated high yield bond fund performance. Aggregate core bond proxy is Lipper aggregated core bond fund performance. Returns as of December 31st, 2015. Sample size for each asset listed is as follows: venture capital: 91-440; PE: 174-630; real estate: 71-207; large-cap equity: 62-674; HY bonds: 30-421; and aggregate core bond: 22-385. Past performance is not a guarantee of future results.

⁵³ Greenwood et al., (2018).

⁵⁴ Enron Corporation in 2001, Worldcom in 2002 and Parmalat in 2003.

Figure 8. Global tech companies IPOs and private financing (millions of dollars)



(*) 2019 data up to July 6th.

(**) Alibaba's IPO (250 billion dollars) accounted for 69% of the total IPO value in that same year.

Source: Morgan Stanley Equity Capital Markets

One of Europe's main challenges is that the average size of VC-funded companies is smaller than in the US, which makes it even more difficult for them to go public. This is the reason why alternative public markets were established. Their looser requirements allowed smaller companies, some with a tech angle, to go public. The first of these alternative markets was the English AIM, followed by the French Alternext, the German Early Standard and then the Spanish MAB. Their growth, however, has been far from impressive, partly due to the illiquidity inherent to the small size of the companies. Since a main exit strategy for VC investments right now is the M&A market (large companies buying successful start-ups), the volume of foreign direct investment as a percentage of GDP has been used as a proxy (although it requires some adjustment since only a part of the investment is associated with technology). Nonetheless, the OECD average is 1.4%, Israel stands at 4% and Spain at 3.2%. Multinationals merging with or acquiring innovative companies may eventually settle in the hub where the start-up was born, as has happened in Tel Aviv and Málaga.

2.2.2. Regulation

The legal framework is just as important as the financial ecosystem or the quality of human capital for the development of a country's entrepreneurial ecosystems.⁵⁵ A measure of bureaucratic burden is the number of days it takes to incorporate a new company, and the number of procedures required to do so. In Spain, it takes 12.5 days of bureaucratic procedures, lengthy indeed when compared with other countries. Setting up a new company in the US takes 5.6 days, and in the UK even less, only 4.5 days. The case of Israel is worth mentioning: the time period is comparable to Spain (12 days), but only 4 separate procedures are required vs. 7 in Spain. The US State of Delaware deserves special mention for its level of digitalisation: one can incorporate a company in just two days and complete the whole process online.

⁵⁵ Armour et al., (2004).

Bankruptcy law⁵⁶ also plays a pivotal role in the development of entrepreneurial ecosystems. More flexible bankruptcy laws generate more entrepreneurs in the CV market⁵⁷ by providing second chance when a first venture is unsuccessful. The Insolvency Regulatory Framework Index⁵⁸ measures the quality of the regulatory system in terms of restructuring or, where appropriate, corporate wind-up. Spain occupies a modest 28th position out of 140 (compared to its 13th position in global GDP). The US leads this index.

Finally, a homogeneous market is crucial for the development of a successful start-up ecosystem. Europe's many internal borders and multitude of local regulations are obstacles to corporate expansion. More examples are the differing requirements for opening a new business (corporate capital requirements, number of procedures, etc.), the differing regulations across Member States (Bankruptcy Law for instance) and differing taxation schemes between individual countries and companies. There are significant differences within countries themselves, and local regulations proliferate, adding volatility. Far from insurmountable, high-growth start-ups must have vision for international expansion from the beginning in order to compete with companies from large homogenous markets, derived from the confidence that financing and the law will accompany them, as the Israelis have exemplified.

2.2.3. Human capital and the importance of high-growth companies for job creation

Entrepreneurship and the growth of newly created businesses requires trained entrepreneurs with a specific personal profile, as well as workers with the appropriate knowledge and skills. In this section we will deal with the development of the required human resources. Entrepreneurship has an associated cultural framework⁵⁹ featured by an attitude towards failure, risk appetite, ability to confront established beliefs and frameworks, and innovation throughout the value chain.⁶⁰ The Total Entrepreneurial Activity (TEA)⁶¹ measurement indicates the population's general appetite for becoming an entrepreneur, generally correlated with the level of income per capita. Then there is New Business Density,⁶² which tracks how many new companies are created per 1,000 people of working age (15-65).⁶³ In turn, the Global Entrepreneurship Index⁶⁴ measures the aggregated level of the entrepreneurship ecosystems in countries and makes a distinction between productivity in the sense of doing things better (efficiency) or doing them differently (innovation). Business innovation is akin to Schumpeter's well-known creative destruction, a process through which the emergence of new firms brings about the demise of existing ones.⁶⁵ Human capital is so critical that there are companies solely devoted to the promotion of talent.⁶⁶ A noteworthy initiative in Spain is the Endeavor movement, which selects and promotes the best high-impact entrepreneurs, and supports them with an unparalleled network of mentors and partners.

Human capital with enhanced entrepreneurial skills makes possible the emergence of High-Growth Enterprises (HGEs), which are an economy's true job creators. A study of Australia, Belgium,

⁵⁶ Armour et al., (2008); Lee et al., (2011).

⁵⁷ Armour et al., (2004).

⁵⁸ WEF, (2018). It assesses the efficiency of regulatory frameworks. Scores range from 0 (lower) to 16 (higher).

⁵⁹ Feld, (2012).

⁶⁰ Saxenian, (1994); Lécuyer, (2006); Kenney, (2011).

⁶¹ Survey conducted by the World Bank.

⁶² Machado, Wilson, (2014).

⁶³ Spain gets similar results as Israel.

⁶⁴ Index produced by the Global Entrepreneurship and Development Institute, based in the US.

⁶⁵ Curiously enough, a loose monetary policy as the current one is a hurdle to this 'Schumpeterian' process, since many unsuccessful companies are sustained by low interest rates or by a banking system reluctant to report losses in their balance sheets.

⁶⁶ Entrepreneur First is an international talent investor. Twice a year it shortlists 100 individuals and connects them with other entrepreneurs to help them develop their innovative ideas.

Denmark, Germany, the Netherlands and the United Kingdom, found that 4-6% of HGEs are not only responsible for 50-75% of new jobs,⁶⁷ but also post higher levels of productivity.⁶⁸ These studies have been validated by further samples in 18 OECD countries, and demonstrate that firms under five years old contributed positively to create employment in almost all periods (including during recessions) and regions.⁶⁹

The notion exists that small and medium-sized companies are the greatest job creators, so policies have tended to positively discriminate them (in some cases hindering newly created firms), while the driving factor of job creation is not the size of the company, but its youth.⁷⁰ By account of studies done in the US, early stage companies were responsible for 20% of new jobs, even though they accounted for just 3% of the domestic economy.⁷¹

Therefore, incentives should target HGEs,⁷² especially in Europe given the lower rate of these companies when compared to the US.⁷³ In any case, as companies develop, it is more difficult to sustain high growth rates⁷⁴ due to the base effect and to outside competition. The more practical approach then, is to support companies with a high growth potential instead of artificially sustaining those that have already experienced it.⁷⁵ Again we mention, that growth can occur in any sector,⁷⁶ and is usually linked to innovative business models, not only to mere technological disruption.⁷⁷ Google as an example, was preceded by over a dozen search engines.⁷⁸

2.2.4. Proximity

This concept refers to a set of interactions between Academia, Industry and Government, and has been described as the 'triple helix'. Proximity is key for universities because their R&D departments are financed by both companies and governments. In addition, the collaboration of firms with universities provides opportunities for students, which has a two-fold effect: first, increasing their academic reputation, as they can boast high early-employment rates; and second, benefitting from former students' donations. Businesses also benefit from proximity to universities, having at their disposal a large pool of educated workers. Furthermore, they can reduce their spending on R&D by collaborating with universities.

However, universities and businesses are not the only beneficiaries from proximity. A close collaboration between academia and industry is positive for governments too, since higher job creation rates boost tax revenues and improves the competitive advantage over other countries.

Stanford University illustrates the proximity concept. Its successful ecosystem for knowledge generation stems partly from the profound academic changes introduced by Terman, who observed during World War II that the alliance between military and civilian researchers was scientifically,

⁶⁷ OECD, (2013).

⁶⁸ Kolar, (2014).

⁶⁹ Criscuolo et al., (2014).

⁷⁰ Stanger and Litan, (2009). Calvino, Criscuolo and Menon, (2016) came to similar conclusions.

⁷¹ Criscuolo, Gal and Menon, (2014) state that of a sample of 17 OECD countries plus Brazil shows that companies younger than five years' old only account for 17% of total employment, but contribute to create 42% of new jobs.

⁷² Henrekson et al., (2014); Nightingale et al., (2014); Lerner, (2010); Shane, (2009); Davidsson et al., (2002).

⁷³ Bravo-Biosca, (2010).

⁷⁴ Brown, Mason and Mawson, (2014); Coad et al., (2014a); Daunfeldt et al., (2015b); Hölzl, (2014); Kolar, (2014); OECD, (2013); Parker et al., (2010).

⁷⁵ Daunfeldt and Halvarsson, (2016).

⁷⁶ Kolar, (2014).

⁷⁷ Guy et al., (2012).

⁷⁸ Among Google's predecessors were Netscape, Askjeeves, Webcrawler, Dogpile and Yahoo.

very rewarding. Among other developments, he strengthened the connection between Stanford science departments and government research agencies, established mixed working groups, and promoted continuous, high-level education by designing courses for the workers of nearby tech companies that advanced their job skills.⁷⁹ These measures contributed to reinforcing the essential proximity between the three main agents, key to the success of Silicon Valley.⁸⁰

Most innovations with commercial potential have been born in the corporate sector,⁸¹ so Terman and Stanford's cornerstone contribution to the development of Silicon Valley was bringing both worlds together,⁸² and then the government, by seeking civilian applications for research developed jointly by military scientists and academics.⁸³ This idea of proximity can be similarly observed in the Cambridge and Israel ecosystems.

2.2.5. Knowledge

The efficiency of R&D investments (specifically efficiency, not just amount invested) is closely related to technological and innovative leadership, according to recent studies. Importantly, salaries among the most technologically advanced OECD countries are up to 33% higher.⁸⁴

Knowledge generation has been traditionally associated with patents that confer an exclusive right to third parties to exploit the invention and intellectual property. This right is temporary and geographically limited, so its scope must be accurately defined. An international patent (recognised in more than one country) is more valuable than a domestic patent (recognised only in its country of origin).⁸⁵ The number of patents registered in relation to the population of a country is a useful proxy to measure the generation of knowledge. For example, in 2017, Spain registered barely 83 patents per million inhabitants; the Eurozone, 415; and Germany, 887.

Although there are many different methods to measure knowledge, results show some interesting contradictions. For example, by patent families⁸⁶ (Figure 9), Japan leads in scientific production (27% of total) followed by Europe (23%), US (20%), China (12%) and Korea (11%), and neither Japan nor Europe are more successful at promoting innovative, high-growth enterprises.

By definition, innovation entails a deviation from the norm, and therefore depends on the diffusion of knowledge among people with a wide spectrum of experiences, a factor that may explain this contradiction in Japan. Japan's island geography and periods of self-isolation no doubt influenced the culturally low openness to foreigners, with an immigrant population of less than 2% and a rate of FDI well below the OECD average. This is also reflected in the low levels of international co-authorship and co-innovation of Japanese patents. Separately, women account for only 15% of researchers as of March 2016, with even lower representation in specialised engineering and science research, implying that the community involved in innovative research in Japan is an

⁷⁹ Among other contributions, Terman spearheaded the creation of Stanford Industrial Park on a nearby land plot. It was the first Industrial Park to be owned by a university, and Terman encouraged some of his students, among which were William Hewlett and David Packard, to start companies there. He became known as the 'godfather' of Silicon Valley for his invaluable contribution to building up the 'triple helix' at Stanford.

⁸⁰ Feld, (2012).

⁸¹ As a matter of fact, Microsoft files more patents than Russia.

⁸² Harayama, (1999).

⁸³ Terman, (1976).

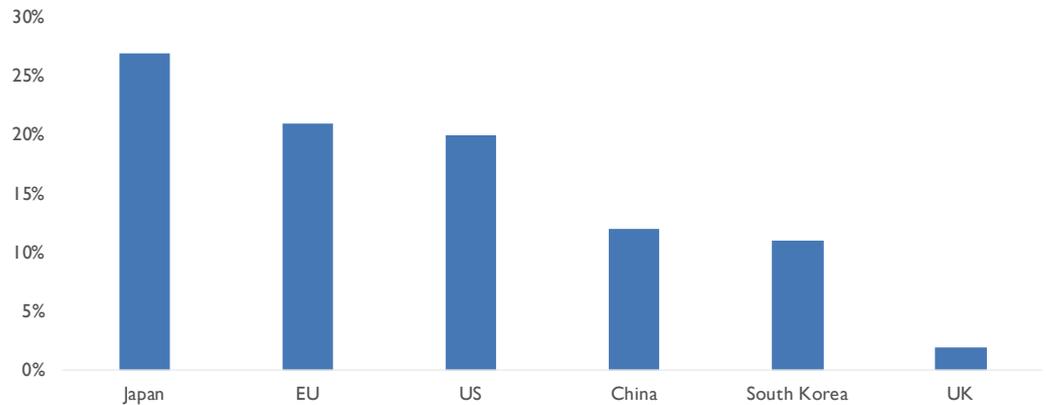
⁸⁴ Sampson, (2018).

