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FOUNDING TEAM CHARACTERISTICS AND PERFORMANCE OF EUROPEAN STARTUPS IN THE NEW SPACE INDUSTRY

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Founding team characteristics and performance of European startups in the New Space industry

This study examines the effects of founders' prior experience on the fundraising capabilities of startups in the context of a high-tech industry undergoing significant structural changes. We explore four combinations of founders' prior experiences: experience in the same industry, entrepreneurial experience, academic experience, and technical background. Using data from 239 European startups in the New Space Industry, operating both in the upstream and downstream segments, we find that a strong presence of previous experience from the traditional space sector does not facilitate new startups in fundraising. Conversely, the presence of technical expertise in the team enhances greater funding for these new ventures.

1. Introduction

In recent years, the global aerospace industry has undergone a structural transformation driven by several concurrent factors. These include the deployment of new technologies (de Concini & Toth, 2019), shifts in the roles of international space agencies, and changes in the geopolitical landscape (OECD, 2022).

Specifically, the reduction in space access costs and the development of new satellite platforms have significantly expanded entrepreneurial opportunities across the space infrastructure value chain and in the realm of services utilizing space data (Rodriguez-Donaire et al., 2022). Furthermore, the emergence of novel public-private collaborations and a reorientation of space agencies towards fostering market-creating innovation to address societal challenges and global trends (Robinson & Mazzucato, 2019) have opened up further avenues for new ventures. The impact of these burgeoning entrepreneurial opportunities is evident in the increasing number of new ventures in the space industry globally. Indeed, the number of startups founded in the sector has surged by 80% between 2014 and 2024 (according to dealroom.com, with 1549 startups founded before 2014 and 2800 between 2014 and 2024). This growing interest is mirrored in the substantial rise in funding received. For instance, venture capital funding in European Space

Tech startups has soared from 85 million euros in 2012 to 1.2 billion euros in 2022 (Dealroom, 2022), with investments evenly distributed between upstream and downstream activities. In the period from 2020 to 2022, Europe accounted for 20% of global VC investment in Upstream Space Tech.

Significantly, the technological evolution in the realm of space activities increasingly relies on the integration of diverse knowledge domains, spanning from advanced software solutions based on artificial intelligence to materials sciences, electronics, quantum communication systems, advanced manufacturing processes, and robotics. Strategic entrepreneurship theory suggests how the management of innovation projects, which capitalizes on the integration of diverse technical skills within an evolving industry characterized by new business models, may be substantially influenced by the diversity in the educational and professional backgrounds of founding team members (Brown et al., 2019; Ireland et al., 2023).

The human capital paradigm posits that founders' competencies form the foundational elements for addressing challenges related to the formation and development of startups (Bell et al., 2011; Colombo & Grilli, 2005; Lazar et al., 2020; Mathieu et al., 2019). The effective combination of team members' competencies, knowledge, and skills stands as a critical asset that can lead a new venture to success. When establishing a new venture, one of the most challenging aspects for entrepreneurs is selecting partners to collaborate with (Forbes, 2005; Reese et al., 2021). Research and entrepreneurial practice suggest that new venture teams with greater diversity in knowledge and backgrounds tend to perform better (Jin et al., 2017; Lazar et al., 2020). This diversity, encompassing various skills, experiences, and characteristics, is often viewed as essential for the survival of the company and is considered a fundamental driver of innovation and success (Honore, 2015; Kristinsson et al., 2016). Therefore, examining the composition and characteristics of teams provides a unique opportunity to understand how new firms navigate initial challenges and barriers during the development process (Der Foo et al., 2005; Lazar et al., 2020). Specific skills of team members have proven crucial in identifying and managing challenges associated with recognizing emerging opportunities (Reese et al., 2021). A team with diversified and comprehensive skills possesses greater ability to handle complex situations, manage internal issues, external competition pressures, and adapt to structural changes in the industry the new firm enters (Samuelsson, 2009; Baard et al., 2014; Mathieu et al., 2019). Consequently, studying the capabilities required to navigate these challenges becomes increasingly relevant. The key to effectively addressing structural changes and

industrial dynamics encountered by all firms lies in the diverse array of competencies and skills within the entrepreneurial team. Therefore, exploring the relationship between entrepreneurial knowledge and skills concerning entrepreneurial success and industrial dynamics is crucial (Cubico et al., 2018; Pennetta et al., 2023; Unger et al., 2011).

New ventures typically operate with limited resources, lack established internal norms, and have few established relationships with external stakeholders such as customers and suppliers (Kazanjian, 1988). Consequently, founders exert significant influence as they guide their new ventures through the entrepreneurial process to establish a company capable of competing in the market (Bruns et al., 2008; Jin et al., 2017). Therefore, founders' human capital significantly influences their ability to address the challenges involved in leading and developing a new venture (Davidsson & Honig, 2003; Grilli et al., 2020; Hashai & Zahra, 2022). Moreover, these businesses are novel within their sectors, unencumbered by rigid routines, usually facing fewer difficulties in organizational coordination, and thus more agile and responsive to external and structural changes in the industry.

Based on these considerations, this work explores the role of entrepreneurial teams' characteristics in facing and exploiting structural changes in the industry and investigates how those characteristics are linked to new venture's performance. We focus on new ventures considering their nature, in fact they typically start with limited resources, lack established internal norms for appropriate behaviors, and have few established relationships with external stakeholders such as customers and suppliers (Kazanjian, 1988). Consequently, founders wield significant influence as they guide their new ventures through the entrepreneurial process to establish a legitimate entity capable of competing in the market (Bruns et al., 2008; Jin et al., 2017). Therefore, it is to be expected that the human capital possessed by founders significantly influences the ability to tackle the challenges involved in leading and developing a new venture (Davidsson & Honig, 2003; Hashai & Zahra, 2022). Moreover, this type of business is new to the sector, free from rigid routines, usually with fewer difficulties in organizational coordination, and therefore more agile and responsive to external and structural changes in the industry.

The so called "new space economy" represents an interesting setting to complement extant empirical literature and analyze the correlations among the characteristics of founding teams and the performance in the context of a changing industry, in which the traditional paradigms

on research, innovation, product development and revenue models are challenged by the availability of new technologies and a transformation of the institutional setting.

This work seeks to assess whether and to what extent the characteristics and backgrounds of founders are associated to a successful startup in the context of a high-tech industry undergoing such radical transformation. The aerospace industry has been historically characterized by a peculiar structure and value chain dominated by a small set of large companies with a consolidated network of suppliers, which might induce specific challenges for new businesses willing to enter the market. Hence, exploring the role of diversity in founding teams, including the presence of members with previous experience in the same sector, can provide valuable insights for understanding the antecedents