⁸⁵ Moreover, the US distinguishes between 'utility patents', 'design patents', and 'plant patents', which cover inventions, designs, and plants and processes, respectively. Utility patents are the most significant of all.

⁸⁶ Patent families avoid filing the same invention twice, since they collect information from different patent offices. Applications submitted in different countries must be included in the same family (OECD, 2009).

extremely homogenous group. Japan may excel at producing patents but its low diffusion of that knowledge has stifled innovation.

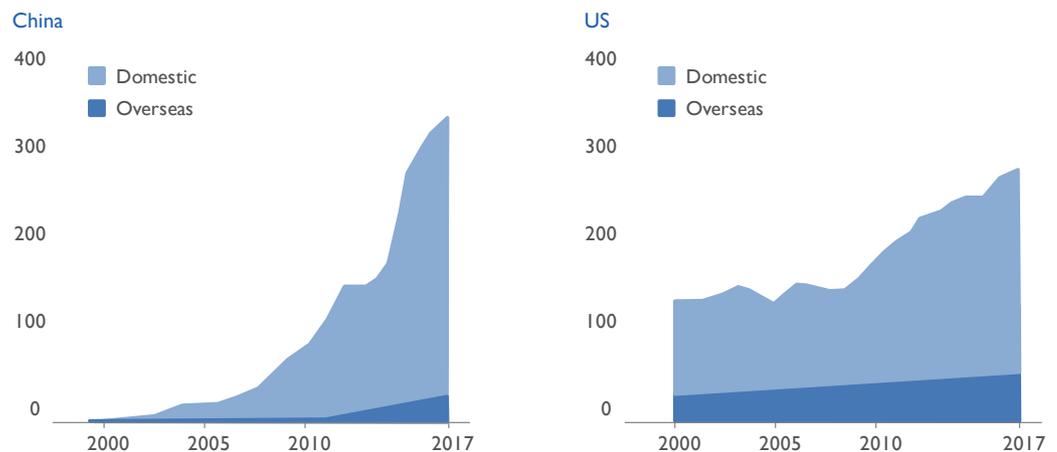
Figure 9. Patent families (global share, %)



Source: World Bank, Arcano Economic Research

Observing patents individually (Figure 10), China leads (with over 300,000) the US, and yet 90% of them are domestic (generally easier to obtain and less associated with innovation). However, almost two-thirds of US patents are international, meaning that they have substantially more scientific and commercial value. The percentage of GDP invested in research and development matters, but so does its productivity in the form of patent generation, especially if they are internationally recognised, as we will discuss later.

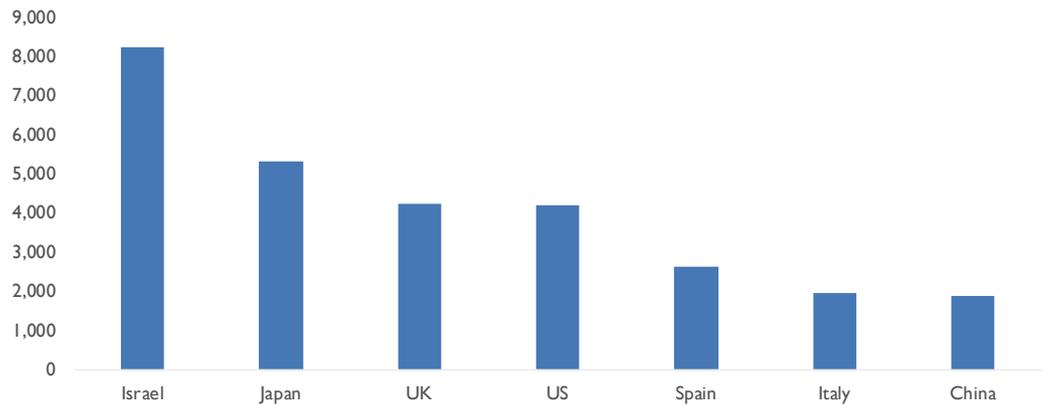
Figure 10. Domestic and international patents granted in China and the US



Source: WPO

Besides patents, the number of researchers per million inhabitants is another metric of knowledge (Figure 11) generation. Israel leads this ranking with 8,250; Spain has only 2,627; and Italy, a comparable country, 1,983 researchers per million inhabitants. Another proxy is the number of papers featured in academic journals, as well as subsequent citations by other scientific journals. Spain is the tenth most quoted by scientific publications. 9.2% of Spanish publications are among the 10% most quoted of total publications globally. In general, this is highly correlated with the quality of scientific research universities of a specific country or area.

Figure 11. Researchers per one million inhabitants



Source: UNESCO Institute for Statistics, Arcano Economic Research

As we have already pointed out, knowledge is not only product of a country's overall R&D expenditure, but of that expenditure's productivity, measured by R&D expenditure over patents filed.⁸⁷ Productivity is in turn correlated to an adequate mix between public and privately funded research. The productivity and volume of R&D increases with proximity to industry. Finding commercial applications generates personal economic rewards for researchers and finances research institution's future projects.

It should be noted however that excessive patent protection can hinder innovation by preventing new products from entering the market. This phenomenon, observed by Michael Heller⁸⁸ in 1998 in the pharmaceutical sector, was dubbed the 'Tragedy of the Anticommons'. Today, this 'tragedy' is a theme in the tech sector, where large companies like Amazon and Google consolidate huge patent portfolios and patent trolls abuse legal protections. An empirical study by Akcigit and Ates⁸⁹ found that the sliding pace of US GDP growth can be traced to the concentration of patents.⁹⁰

2.2.6. Access to markets

The access-to-market conditions of an ecosystem are crucial to their output of innovative, venture backed, high-growth enterprises.⁹¹ This relates to how easy it is for an entrepreneur to start a business and grow it. Market concentration, as measured by the World Bank, determines how competitive a market is by the number and market share of companies in different sectors, as well as their price-setting power. While the US and Japan stand out, Spain occupies a reasonable 30th position in the ranking.

Other indicators of a market's quality are its unemployment rate, since joblessness reduces consumption, and its size, relevant for the plan of any new, high-growth firm.

⁸⁷ Another good indicator for the economic impact of R&D is the balance of technological royalties, the difference between what a country pays for using foreign inventions and what it receives for the use foreigners make of national inventions.

⁸⁸ Heller, (1998).

⁸⁹ "Knowledge in the hands of the best, not the rest: The decline of US business dynamism", (2019).

⁹⁰ 50% of patents are owned by companies (1% nowadays vs. 40% before the 90s). In the late 80s, new companies were responsible for filing 90% of patents. That percentage has fallen to less than 40% at present.

⁹¹ Romanelli, (1989).

2.3. Productivity, entrepreneurship and Venture Capital

Paul Krugman famously said, “Productivity isn’t everything, but in the long-run it’s almost everything”. The great paradox of the fourth industrial revolution is that major breakthroughs in different fields of innovation have not yet translated into significant productivity gains. The impact of scientific revolutions does take long to be felt (adoption of the steam engine is a good example), but as we discuss ahead, some have argued whether productivity is being accurately measured in the digital economy. In addition, the emergence of innovative companies eats the market share of existing companies, sending their productivity down, so total productivity is only offset when the older companies disappear.⁹² With interest rates as low as they are, the natural disappearance of less efficient companies is now a much longer process.

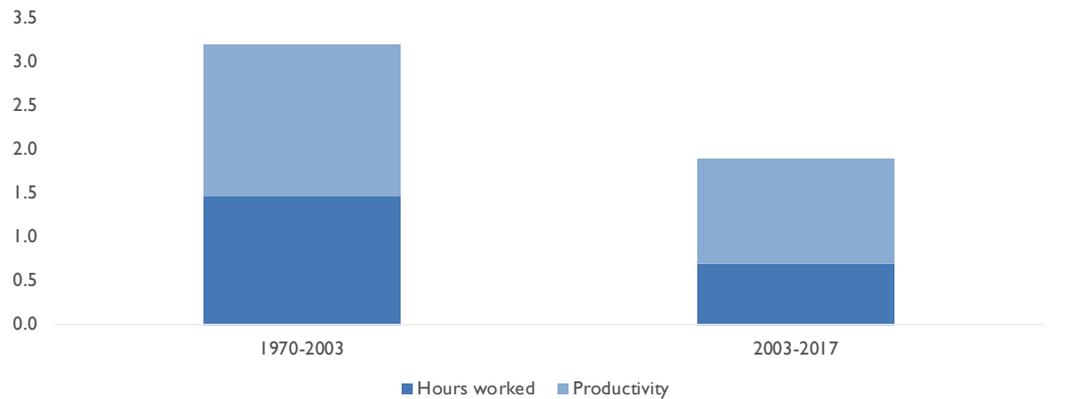
Despite the success of localised entrepreneurial ecosystems, some argue that shrinking productivity can be partly explained by the divorce between innovation (academic research) and implementation (mainly undertaken by businesses), as the percentage of scientific papers published by private firms has fallen since 1970. Promoting proximity through corporate labs and university research parks is a solution to take away from the most successful ecosystems.⁹³

Productivity is one of the drivers with the greatest impact on a country’s growth and quality of life of its population. Long-term GDP growth depends mainly on two elements: (i) demographics (increase in labour force, measured as the number of employed people or hours worked), and (ii) productivity growth (increase in average output per unit of input, either by number of employed people or hours worked). Thus, more than half of the increase in real GDP (net of inflation) over protracted historical periods (1970-2003) where growth neared 3% on average per year in the US, was derived from productivity growth (Figure 12). In somewhat shorter historical periods (2003-2017), real GDP growth stood below 2%, due to a sharp decline in population growth (hours worked rose barely 0.5%), and to further deterioration in productivity which, in any case, has gained weight as a growth-generating factor (with a contribution of nearly 60%). Moreover, productivity gains not only bring about growth, but also social welfare. The more productive a workforce is, the higher the sale per employee ratio, and as such, the more margin the company will have to raise wages without deteriorating margins. There is a balanced distribution of growth among all players.

⁹² US labour productivity increased 1.8% from 1870 to 1920, and 2.8% from 1920 to 1970. However, it has declined to levels of 1.6% between 1970 and the present. Gordon, (2016).

⁹³ NBER, (2019).

Figure 12. Average annual real GDP growth in the US per factor (%)



Source: OECD, Arcano Economic Research

Having examined the relevance of productivity for a country's overall growth and welfare, we can now analyse its main drivers. Greater productivity is associated historically with higher levels of investment in education,⁹⁴ R&D⁹⁵ and infrastructure, and other factors, such as favourable regulation,⁹⁶ financial development⁹⁷ or average company size⁹⁸ also play a role. Innovation is crucial, as discussed below.

An up-to-date (November 2018) and relevant work⁹⁹ by the Global Entrepreneurship Network (GEN), analyses the importance of innovation for productivity generation, and entrepreneurial capacity for boosting innovation. Another study¹⁰⁰ that analysed four European countries, including Spain, found that innovation at a company level was the main driver of productivity gains. A third study, looking at Spain, showed a positive correlation between innovation and productivity, although somewhat more indirect.¹⁰¹ Based on data from a panel of Spanish manufacturing companies between 1990 and 1999, it argues that product innovation is an essential catalyst for increasing exports by small, previously non-exporting companies.

Before analysing the conclusions of the 'The Global Entrepreneurship Index. 2018' (GEN), it may be useful to explain some concepts further. First, the method used to measure productivity growth is different from the one described above. While we have defined as components of GDP growth, the number of hours worked and their associated productivity, we now enhance the analysis by breaking down GDP growth into more factors: i) increase in the number of hours worked (amount of labour), ii) increase in investment, amount of productive capital (capital goods, construction), and iii) increase in aggregate productivity of all factors of production: capital and labour (known as TFP, Total Factor Productivity). It refers to the increase in output of the existing factors of production, excluding the incorporation of new ones.

⁹⁴ Martínez, (1996).

⁹⁵ Castillejo et al. (2005); Vivero, (2010).

⁹⁶ Alonso-Borrego, (2010).

⁹⁷ Rodríguez et al., (2016).

⁹⁸ Díaz and Sánchez, (2007).

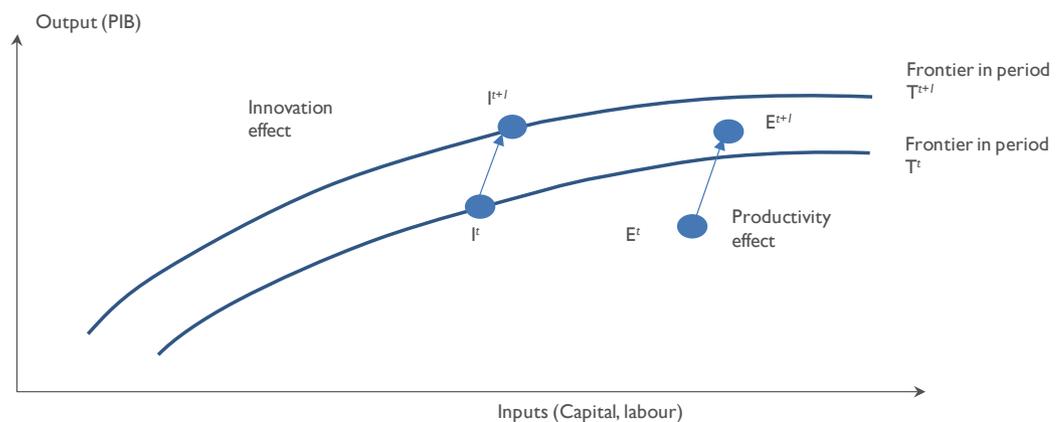
⁹⁹ The Global Entrepreneurship Index. (2018).

¹⁰⁰ Griffith et al. (2005).

¹⁰¹ 'Innovation and exporting: Evidence from Spanish Manufacturing' produced in 2007 by Bruno Cassiman (IESE, KU Leuven y CEPR) and Ester Martínez-Ros (Universidad Carlos III),

The above-mentioned report argues that productivity increases, measured as TFP, is further broken down into: (i) productivity effect, (ii) innovation effect. The first is associated with 'doing things better' and has to do with the efficient allocation of available resources in existing businesses and processes. The innovation effect is related to creating new things or finding new ways to do them. It is associated with Schumpeter's approach of entrepreneurship or destructive creation (the need that less efficient companies are replaced by new, more innovative ones). Entrepreneurship, therefore, plays a crucial role in generating innovations that speed up progress. The innovation effect is usually related to technology, although not exclusively so. A valid example would be the 'Cirque du Soleil', which decided to perform without animals, cutting costs significantly with no negative impact on income; as a result, its profitability climbed notably. Figure 13 illustrates the factor productivity curves.

Figure 13. Sources of productivity (TFP)



Source: 'The Global Entrepreneurship Index. 2018', GEN. November 2018

Figure 14 illustrates the weight of both productivity and innovation on TFP in different countries. Although there are large differences on an individual bases, on average, for an average annual TFP productivity increase of +1.4%, in a given period, the innovation effect accounts for almost two thirds. In the US, it accounts for 100% of the TFP increase. In Spain, it exceeds 100%.

Figure 14. Sources of productivity per country, 2012-13¹⁰²

| Country | Total Factor Productivity (TFP) | Productivity effect | Innovation effect |
|---------|---------------------------------|---------------------|-------------------|
| Germany | 1.05% | -0.74% | 1.80% |
| China | -3.97% | -7.42% | 3.72% |
| Spain | -0.44% | -1.74% | 1.32% |
| France | 0.59% | -0.43% | 1.02% |
| Italy | -0.27% | -1.00% | 0.73% |
| Japan | 2.80% | 0.86% | 1.93% |
| UK | 3.25% | 1.49% | 1.73% |

Source: 'The Global Entrepreneurship Index. 2018', GEN. November 2018

¹⁰² When analysing the evolution of productivity in aggregate terms in an economy, it is important to separate the composition effect from the rest. That is to say, if sectors that are less productive and more intensive in terms of unskilled labour (tourism, construction, etc.) gain a lot of employment, average productivity will decrease even if productivity rises for individuals in all sectors.

Having explained the benefits of measuring productivity via TFP, and breaking it down into productivity and innovation effects, the next step in the analysis will consist in proving the correlation between the level of entrepreneurship and productivity, measured as TFP. The report found a relatively strong correlation between both factors, more significant in the case of the innovation effect within the sources of productivity (Figure 15).

Figure 15. Correlation between level of entrepreneurship, (GEI¹⁰³ ranking), productivity (TFP) and its effects

| Variables | Correlation |
|---|-------------|
| Global Entrepreneurship Index (GEI) vs. Total Factor Productivity | 0.35 |
| Global Entrepreneurship Index (GEI) vs. productivity effect | 0.09 |
| Global Entrepreneurship Index (GEI) vs. innovation effect | 0.39 |

Source: *The Global Entrepreneurship Index. 2018*; GEN. November 2018

The data doesn't leave much room for argument: (i) growth in productivity entails increased social welfare, (ii) entrepreneurship is a key driver of productivity.

¹⁰³ Stangler and Litan, (2009). Calvino, Criscuolo and Menon reached similar conclusions later, (2016).

3. Entrepreneurship and innovation in Spain

After analysing the key drivers of successful innovation and start-up ecosystems, we present a snapshot of the state of affairs in Spain, with its advantages and areas for improvement. There is often an erroneous focus on the latter and a misguided notion that what works in other countries must work for Spain. This can actually be counterproductive. It makes more sense for an ecosystem to adapt and grow around a location's natural competitive advantages than to force a particular industry or expertise to take root.¹⁰⁴

3.1. Success stories

In recent years, Spanish cities have cultivated innovation ecosystems with reasonable success, namely, Barcelona, Madrid, Málaga and Valencia.

Barcelona is the second European city by number of new programmers per year, and occupies the third and fifth positions in the European and global rankings¹⁰⁵ respectively, for its capacity to recruit talent – its warm weather and beach location are definitely enticing assets –. Currently 72,500 programmers are employed in Barcelona (22nd position in Europe), which counts 1,197 start-ups (sixth). According to the Global Entrepreneurship Monitor (GEM) survey, Catalans express fear of entrepreneurship below the national average (39% vs. 43%). In addition, they perceive that they have the knowledge and skills necessary to start up new ventures (58%), not only above the average in Spain (45%), but also the highest in the country. Barcelona's position in the rankings of best cities for entrepreneurs ranges from 25th to the 30th, but is considered to be amongst the fastest growing. It should be noted that the Pompeu Fabra University is investing heavily in its Artificial Intelligence department, in an attempt to boost the specialisation of the area's tech workforce. Finally, the appeal of the 'Barcelona brand' is a powerful force of attraction for qualified foreign tech professionals, a significant competitive advantage for the evolution of its technology ecosystem.

Madrid counts 1,235 start-ups (5th position in Europe)¹⁰⁶ and 111,800 programmers (6th). In terms of entrepreneurial culture, Madrid residents' fear of entrepreneurship is below the national and European average (41%, 43% and 44%, respectively). The capital city falls short of the national average (43%) in the perception of their knowledge and entrepreneurial skills. Consulting firm EY carried out a study¹⁰⁷ that ranked Madrid as the fourth European city in terms of technological potential. However, financing is heavily skewed towards Barcelona. Of the 1,300 million euros that have been invested in 2018 in Spain (63% more than the previous year), 871 million have gone to Barcelona, and 342 million to Madrid.¹⁰⁸

The 'Málaga Valley' ecosystem, currently known as Andalusia's Science Park (PTA), is an initiative which deserves special mention. It was born in 1992 following the guidelines set in the previous section, namely: creation and attraction of talent for entrepreneurship. The ecosystem has thrived as a result of the close link with academia (in this case with the University of Málaga, which produces a significant number of engineering graduates). The on-campus 'Green Ray' building combines

¹⁰⁴ According to Daniel Isenberg in '[The Big Idea: How to Start an Entrepreneurial Revolution](#)', there are nine prescriptions for creating an entrepreneurship ecosystem: 1) Stop Emulating Silicon Valley. 2) Shape the Ecosystem Around Local Conditions. 3) Engage the Private Sector from the Start. 4) Favour the High Potentials. 5) Get a Big Win on the Board. 6) Tackle Cultural Change Head-On. 7) Make a reasonable allocation of resources, do not overinvest. 8) Don't Overengineer Clusters; Help Them Grow Organically. 9) Reform Legal, Bureaucratic, and Regulatory Frameworks.

¹⁰⁵ Atómico (2019)

¹⁰⁶ Mobile World Capital, (2019).

¹⁰⁷ EY, (2019).

¹⁰⁸ Mobile World Capital, (2019).

university research with corporate entrepreneurship programmes. Curriculums are designed jointly by industry players and the university. The University contributes not only syllabus expertise, but also finds with teachers with practical experience in the subjects, for the maximum benefit of the employees of companies taking classes at the university. Initial success stories (a high profile start-up was sold to a multinational), and the region's many attractive features (rent costs are around ten euros a square metre, the salaries of first-year programmers range from 20,000 to 25,000 dollars, a third of the cost of Silicon Valley or Israel) have encouraged large companies such as Ericsson, Oracle, IBM and Accenture, among others, to set up research centres. Today, the PTA has 20,000 employees, half of them programmers (a quarter of whom are foreigners), and is growing at a rate of 1,000 employees per year. Málaga is bound to become one of the benchmark technology hubs in Europe. Its main area for improvement is the lack of a local financial ecosystem (VC).

Finally, Valencia has 261 start-ups, accounting for 6.3% of the country's total (4,115). According to Global Entrepreneurship Network (GEN), the entrepreneurial culture in the area is similar to the Spanish average (43%) in terms of fear of entrepreneurship, reasonable, since they perceive a lack of knowledge and skills compared to the national average (only 41% declare confidence in their entrepreneurial skills and knowledge, the lowest figure in the country). Mercadona's contribution to the development of the Valencian ecosystem is worth highlighting. Seven years ago, the grocer and other backers founded the 'Lanzadera' accelerator and incubator, which since its inception has boosted the development of over 300 start-ups.¹⁰⁹

Spanish cities are raising a great deal of interest. A map of key regions for entrepreneurship in Spain published by South Summit affirmed that the number of international investors in the country increased 70% while their investment portfolio in the country grew 60%.

3.2. A snapshot of the current state of affairs in Spain

The first step in performing an objective analysis of the situation in Spain is to outline the universal factors of importance in the success of an ecosystem, covered in the previous chapter. With this out of the way, we can hone in on Spain's individual strengths and weaknesses. Based on the conclusions reached in this chapter, the last chapter of this report includes our recommendations on how to improve the ecosystem locally and nationally. The determinants and sub-determinants of entrepreneurship were categorised in an oft-cited report by the European Commission in 2016. The paper distinguishes between two stages in the life of a firm: i) the start-up creation stage, which is measured by their Entrepreneurship Index, and ii) the start-up growth stage, associated with their Scale-up Index. Spain ranks below the European average in both indexes (Figures 16 and 17). In the Entrepreneurship Index, Spain scores an average 4.95 vs. Europe's 6.60; and 4.43 in the Scale-Up Index vs. Europe's 5.48, with being 8 the maximum score in both indexes. Clearly, there is substantial room for improvement in both stages. The report also breaks down the different indices and sub-indices that comprise the Entrepreneurship and the Scale-up Index, which helped us establish specific improvement goals.¹¹⁰

¹⁰⁹ (May 16th, 2019). [Juan Roig incorpora 28 nuevas empresas en su Lanzadera](#). *Expansión*

¹¹⁰ European Commission, (2016).

Figure 16. The Global Entrepreneurship Index rank and determining factors of Spain and the EU

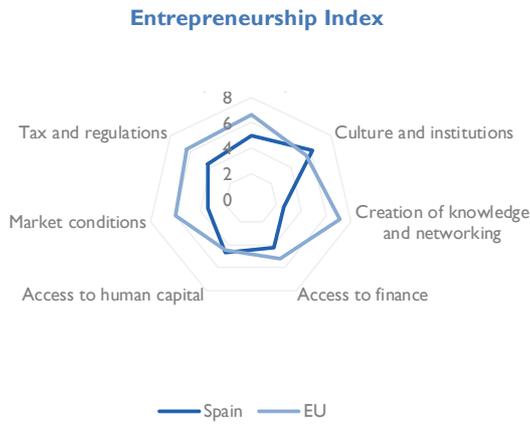
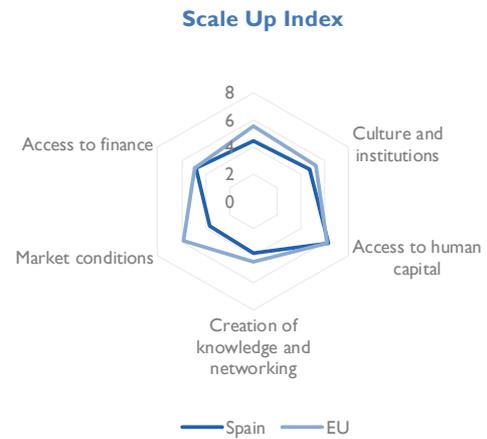


Figure 17. The Global Scale Up Index Rank and determining factors of Spain and the EU



Source: European Commission, Arcano Economic Research

The report also quantifies the importance of each factor. In the Scale-Up stage, the growth phase of a start-up, the importance having access to funding, and specifically to VC, is clear, as shown by Figures 18 and 19 (the sub-factor weighs heavily on the total index). The positive correlation between the abovementioned scale-up stage and access to financing exceeds 85%. Then, breaking down the ‘access to finance’ factor into its subcomponents, one can see the importance of the ‘ease of access to VC’ (correlation of 79.6%) and an even higher importance of late stage VC (correlation of 79.8% with the total index).

Let’s observe then, the factors that must improve for Spain to move up the ranking.

Figure 18. Correlation between the Scale-Up Index and its key factors

| Index and pillars | I |
|---|-------|
| 1. Scale-up Index | 1.000 |
| 2. Culture and institutions | 0.914 |
| 3. Access to human capital | 0.861 |
| 4. Creation of knowledge and networking | 0.418 |
| 5. Market conditions | 0.859 |
| 6. Access to finance | 0.854 |
| 7. Tax and regulations | 0.717 |

Figure 19. Correlation between the ‘Access to finance’ factor and its key sub-determinants

| Pillar and indicators | I |
|-------------------------------------|-------|
| 1. Access to finance | 1.000 |
| 2. Bank loans to the private sector | 0.667 |
| 3. Ease of Access to VC | 0.796 |
| 4. VC at a late stage | 0.798 |
| 5. Access to finance via equity | 0.822 |
| 6. IPO | 0.776 |

Source: European Commission, Arcano Economic Research

The following points identify the areas where Spain can improve in both stages of a start-up’s life, then point out the determinants that account for Spain’s poor position in the Entrepreneurship Index and the Scale-Up Index.

3.2.1. The entrepreneurship stage requires improvement

Four factors are mainly responsible for Spain's below average position on the Entrepreneurship Index, ordered here from most to least negative impact: creation of knowledge and networking,¹¹¹ market conditions, taxes and regulation and access to financing. An assessment of the Entrepreneurship Index criteria where Spain is worse off is undertaken in Figure 20. The 'creation of knowledge and networking' factor is second in importance, and is where Spain presents the largest gap. 'Market conditions'¹¹² have a moderate impact and 'taxes and regulation',¹¹³ relatively limited. 'Access to finance'¹¹⁴ is a factor of medium relevance. In conclusion, the areas that most need improvement, listed by relevance are: 1) Knowledge creation and networking, 2) Access to finance and 3) Market conditions.

Further on, we discuss how Spain can begin improving these key metrics.

Figure 20. **Correlation between the entrepreneurship factors and the Entrepreneurship Index and comparison to the European average**

| | Entrepreneurship Index | Culture and institutions | Knowledge creation and networking | Access to finance | Access to human capital | Market conditions | Tax and regulations |
|-------------|------------------------|--------------------------|-----------------------------------|-------------------|-------------------------|-------------------|---------------------|
| EU | 6.60 | 5.50 | 7.09 | 5.24 | 4.50 | 6.06 | 6.35 |
| Spain | 4.95 | 6.10 | 2.66 | 4.19 | 4.67 | 3.40 | 4.35 |
| Difference | -1.65 | 0.60 | -4.44 | -1.05 | 0.18 | -2.66 | -2.00 |
| Correlation | 1.00 | 0.85 | 0.83 | 0.72 | 0.71 | 0.64 | 0.39 |

Source: European Commission, Arcano Economic Research

Enhancing knowledge creation and networking in the entrepreneurship stage

Below, we describe Spain's position in each of the sub-determinants of the 'knowledge creation and networking' factor by weight of importance, in which Spain is significantly lagging behind Europe.

- 1) **Expenditure on research, development and innovation (R&D) as a percentage of GDP.** R&D investment in Spain is approximately 1.2% of GDP, low compared to the European average of 2.1%, and very far from the 2020 target set by Brussels of 3% to catch up with Japan, the US (3%), South Korea and Israel (4%). The low number in Spain is partly because of the low level of private sector investment, less than half the European average: 1.41% of GDP in neighbouring countries, and only 0.66% in the case of Spain. Public investment though, is also below the Eurozone, at 0.06%. Since the Great Recession, Spain actually reduced the weight of investment in R&D over GDP¹¹⁵ while Germany has invested to reach the European target (3%). Research spending by higher-education institutions, the final component of total R&D expenditure, in Spain is 0.13 percentage lower than the Eurozone. By margin of difference

¹¹¹ Networking is the exchange of information and ideas among people with a common profession or special interest, usually in an informal social setting.

¹¹² Features of the market where entrepreneurs operate (company concentration, unemployment, entry and barriers, size, etc.).

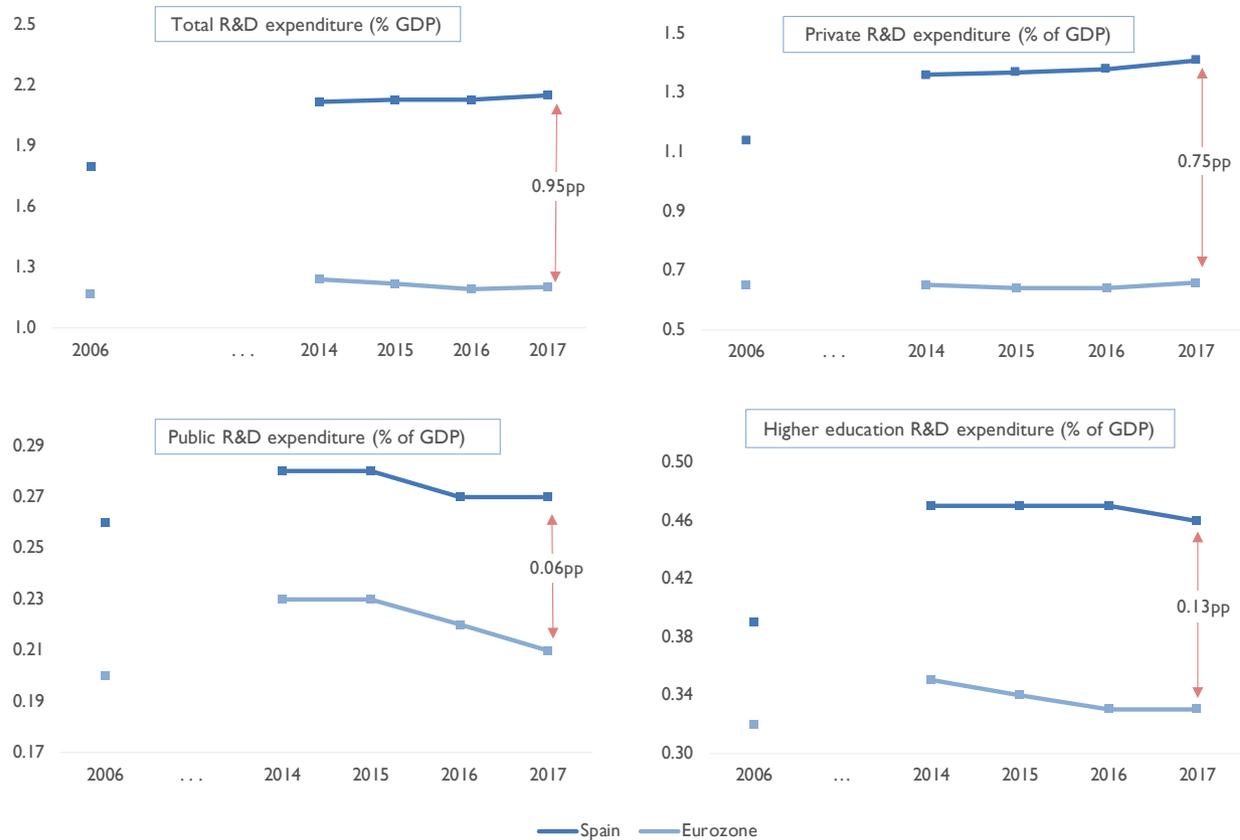
¹¹³ Regulatory environment, both fiscal and administrative (number of days and steps to incorporate a company, tax burden, labour market conditions to hire and/or dismiss employees, etc.).

¹¹⁴ Access to finance is a very significant factor, since start-ups cannot grow without financing. It includes access to VC all throughout the stages of a start-up, funding through BA, bank loans, etc.

¹¹⁵ Eurostat. (January 10th, 2019). [First estimates of Research & Development expenditure.](#)

with the rest of Europe, the lack of private investment is the most significant force dragging Spain in the measure of expenditure on R&D.

Figure 21. **R&D expenditure (as a % of GDP)**



Note: Spreads do not add up due to rounding, and the R&D expenditure of non-profit organisations in Europe, which is negligible in Spain.

Source: Eurostat, Arcano Economic Research

- 2) **Protection of intellectual property.** Indicates the perceived level of protection of intellectual property. Spain obtained 4.4 points in the WEF¹¹⁶ survey, a modest figure in relative terms (about two points below the main European countries), indicating a generalised feeling that the legal system is inefficient in resolving legal disputes.
- 3) **Number of patents per billion euros of GDP (in PPP, purchasing power parity).** While the Eurozone issues 3.89 patents per billion of euros of GDP, Spain only issues 1.42. Moreover, if we look at the number of patent applications per million inhabitants, Spain (83) is well under countries such as Italy (215), UK (282) or Germany (887), and far below the Eurozone average (415).
- 4) **Innovative companies.** In Europe, the percentage of companies engaged in innovative processes totalled 49%, in Spain it was just 34%, despite the fact that according to a study by BBVA¹¹⁷, between 1990 and 2016, Spanish companies who implemented robotics into their operations experienced productivity gains of over 25% during the four years following the adoption of robots.

¹¹⁶ World Economic Forum. (2018). Survey rating scale is 1-7, 1 being the lowest intellectual rights protection and 7, the highest.

¹¹⁷ BBVA, (2018).

Clearly, the ability to generate knowledge is one area where Spain can significantly improve, further exemplified by the inefficiency in output per unit of public investment in R&D. From 1990 to 2015, the average number of inventions per one million dollars of public R&D expenditure was 0.3, as opposed to Israel with 7.6 inventions, and comparable countries such as France, Germany, Sweden and the UK with 1.3.¹¹⁸

Additionally, Figure 22 presents a comparison of the different areas related to scientific production. By measure of researchers per million inhabitants, Spain is again lagging behind with 2,873, while Germany, the UK and France have almost twice that figure. Only 37% out of those 2,873 researchers are in the private sector, very low compared to the Eurozone.

Continuing with the indicators associated with knowledge creation, the number of PhD's in Spain is also much lower than the Eurozone average. Figure 22 shows how in 2016, Spanish GDP, adjusted for purchasing power, was in the 16th position globally. By that benchmark, if the country scores lower than 16 in some measure of global ranking, it implies that the country is doing relatively well, and vice versa. Spain occupies a sound 11th position in a world ranking of number of scientific citations, but still far from the largest European economies.

The other items in the table related to the generation of knowledge can be grouped under the heading 'output productivity'. The Spanish patent production rate is subpar, as is the rate of production of patent families (27th in the ranking, far from Germany or France). Spain is in a weak position because research resources are not properly oriented towards market applications. The reason, as we have previously speculated, is likely the lack of interaction between academia and industry.

Spain's Independent Authority for Fiscal Responsibility (AIReF) affirms that a characteristic of the Spanish financial ecosystem is the low involvement by the private sector in financing research and innovation.¹¹⁹ Spain has a low number of researchers compared to other European countries, with an even lower weight of private researchers.

AIReF also finds that research productivity is worse than in the Eurozone, both by the public and private sectors: 0.21 patents are filed in Spain per million euros of private investment (compared to 0.28 in Europe), and 0.66 patents per million euros of public investment (compared to 1.42 in Europe). Another key indicator of research productivity is the balance of technological royalties.¹²⁰ Spain fares better than the Eurozone (-0.3% as opposed to -0.59% of GDP), but far below comparable countries such as Germany, the UK or France, whose positive balances mean the use of patents for innovation do not drain GDP.

Finally, some studies¹²¹ which have established a positive connection between R&D efficiency and a country's per capita income, find Spain still scores lower than many comparable nations, including Italy, Germany, UK, Holland, and the Nordics.

¹¹⁸ OCDE, (2019).

¹¹⁹ AIReF, (2019).

¹²⁰ Money flow generated by the use of patents among countries. It is the difference between the royalties one country pays for using foreign inventions, and those that it earns from a foreign country using its own inventions.

¹²¹ Sampson, (2018).

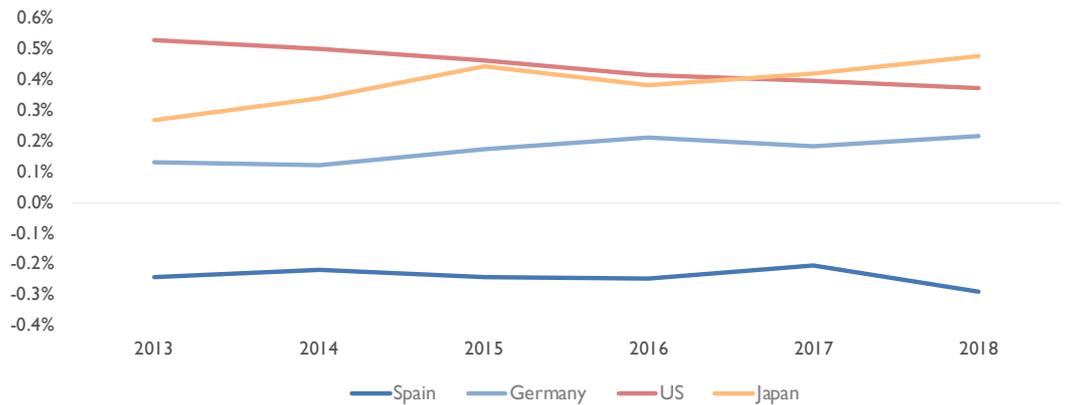
Figure 22. Analysis of scientific production

| | | Spain | Germany | UK | France | Italy | Eurozone |
|-----------------------|---|---------|---------|-------|--------|--------|----------|
| Human resources | No. of researchers, per million inhabitants, 2017 (*Europe, 2016) | 2,873 | 5,036 | 4,376 | 4,441 | 2,294 | 3335* |
| | Private sector researchers, % over total researchers, 2017 (Eurozone, 2016) | 37.2 | 59.6 | 37.9 | 60.2 | 42.5 | 49 |
| | No. of Ph.D.'s, % over people aged 25-34, 2018 (*Europe) | 0.4 | 0.83 | 0.89 | 0.63 | 0.43 | 0,78* |
| Scientific production | No. of publications, global ranking / global GDP ranking, 2016 | 11°/16° | 4°/5° | 3°/9° | 7°/10° | 8°/11° | N.A. |
| | No. of citations, global ranking, 2018 | 11 | 3 | 2 | 6 | 8 | N.A. |
| | H index, global ranking, 2018 | 11 | 3 | 2 | 5 | 8 | N.A. |
| | Publications in the global top 10% most cited, % over total domestic publications, 2015 | 9.2 | 11.4 | 15.3 | 11 | 10.4 | 11.1 |
| Patents | Per million inhabitants, 2017 (* weighting of countries in the table) | 83 | 887 | 282 | 373 | 215 | 415* |
| | Per million euros of private expenditure in R&D, 2017 | 0.21 | 0.28 | 0.21 | 0.29 | 0.29 | 0.28 |
| | Per million euros of public expenditure in R&D, 2017 | 0.66 | 1.42 | 2.14 | 1.50 | 1.40 | 1.42 |
| | Per billion euros of GDP, 2017 | 1.42 | 5.76 | 2.33 | 4.14 | 2.40 | 3.89 |
| Patent families | No. of patent families, global ranking, 2018 | 27 | 5 | 19 | 12 | 22 | N.A. |
| | Per million inhabitants, 2018 | 27 | 295 | 100 | 144 | 62 | N.A. |
| Financial impact | Balance of royalties, % over GDP, 2018 | -0.30% | 0.22% | 0.34% | 0.07% | -0.01% | -0.59% |
| | Total R&D expenditure, % over GDP, 2017 | 1.2 | 3.02 | 1.66 | 2.19 | 1.35 | 2.15 |
| | Private R&D expenditure, % over GDP, 2017 | 0.66 | 2.09 | 1.12 | 1.42 | 0.83 | 1.41 |
| | Public R&D expenditure, % over GDP, 2017 | 0.21 | 0.41 | 0.11 | 0.28 | 0.17 | 0.27 |

Source: WIPO, OCDE, World Bank, Eurostat, AIREF, Arcano Economic Research

As we have already mentioned, scientific production has an impact through the royalty balance, which in Spain is negative (Figure 23), meaning that we pay more than we earn for using a third country's intellectual property.

Figure 23. Balance of royalties (% of GDP)



Source: World Bank, Arcano Economic Research

Improving access to funding at the entrepreneurship stage

Below, we explain the main components of this determinant of great importance, both because of its impact on entrepreneurship, and because Spain presents levels lower than the European average.

- 1) **Early-stage financing over GDP.**¹²² VC financing to early-stage firms, as a percentage of GDP in Spain (0.02%) falls short of countries such as the US (0.16%), UK (0.04%) or France (0.03%). In this segment, Israel's VC financing over GDP is a high 0.27%.¹²³ The volume of financing in this critical VC segment in Spain is obviously far below where it needs to be.
- 2) **Business angels.** Spain occupies the 23th position in the ranking of BAs per 10,000 euros of GDP. This figure is close to the European average, so it does not indicate weakness.

As for 'market conditions', another key determinant of entrepreneurship, Spain stands as follows:

- 1) **Market dominance.** Spain occupies a modest 30th position out of 137.¹²⁴
- 2) **Unemployment rate.** The most negative factor for Spain, since its joblessness is significantly higher than the OECD average.
- 3) **Domestic market openness.** Spain ranks fourth-highest in terms of entry barriers for start-up companies. The different and disperse regulations of autonomous communities cause significant fragmentation of the market.

In summary, Spain must improve upon the following key determinants of the entrepreneurship stage: 1) Knowledge creation and networking, 2) Access to financing, and 3) Market conditions. For the first determinant, there is much work to do to place Spain among leaders. The volume and productivity of R&D expenditure (especially in the private sector) must increase, and the country needs to invest in generating more productive researchers and PhD's so that more companies can undertake innovative processes. For the second factor, Spain's main weakness is the relative volume of financing to early-stage firms, and a lack of options outside of bank financing. For the final factor, Spain has many sectors dominated by just a few business groups, the

¹²² Three-year moving average.

¹²³ OECD, Entrepreneurship Financing Database.

¹²⁴ The index is based on a survey conducted by the WEF: 'In your country, how would you characterise corporate activity? Dominated by a few business groups (1) or spread among many firms (7)?'

unemployment rate is significant, and the domestic market is featured by lack of 'openness', with a significant dispersion of autonomous regulations.

Having analysed the factors responsible for our poor position versus Europe at the entrepreneurship stage, we will now focus on the determinants in the scale-up stage.

3.2.2. The scale up stage requires improvement

Spain's performance at the scale-up stage is much more balanced than in the entrepreneurship stage, but there are still some significantly underperforming determinants. Ranked by importance: market conditions, taxes and regulation, access to finance and culture and institutions. It is important to look at the most significant factors and analyse in which Spain is worse off, as well as their degree of impact on entrepreneurship (Figure 24). From this combined analysis, we draw the conclusion that Spain must improve, in order of importance and underperformance, access to finance, culture and institutions, and market conditions.

Figure 24. **Correlation between entrepreneurship factors and the Scale-Up Index and comparison with the European average**

| | Scale-Up Index | Culture and institutions | Access to human capital | Market conditions | Access to finance | Taxes and regulations | Knowledge creation and networking |
|-------------|----------------|--------------------------|-------------------------|-------------------|-------------------|-----------------------|-----------------------------------|
| Spain | 4.43 | 4.74 | 6.30 | 3.79 | 3.68 | 4.79 | 2.73 |
| UE | 5.48 | 5.27 | 6.21 | 4.46 | 5.88 | 4.94 | 4.23 |
| Difference | -1.05 | -0.54 | 0.09 | -0.66 | -2.20 | -0.15 | -1.50 |
| Correlation | 1.00 | 0.91 | 0.86 | 0.86 | 0.85 | 0.72 | 0.42 |

Source: European Commission, Arcano Economic Research

Improving access to funding at the scale-up stage

This factor is divided into four key indicators:

- 1) **Banking credit to the private sector.** The flow of bank financing to start-ups has improved in recent years, but there are still few hybrid, venture-debt instruments to meet the needs of young businesses.
- 2) **Easy access to VC.** The survey conducted by WEF answers the question 'In your country, how easy is it for entrepreneurs with innovative but risky projects to find VC?' Spain is at the bottom of the ranking, which despite some improvement means it is still lagging peers.
- 3) **Easy access to VC in second financing rounds.** Spain raises six times less capital over GDP¹²⁵ than the country that raises the most capital and less than half of the European average.
- 4) **Easy access to the financial sector.** Survey conducted by WEF on how easy it is for companies to access capital markets. Spain ranks 50th out of 140.

In short, Spain ranks among the worst countries in terms of access to finance in the scale-up stage. Companies need financing throughout their lifespan, but early-stage companies are the most difficult to finance, because of the greater perceived risk. Therefore, promoting financing at this stage, especially VC, is key to achieving a powerful start-up ecosystem.

¹²⁵ Three-year moving average.

Enhancing culture and institutions at the scale-up stage

This factor is based mainly on three indicators:

1) **Judicial integrity.** This includes confidence in the rule of law, impartiality and independence of the judiciary and the effectiveness of law.¹²⁶ Spain is positioned above the European average, at the same level as countries such as the US, the UK or Israel.¹²⁷

2) **Meritocracy in senior management positions.** Spain is far from the average, based on a WEF survey¹²⁸ that measures whether senior positions at companies are occupied according to merit and qualifications of the candidate, or rather based on family and friend relationships. Out of a maximum score of seven, Spain is around one point below the main European countries, meaning that senior management positions are often occupied by relatives or friends and not by people chosen for merit or qualifications.

3) **Willingness to delegate authority.** Spain ranks in the bottom fourth, only ahead of Hungary, Bulgaria and Italy.¹²⁹ The capacity to delegate requires an environment of trust and depends on two factors: competence of the subordinate and confidence of the one who is delegating.

Enhancing market conditions at the scale-up stage

This factor may be broken down as follows:

1) **Market size / purchasing power.** It measures the Gross National Income per capita, which in Spain is slightly below the European average.

2) **Global competitiveness Index.**¹³⁰ According to WEF, Spain occupied the 26th position in 2018. Some of our neighbouring countries such as Germany, UK and France rank 3rd, 11th and 17th, respectively. Therefore, there is significant room for improvement.

3) **Cross-border e-commerce among EU countries.** With barely a 5% e-commerce adoption rate, Spain is positioned slightly below the European average, far from the 20% and 30% rates of the US and China.

4) **Stock of foreign direct investment as a percentage of GDP.** In Spain, it amounted to 48.5% in 2018,¹³¹ while in France and Germany¹³² it only accounted for 28.3% and 22.2%, respectively. This highlights the relevance of foreign investment for Spain.

¹²⁶ Fraser Institute, (2018).

¹²⁷ World Bank

¹²⁸ Response to the survey question 'In your country, who holds senior management positions in companies?' 1 = usually relatives or friends without regard to merit; 7 = mostly professional managers chosen for merit and qualifications.

¹²⁹ Response to the survey question 'In your country, to what extent does senior management delegate authority to subordinates? 1 = not at all; 7 = to a great extent.

¹³⁰ The Global Competitiveness Index 4.0 assesses the macro and microeconomic aspects of a country's competitiveness, defined as the number of institutions, policies and factors that drive its output level, with which we will deal later in the report. Spain ranked 26th in 2018.

¹³¹ Sifdi. (2018). [La inversión extranjera directa en España.](#)

¹³² UNCTAD. (2018). [World Investment Report.](#)

3.3. The issue of financing innovation in Spain: the equity gap

Having analysed the determinants of Spain's position in the entrepreneurship and scale-up stages, showing clear room for further improvement, we would like turn our focus to the issue of financing.

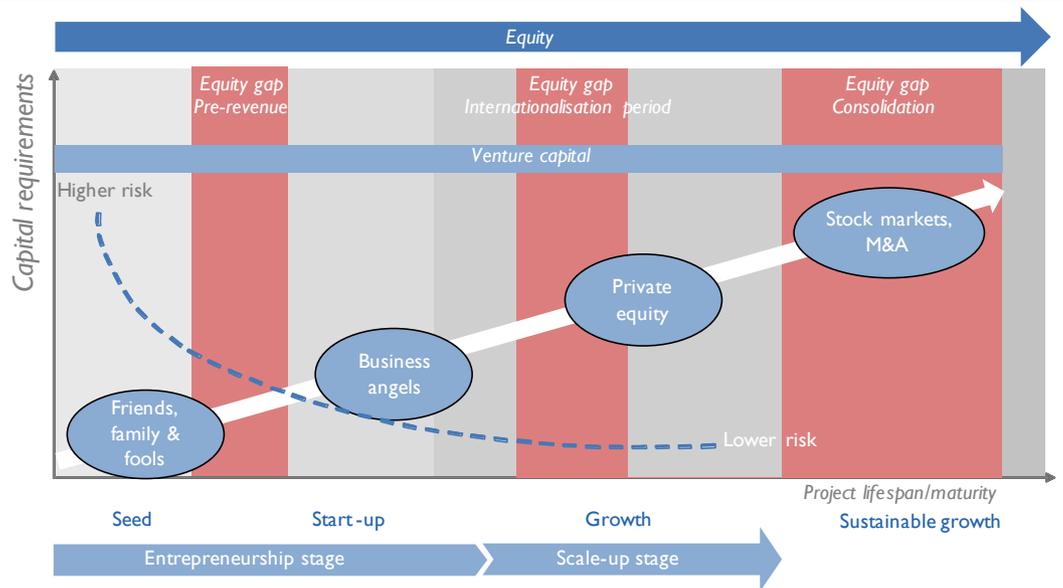
Although Spain is lagging behind in the 'access to finance' factor in both stages, it is relatively worse off than Europe in the latter, the Scale-Up Index (Figure 25). There are clear equity gaps present in the financial ecosystem. One of the goals of this report is to help fill these gaps by encouraging investment, either via debt or equity (Figure 26).

Figure 25. 'Access to finance' factor at each stage

| | Entrepreneurship Index | Scale-Up Index |
|-------------|------------------------|----------------|
| Spain | 4.19 | 3.68 |
| EU | 5.24 | 5.88 |
| Difference | -1.05 | -2.20 |
| Correlation | 0.72 | 0.85 |

Source: European Commission, Arcano Economic Research

Figure 26. Capital requirements according to project maturity

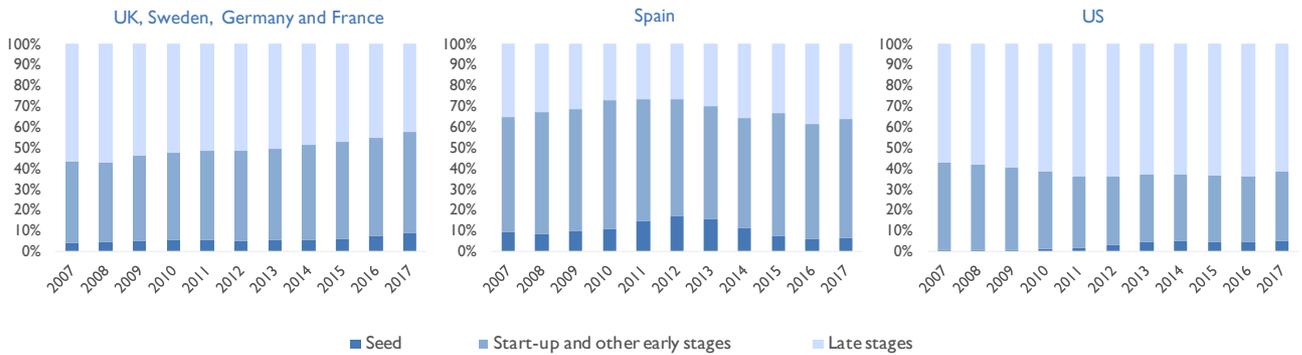


Source: Peralta, Sánchez, Roman, IE University, Arcano Economic Research

As a start-up matures, its funding needs increase. The more the company and its value grow, the greater the volume of funds required. Logically then, the volume of early-stage investment should be lower than the volume of late-stage investment. If this is not so, it may indicate an existing equity gap. If companies are not able to secure investment at all stages of growth, a company that raised early-stage capital may die in the late-stage. Additionally, the perception that successful 'seed' and other early-stage investments will continue to find financing throughout their growth cycle, creates a virtuous circle that helps to raise more capital throughout. The situation in Spain is lopsided, as shown by Figure 27. The weight of total investments in early and seed stages is proportionally greater than in late stage ventures. It is important not to misunderstand this figure; a higher percentage of capital is greater in early stage in Spain does not mean that the absolute

dollar amount is enough. Remember, the aggregate spending on VC (and early-stage VC spending) is far less in Spain than in other countries. As such, there is no solid perception among early-stage investors that they will be to exit their investments successfully. Europe in this sense, is also considerably worse off than the US.

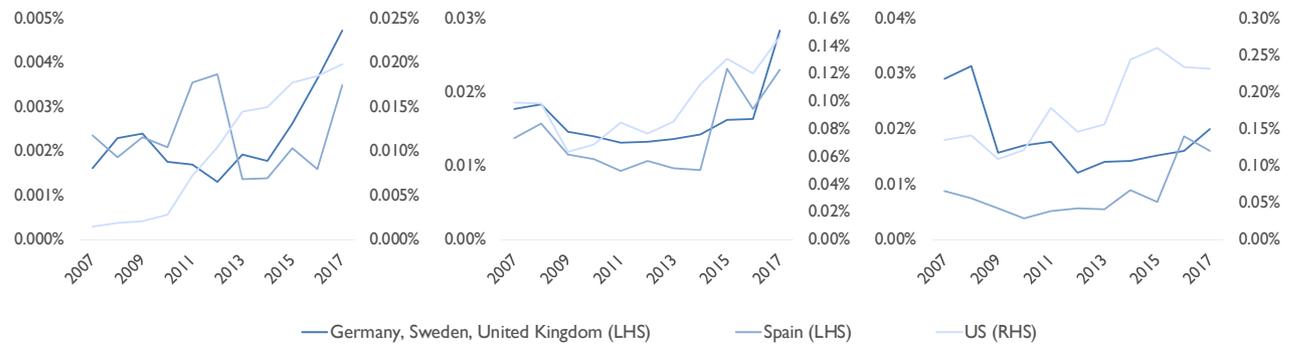
Figure 27. Share of capital invested at each stage



Source: OECD, Arcano Economic Research

The composition of investments in Spain is not coherent with the natural growth cycle of companies, and the volume of investment (measured by percentage over GDP) not nearly enough, lagging far behind other European countries and the US at every stage. This report aims to encourage a favourable framework for financing in Spain by providing recommendations to increase the total amount of investment available throughout the life of a company.

Figure 28. Capital invested (% of GDP) at each stage



Source: OECD, Arcano Economic Research

3.4. A snapshot of the current state of affairs in Spain: conclusions

There are some hubs in Spain that can, to a certain extent, be considered successful entrepreneurial ecosystems, namely Madrid, Barcelona and Málaga. Objectively though, the country has a long road ahead before any of its ecosystems are truly world-class. Rankings produced by independent and reliable entities quantify Spain's underperformance. They assess the country's position against the European average in the major determinants and sub-determinants of entrepreneurship, with Spain faring better in some than in others. Our analysis centres on the most relevant determinants, and those in which Spain ranks weakest.

In both the entrepreneurship and scale-up stages, Spain falls short of the European average. As for the entrepreneurship stage, Spain's largest gaps are in (by order of importance): knowledge creation (patents, for example, especially through private research), access to finance (mainly VC) and market conditions (business concentration, unemployment, domestic market openness). Throughout the scale-up phase, Spain's weaknesses are: insufficient access to finance (again VC), the culture and social fabric for entrepreneurship (confidence in management, willingness to delegate), and the market's conditions (competitiveness index).

Notably, the 'access to finance' determinant is significant to both indexes, and one of the determinants in which Spain fares worst, especially in the scale-up phase, when growth is a more pressing and capital-intensive process. Our analysis of these and other key indicators concludes that there are equity gaps in Spain's financial ecosystem, especially for late phase start-ups,¹³³ although the largest problem is a lack of financing through all phases of the growth cycle. It must be understood that for effective funding of innovation, policies cannot target just one of the phases of the cycle, since entrepreneurs need access to financing at all stages. Despite a major evolution of the VC ecosystem in the last few years, Spain still has a long way to go if it wants to catch up with comparable countries. Spanish entrepreneurs are often forced to resort to foreign investment when their companies reach a considerable size. Events such as the South Summit have significantly enhanced Spain's visibility in the international arena, but there is added risk and difficulty of having to resort to foreign funds, potentially causing some successful projects to fail. Local financing also tends to provide a greater level of managerial involvement and local expertise. Nonetheless, start-up ecosystems benefit from the sophistication and knowledge of foreign investors.

¹³³ Many of our collaborators also mentioned that finding funding for a pre-revenue venture is extremely difficult in Spain.

4. Recommendations

This report identifies specific areas of improvement in Spain with the aim of promoting innovation ecosystems of the highest calibre. Our analysis shows there are four key determinants of successful ecosystems that need significant improvement: access to financing, generation of commercially viable knowledge (patents), the entrepreneurial culture and the regulatory framework.

4.1. Ideas for improving access to financing for start-ups at both the entrepreneurship and scale-up stages

We have described how different indicators point to gaps in Spain's financial ecosystem, identifying access to capital as one of the largest areas for improvement. Equity gaps, we reiterate, occur when certain stages of the financing chain are neglected in favour of others. There is an evident equity gap in Spain throughout the VC industry. We recall here that Spain invested in VC only 0.05% of its GDP, a tenth of that of Israel or the US and half the European average. However, in the BA segment, for example, Spain allocates 23 euros for every 10,000 of GDP, a figure similar to Europe. VC, crucial to the growth of start-ups, and with hugely positive externalities in terms of job creation, is the segment of financing where Spain most needs reinforcement, as corroborated by studies that determine access to growth finance as the greatest obstacle in Spain.¹³⁴ It is precisely the equity gap, the lack of capital in the VC industry that needs to be remedied. Let's explore some ideas.

First: Facilitate investment by pension funds in VC

We have seen how a law promulgated in the US in 1979 was instrumental in unleashing investment by American pension funds in VC.¹³⁵ This in turn, is critical for understanding why the American innovation ecosystem has always had far more funding opportunities, undoubtedly a competitive advantage that explains this country's overwhelming relative superiority over Europe. In Europe there are about six trillion euros in pension funds, but their investment in VC is minuscule compared to that of American funds (the total VC industry saw 100 billion dollars invested in the US in 2018 vs. only 21 in Europe).¹³⁶ Specifically, pension funds based in Southern Europe are significantly more risk-averse. Nordic countries stand out: since 2013, 16% of the capital raised by VCs has come from pension funds (seven times the European average).¹³⁷ Spain is lagging behind, evident from the low VC investment per capita. Apart from the fact that Spain's proportion of household wealth stored in pension funds is much lower than other Western countries,¹³⁸ paradoxically, national regulations demand daily liquidity requirements of pension funds¹³⁹ (something which does not happen in almost any other country). This is highly questionable... why would a person in their forties, saving for retirement, need daily liquidity? The result is that pension

¹³⁴ European Commission, 2016.

¹³⁵ Pension funds and VC both tend to have a long-term investment horizon, making them highly compatible.

¹³⁶ Clark, K. (November, 2019). [Venture Capital investment in US companies to hit \\$100B in 2018](#). *Techcrunch*; Miralles, R. (February 8th, 2019). [Key Trends and Statistics That Will Shape European Venture Capital for 2019](#). *Crunchbase*.

¹³⁷ Atómico, (2018).

¹³⁸ An alternative recommendation is to increase the weight of Spanish savings into pension funds and insurance companies, which is far from the European average. This could be done by applying greater tax incentives than to other types of savings, such as deposits, traditional funds, etc., or even by discouraging options such as housing investment, or by promoting renting so that families earmark less money to pay for a house, and therefore have more to save in pension funds and life insurance products. It is advisable to promote a more sophisticated and less conservative financial culture. The fact that banks enjoy a virtually monopolistic situation (the bulk of savings end up in their hands) means they have no incentive to invest in riskier assets (they would prefer to have their reputation unchallenged). Promoting EAFIS (independent financial advisors) via regulation or tax incentives would increase the percentage of savings managed by these.

¹³⁹ Article 75 of 304/2004 Royal Decree.

funds are pressured to prioritize both liquid investments (meaning hardly any investment goes to VC) and foreign companies, which often generate greater liquidity due to their larger size.¹⁴⁰ Pension funds in Spain have a balance sheet of 100 billion euros, and the long-term funds of insurance companies have 185 billion. Following the example of Switzerland, which allows pension funds and insurers to allocate up to 5% of their balance to VC, Spain would be open a source of domestic capital of five billion euros from pension funds and more than nine billion from insurers.

Second: Encourage funding of technology with private savings

Many countries like the UK, Italy and France have adopted legislations that encourage allocation of private savings towards VC fund-of-funds, who are also allowed on occasion to invest in technology companies listed on alternative markets. To avoid liquidity issues, these funds are closed in such a way that investors can only demand liquidity over a multi-year period. This way, it becomes easier for the portfolio manager to identify medium-term technology trends and finance them. In order to encourage these vehicles, as well as others linked to seed investment, these countries have approved tax benefits, generally linked to personal income tax deductions. In the UK, for example, the 2011 Seed Enterprise Investment Scheme was instrumental in fostering the current wave of tech financing. In the US, there is already a regulatory framework enabling individuals to invest in this asset class which, as we have seen, generates more than reasonable returns, especially through vehicles like VC fund-of-funds, which minimize risk for the individual, who often does not have the capacity to make an informed selection of a manager.¹⁴¹

Third: Regulate with a positive bias towards VC

Although PE and VC are often assimilated, they are two very different industries. Venture capital uses less resources overall, yet it generates enormous positive externalities in the form of research and development, which contributes to changing the productivity of an economy. For that reason, many legislators have introduced fiscal and regulatory treatments particularly favorable to VC. We believe Spain should move in this direction. Academic research has shown how VC financing is closely related to the regulation of pension funds (as we have already pointed out), but also to the taxation of capital gains. Lower taxation burdens are correlated with the amount of funding the VC industry can attract.¹⁴² This in turn generates major externalities: high-growth enterprises create jobs in innovative sectors, contributing to tax revenues via social security and income tax sustainably, due to the difficulty of replicating this value-added model.

Fourth: Foster Corporate Venture Capital initiatives

Mature Spanish companies are relatively weak innovators, and so far they barely participate in the start-up financing chain, unlike in other leading countries. We have seen how approximately a quarter of VC's global funds are corporate (in the case of Israel, half): that proportion in Spain does not even reach 4% of the national investment in VC.¹⁴³ Corporate investment in VC is a powerful tool for large companies to generate innovation. Developing a regulatory framework that facilitates the

¹⁴⁰ Switzerland has just approved a decree allowing pension funds to invest up to 5% of their balance in VC. [Link](#). Since pension funds in Spain manage close to 100 billion euros, a similar law would imply an additional five billion euros of available funds in the ecosystem (Inverco). Almost twice as much would be available if insurers could invest up to 5% of their balance in VC (the industry managed 185 billion euros in 2018 according to Unespa).

¹⁴¹ Arcano has a PE "fund of funds".

¹⁴² Gompers y Lerner, (1998b).

¹⁴³ ASCRI, (2018)

breakthrough of CVC¹⁴⁴ (both foreign and Spanish) would help significantly to alleviate the equity gaps that exists in Spain.¹⁴⁵ At the corporate level, there are many policies that can be adopted to promote these vehicles (the Chinese Internet giant Alibaba has been very successful): creating separate legal subsidiaries, encouraging growth over profits, tolerating failure and minimising red tape.¹⁴⁶ At the moment, a CVC programme has been created in Spain to invest in Israeli companies, through which more than 20 million euros have been invested.¹⁴⁷ Creating this kind of program for investing in Spanish companies could successfully channel more investment in Spain. Scaling the current weight of 4% of Spanish CVC to the 23% that is the global average would imply an additional investment of 52.7 million euros in innovative companies.

Fifth: Supporting the transfer of knowledge to the next generation of founders

After a successful exit, founders are well positioned to start a new business, having acquired knowledge, experience and capital. Like this, they become critical assets for the whole innovation ecosystem.¹⁴⁸ Since the compensation of many entrepreneurs comes in the form of stock-options, it is common sense to tax these at lower rates for new companies than for established firms.

Sixth: Encourage development of university VC funds

Universities are in an enviable position within the entrepreneurial ecosystem. To make the most out of it, many have created their own investment funds. Funds associated with academic institutions benefit from the proximity to research: they apply new knowledge for commercial purposes, creating companies from research projects (spin-offs). This scheme is in use at Ben Gurion University (cybersecurity) and Cambridge (new VC fund, Cambridge Innovation Capital, 300 million dollars). On the other hand, profits coming from the funds stay partly in the coffers of their alma mater and fund further research projects. Promoting this kind of fund, and applying academic research to commercial use is key.

Seventh: Promote and strengthen public-private innovation financing programmes

We have outlined how successful financing for entrepreneurship generally comes in the form of equity, not debt. This is how public aid for private research is doled out in countries with great foresight like the US, Israel and Germany. States calculate that because of the development that occurs within companies that receive research funding, financing research through non-repayable grants generates huge externalities (future tax revenues) that outweigh the sunken cost of the subsidy. In Spain, a portion of public aid to R&D&i comes in the form of debt, not equity, which may explain why only half of the available budget for this type of aid is used at all. Consequently, public investment in Spain in R&D and innovation is 6 percentage points below the Eurozone with the private sector 75 percentage points below. Narrowing this gap is a necessity. The Government of Spain, for its part, promoted the Fond-ICO programme in 2012, which led co-investment by the public development bank (ICO) in both PE and VC financing programmes. This program of co-investment with the private

¹⁴⁴ Via less severe regulation that promotes investment by companies. In this vein, on January 1st 2019, the draft bill for the promotion of the start-ups ecosystem was released for public consultation. One of the improvements is the increase in the deduction for investors, both individuals and legal entities. These will be able to deduct up to 50% of the invested with a limit of 150,000 euros per year. Currently they can deduct up to 30% with a limit of 60,000 euros per year.

¹⁴⁵ There are very few cases of CVC in Spain. Repsol, for example, recently acquired 17% of a start-up (Recreus) via it's VC fund, Repsol Corporate Venturing.

¹⁴⁶ BCG, (2018).

¹⁴⁷ Molina, C. (July 3rd, 2017). [Crean un fondo para que las empresas del Ibex inviertan en tecnología israelí](#). *Cinco Días*.

¹⁴⁸ OCDE, (2014).

sector, always via funds and not via direct investments in companies,¹⁴⁹ allows to maintain economic incentives for the private sector and has been key to the development of the VC industry in Spain. Our study concludes that Spain mostly lacks capital in VC, making it advisable to focus future co-investment schemes on this segment.

Eight: Increase the budget of Fond-ICO

An objective view of Spain's financial ecosystem shows gaps throughout the growth chain in terms of absolute values. Therefore, apart from the measures described above, we highly suggest increasing the public budget for co-investment in VC. French start-ups, as soon as they need capital to grow, receive considerably more financing than Spanish ones do. This discrepancy is not necessarily motivated by a qualitative disparity between French and Spanish start-ups. Instead, one of the main reasons is that the French BPI program, equivalent to the Spanish Fond-ICO, has a budget five times larger. We believe that increasing the Spanish public budget allocated to VC can be one of the short-term levers with the greatest impact, as the Fond-ICO in Spain has already demonstrated.

4.2. Ideas to boost innovative knowledge in Spain

As we have explained, although Spain does not underperform in terms of scientific production (papers, citations), it fails to generate patents at an adequate level. This implies that the productivity of Spain's research effort is questionable. That is to say, the Iberian country produces an acceptable level of research papers (in line with its economic power), that are cited even more than what its world GDP ranking would suggest, yet still it errs profoundly in converting this research into patents. As we have previously observed, Spain files 83 patents per million inhabitants, compared to the European average of 415 and the German average of 887.¹⁵⁰ Let's examine some ideas that could help address this deficit.

First: Balance the relationship between private and public research

The most successful innovation ecosystems tend to have R&D funding with a proportion of one-third public and two-thirds private, reflecting the commercial viability of the research effort and the close link between industry and the academic environment. Objectively, the level of investment in R&D over GDP is lower in Spain than in the Eurozone, and lower still in the private sector than the public sector. Also, the productivity of investment is relatively worse in the public sector. Improving and balancing the relationship between the two sectors would generate positive externalities for both. The Spanish State grants incentives to promote private R&D. However, as we have observed, when incentives are established in the form of debt rather than equity or non-refundable subsidy, it means that only one out of every two euros available are used, resulting in lower R&D and the lower mix of public and private research. We believe that orienting public aid towards non-repayable subsidies (as Germany does) would help increase the volume of private investment. These, in turn, should translate into significant positive externalities: new patents and increased productivity would allow the State to recover the 'lost' money it invested initially.

¹⁴⁹ Generally speaking, public-private investment programmes have been the most successful, Israel or New Zealand for instance. Cfr. Lerner, (2010). Other key recommendations for successful public initiatives from this report are: 1) resist the temptation to establish excessive requisites or barriers that limit the flexibility of entrepreneurs or investors, 2) take advantage of the local expertise, scientific and academic, 3) recognise the long-term horizon associated with returns on public initiatives, 4) avoid initiatives that are too large or too small.

¹⁵⁰ World International Property Organization, (2017)

Second: Create a *Spanish Innovation Authority*, independent from political power

As we have already mentioned, the Office of the Chief Scientist (OCS) was key to boosting Israel's innovation plans (CSO), with medium-term targets, and autonomy from political power. Successful ecosystems have proven that specialisation is key, therefore the investment effort should not be homogeneous across autonomous communities, in our opinion, but focus on those areas that present a competitive advantage. Hence, an IEA figure, not linked to political power – as is the Governor of the Bank of Spain – could set innovation objectives, allocate financial resources based on actual needs, and detect the competitive advantages of each location to create specialized hubs, free from any pressure from local authorities. The Israeli case illustrates that this is a good choice.

Third: Promote University Technology Transfer Offices (TTOs)

We have seen how Israel has successfully developed university offices whose mission is to connect innovative research developed by either of its nine research universities with multinationals that can make commercial use of the research. Technology Transfer Officers travel the world matching supply with demand, bringing home lucrative royalty deals that enrich the researcher, the university and the TTO itself. In our opinion, there is much room for improvement in Spain in this regard. The office also communicates market needs to researchers, so that they can focus on finding solutions to global needs. Moreover, the financial incentive spurs the transfer of scientific knowledge (papers, in which Spain fares well) through patent generation (in which Spain performs poorly).

Fourth: Promote research dialogue among companies, VC firms and start-ups

All the successful ecosystems analysed show that when these stakeholders stay in close interaction, the production of innovation soars.¹⁵¹ This is precisely one of Spain's main weaknesses.¹⁵² Pioneering initiatives such as that of the 'Green Ray' in Málaga, a building sponsored by the University of Málaga where all three players (University, Industry, and Government) coexist and collaborate. This type of initiative should be modelled by universities across the country. Cambridge Innovation Capital is another fruitful example of academia spurring innovation, in this case the University being the largest shareholder of the VC fund.¹⁵³

4.3. Ideas to improve the entrepreneurial culture

First: Make success stories visible and support them publicly

A renowned executive of the Spanish VC sector interviewed for this report stated, "Spaniards are not afraid of failure, they are afraid of success!" while citing prominent examples of start-ups that have battled intense public scrutiny and social criticism. For instance, the young founder of Glovo, Oscar Pierre, a graduate from the Universitat Politècnica de Catalunya (a public institution that is neither an elite institution nor inaccessible to the bulk of the population), would probably be a paradigm of entrepreneurship and admired in other countries for having been able to create a service of real utility and more than 800 permanent jobs (apart from over 21,000 temporary delivery driver jobs). However, an Internet search for his name makes clear the negative bias of public opinion in Spain (and how foreign media is much more admiring of the young founder). The GEM Index ranks Spain among the last European countries (only above Greece) in terms of

¹⁵¹ Israel has a free search engine that allows you to find any innovative company in the country, as well as know more specific data such as funding rounds, equipment, ratings, statistics, graphics, etc.

¹⁵² We find few examples. Last July, the European University, together with IBM, created the first business and technology school to promote technological talent in Spain. [Link](#).

¹⁵³ Cookson, C. (March 31st: 2019). [Cambridge fund raises £150m in year's largest UK tech round](#). *Financial Times*.

perceived opportunities. Spaniards are at the bottom in terms of entrepreneurial motivation, a result of the above mentioned lack of entrepreneurial culture, as they tend to criticize, rather than support, success stories.

In our opinion, cases of success should be made visible and publicly lauded because success stories are what kick-start a virtuous cycle. New entrepreneurs are encouraged to follow the footsteps of those who have succeeded, who, as we mentioned previously, not only tend to invest large amounts in new ventures, but also provide their invaluable experience. In short, bringing to the spotlight individuals who have been able to successfully implement innovative business models could prompt the required cultural shift to transform Spain into a start-up nation.

Second: Rethink the education system

By the time children entering school today finalise their studies, two-thirds of the available jobs will be radically different than what exists now. Does the education curriculum prepare for this reality? The great challenge of the fourth industrial revolution is the continuous training of workers, which has been key in the success of certain ecosystems analysed in this paper. Many jobs will disappear while others change radically, and since the least qualified workers are those who receive the least continuous training, the problem will exacerbate.¹⁵⁴ In the face of fast-paced innovation, it will be essential to develop cognitive skills such as the desire to innovate and start new ventures, and the capacity to delegate. Presenting entrepreneurship in education as an alternative to the traditional salaried employee approach, may be key to improving our entrepreneurial culture. Currently, no Spanish university ranks among the top ten in Europe graduating founders of companies¹⁵⁵. In general, few Spaniards (less than 30% compared to 70% in the US or 44% in the UK) see opportunities to start up new companies in their environment, a cultural burden also linked to an aversion to failure. In fact, the OECD recommended Spain make advertising efforts to promote entrepreneurial-related studies¹⁵⁶ and about the importance of teaching students to overcome the fear of failure. By changing the traditional 'graduate and get a job' mentality, more Spaniards would see and pursue opportunities for entrepreneurship.

Third: Promote equity-financed studies

Undertaking a technical PhD or Master's degree in fields such as artificial intelligence entails a substantial financial investment that is usually affronted with loans. Repaying those loans then ends up conditioning the student's future job decisions, forced to go for a low-risk option instead of potentially embarking on an entrepreneurial venture. Back in the 60's, Friedman proposed an equity-based financing scheme, so that the lender takes a percentage of the person's income, whatever the amount may be, instead of a fixed repayment. The economic viability of such a scheme should obviously be developed on a case-by-case basis, but the proposal seems attractive enough.

¹⁵⁴ Recently, Indra admitted that it had problems finding certain employee profiles to cover 800 positions, even though more than three million are unemployed in Spain. DigitalES, has determined that it won't be possible to fill 1000 jobs due to the low qualifications of job applicants. [Link](#).

¹⁵⁵ Atómico, (2018).

¹⁵⁶ OECD, (2015).

4.4. Ideas to improve the business environment and regulatory framework

First: Help expand the business sector

There exists a direct correlation between company size and productivity. In absolute terms, large firms invest more in innovation than small firms despite assigning small percentages of their budget to R&D. Removing the red tape barriers that hinder business growth in Spain is a must to generate innovation-prone investment ecosystems. Not always regulatory, company growth is sometimes hindered by cultural issues. Many Spanish SME owners are reluctant to give up or share control of 'their' companies via a merger or an acquisition. Changing this mentality requires tax incentives that encourage the type of deals that increase the size of companies, for example, examining the treatment of capital gains generated by the sale of a company, according to the company's profile.

Second: Relax the rigidity of the labour market

There is a direct relationship between the rigidity of a labour market and the level of entrepreneurship in an economy. Spain should model its labour regulation after those countries with higher rates of entrepreneurial success. Legislation must adapt to new business models, not the other way round. Fiscal incentives such lowering the tax burden associated with hiring or dismissing employees (to a certain and reasonable extent) are one concrete way that this can be achieved.

Third: Promote visas for skilled foreign workers wanting to become innovative entrepreneurs

One third of innovative start-ups in Europe are founded by high-skill immigrants and two-thirds of innovative entrepreneurs hold postgraduate degrees. Foreign talent, especially when the local ecosystem lacks certain skill sets, can be necessary for the growth of a company. Therefore, restricting qualified immigration is very short-sighted. We propose the creation of a 'talent passport', in line with what France has been doing since 2016, which allows different types of visas for entrepreneurs, workers and investors, includes a fast-track residence permit and access to mentorship at designated business incubators and accelerators. Spain captures 6.7% of all technological jobs outsourced to Europe (ranked 4th after the United Kingdom, Germany and France), and 8.7% of worker transfers within Europe, behind the United Kingdom and Germany.¹⁵⁷ Capitalising on the fact that Spain is already an attractive destination (low-cost, high-quality of life), eliminating bureaucratic obstacles that prevent companies from attracting the foreign talent they need, as most of the experts we have conferred with have expressed, would be a huge boon to the quality of human capital within the Spanish ecosystem.

Fourth: Remove barriers to market unity

Israeli start-ups understand from the get-go, given the tiny size of their domestic market, that the entire world is their target market. Spain has a significantly larger domestic market, but the countless local regulations (which are also subject to continuous change) means it is really 'many little Israels'. In addition, Spain is known for its high barriers of entry (sometimes due to well-intentioned regulations mistakenly designed to 'protect' SMEs), which limit entrepreneurial competition. Efforts must be made to standardise local and European regulations so that Spanish start-ups are born with a clear vision of market expansion.

¹⁵⁷ Atómico, (2018).

Fifth: Analyse the wage insurance option

Robert Shiller, a Nobel laureate in economics, has long advocated for 'wage insurance' schemes. By paying a small premium on their wages, workers can cash out an insurance policy if they are fired or change to a lower paying job in order maintain their previous earnings level. Obviously there are some issues with this type of scheme, as it can encourage workers to take less demanding positions, but in general, having the financial freedom to quit a high-paying job would likely encourage a lot of high-skilled workers to launch their own ventures.¹⁵⁸

Sixth: Bringing digital transformation to bureaucracy

Spanish entrepreneurs complain fiercely about the time they waste having to jump through bureaucratic hoops. Spain, notorious for requiring even the most basic legal documents to be signed before a notary, should bring its bureaucracy into the digital age, similarly to the State of Delaware,¹⁵⁹ a move that could significantly reduce barriers of entry into the market. One measure of success here would be to reduce the time needed to incorporate a company from six days in the medium term, to two in the long term.

Seventh: Improve the taxation of stock options, since they 'finance' talent attraction

High-quality human capital, as we have mentioned throughout, is essential for the development of start-ups. These early-stage firms usually lack the financial resources needed to attract talent by offering competitive wages. Stock options are a crucial tool to draw in and retain employees,¹⁶⁰ and therefore pivotal for their development.¹⁶¹ In 2015, the legislation ruling stock options was tightened, and companies must offer now the same scheme to all workers, who are taxed twice: the first time when the options are exercised (capital gain or loss for the difference between the strike price and the market value), and the second, when they are sold and classified as ordinary wage income. It makes little sense for stock option regulation to be uniform for large companies and start-ups. In our opinion, taxation on stock options should be revised and the double taxation as ordinary income, removed. With this simple change, Spanish start-ups would have it much easier to attract the expensive, high-skill talent they need, and would also encourage the phenomenon of 'entrepreneurial recycling' discussed previously, in which a successful entrepreneur reinvests their exit proceeds into new ventures.

Eighth: Improve conditions to move up in global competitiveness rankings

The Global Competitiveness Index, elaborated by the WEF, analyses four main areas of an economy: the enabling environment, human capital, the market and its innovative ecosystem. These areas are composed of several sub-pillars that deepen the understanding of how countries are performing in each area. The index places Spain in 26th position out of 140 (bearing in mind that Spain ranks 16th in GDP), much further down than European countries such as Germany (3), Switzerland (4), Holland (6) and the United Kingdom (8). At least, Spain is ahead of Italy (31) and

¹⁵⁸ Thomas, M. (April 4th, 2006). [Shiller: Livelihood Insurance](#). *Economist's View*.

¹⁵⁹ The State of Delaware allows all bureaucratic procedures required for the formation of a legal business to be done online. There is no need to contribute initial capital, or even to have a physical address in the state. The whole process takes less than two days.

¹⁶⁰ A type of remuneration that designates part-ownership of the firm to the employee. It consists of the acquisition of company shares for a lower price than market value.

¹⁶¹ Hanrekson y Sanandaji, (2017).

Portugal (34). However, a closer inspection of each individual area will help us understand which aspects should be improved in order to increase the global competitiveness ranking.

- **Environment.** The Global Competitive Index highlights Spain's intense administrative and bureaucratic burden as its main area for improvement. The nation ranks 120th out of 140 in terms of the financial capacity of businesses to meet legal requirements regarding permits, regulations, reporting, etc. Moreover, such requirements do not facilitate, and actually hinder, the creation of new companies, as shown by the country's position in the ranking of time needed to create a company (81th out of 140 in WEF's ranking). The government also needs to improve its adaptability to disruptive business models, such as e-commerce and fintech. By this measure, Spain ranks 89th out of 140.
- **Human capital.** The WEF index places Spain in a modest 37th position out of 140, its main weakness being related to the quality of the education system and poor technological literacy of the population (71st out of 140). Technological disruption is outpacing government reform, which should have already pushed improvement in technological skills. As a result, the Spanish tech sector lacks workers with deep technological experience, and that have the capacity to pioneer new technologies in new markets.
- **Market.** The heavy tax and regulatory burden is another one of Spain's major drawbacks, the impact of which is measured by the ranking of 'distortive effect of taxes and subsidies on competition', in which Spain ranks (106th out of 140). Additionally, the tax burden is a significant barrier that results in (i) foreign companies choosing other alternatives in Europe to set up subsidiaries, as there are much cheaper options than a 25% corporate tax rate (Ireland's is 12.5% for example); (ii) companies not investing in human capital (WEF ranks Spain 132th of 140 in terms of labour tax burden); (iii) entrepreneurs refraining from embarking on disruptive ventures, since the regulatory burden can come down hard on toe-stepping companies (Spain ranks 120th out of 140 in terms of regulatory burden).
- **Innovative ecosystem.** Spain lacks entrepreneurial culture, both at the enterprise and individual level. Spain's large and established firms are not heavy investors in innovative R&D. WEF ranks Spain 96th out of 140 in this respect. The effect of culture on individuals in Spain is that they are generally afraid of failure, and lack a strong motivation to undertake risky ventures. WEF, in this regard, ranks Spain 89th. All of this has an effect on Spain's patent production, which as we have seen, is far below the levels in the other large European economies.

5. Conclusion

Stringing together the main ideas of the report, the first notable mention is the idea that productivity is the most sustainable driver of an economy, especially when the population is declining. Greater productivity fuels social welfare through the combination of wage and corporate profit increases, and reduces inequality, which secures lasting 'social peace'. At the same time, we have argued that productivity is mainly driven by innovation, and that entrepreneurship has a deep impact on innovation; in fact, high-growth enterprises are responsible for an enormous percentage of new jobs created. The outsized impact of entrepreneurship on prosperity is what has led us to this in-depth analysis of Spain's margin for entrepreneurship improvement. To this end, we have studied entrepreneurship's main determinants and the most relevant success stories from across the world, as well as how Spain is positioned in order to detect major areas for improvement. We conclude the report with a set of practical recommendations for Spain, with the aim of helping boost the country's prosperity.

The most successful start-up ecosystems detected and herein analysed are Silicon Valley and Boston-Cambridge in the US; Israel; and Zhongguancun in China. The main determinants of entrepreneurial success identified are:

- Proximity and close interaction between key stakeholders (government, academia, private sector, VC, start-ups).
- Creation and dissemination of knowledge (finding profitable applications to patents).
- Easy access to financing throughout the entire chain, from BA to PE to stock markets (VC).
- Favourable institutional, regulatory and fiscal framework (sturdy and aligning incentives).
- Quality human capital (with a suitable educational and entrepreneurial profile).
- Entrepreneurial culture (sincere social recognition of the entrepreneur).
- Easy access to markets. Favourable environment implies limited business concentration, low unemployment, high GDP and income per capita, and homogenous regulation across autonomous communities.

After analysing the determinants of entrepreneurship and quantifying the main areas where Spain must improve, we have outlined a number of useful recommendations. Shortage of financing at a national level, and throughout all stages of a company's growth (but especially the early entrepreneurship and late scale-up phases), is undoubtedly the largest concern. The critical scale-up phase is when a new company really starts to gain momentum and capital requirements increase significantly, so if there isn't enough capital available, the venture risks failing prematurely and unnecessarily. Spain is also falling behind in generation and dissemination of knowledge, meaning it should work to increase the number of patents issued and their effective applications, as measured by the balance of royalties. Also worth mentioning for their need for improvement and importance to an ecosystem: the physical and collaborative proximity of key stakeholders, the formation level of human capital, and the fiscal-regulatory framework. Our related proposals are as follows:

- Facilitate the investment of pension funds and insurance companies in VC.
- Promote corporate venture capital (CVC) funds.
- Implement regulations that positively discriminate VC.
- Encourage investment in R&D via non-refundable public subsidies.
- Bring down barriers to market unity.
- Promote and facilitate the virtuous circle of entrepreneurship.
- Attract technological talent.
- Create an independent Spanish Innovation Authority.

- Promote university technology transfer offices.
- Facilitate proximity and dialogue among industry, academia and the military.
- Reform the educational system.
- Publicly support and visualise success stories.

By not doing anything, Spain is cheating itself in a game of Solitaire. Technological disruption is an unstoppable force that will transform our society, putting at risk a countless number of jobs in the short term, especially those that are low-income and low skill. The US and China are clearly overtaking Europe, and Spain lags Europe. Spain doesn't have the option to not promote entrepreneurship, it is a necessity to increase the nation's prosperity and should be independent of partisan ideology (Sweden, a social democracy, and the US, a neoliberal nation, similarly have promoted and excelled at producing innovative technology and high-growth enterprises). Therefore, Spain is in the position where consensus much be reached in order to quickly implement policy that supports entrepreneurship, before it falls further behind.

We all carry the entrepreneurial flame within us. Entrepreneurship is repressed at a large scale. Even in the poorest countries, 25% of population affirm wanting to become entrepreneurs.¹⁶² The issue though, is supporting that ambition through efficient management of the available human and financial resources. It is no easy task, but throughout this report we have attempted to provide ideas and considerations to that aim. The Hamilton-Mann-Perkins equation states: "innovation plus education, plus a social safety net, equals the sum of prosperity".

Is that not what we wish to achieve?

¹⁶² Blanchflower y Oswald, (2000). In countries like the US, Poland and Portugal, the ratio was around 70%.

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Arcano Alternative Markets S.L.U.

José Ortega y Gasset 29, 4^a planta

28006 Madrid

+34 91 353 21 40

www.arcanopartners.com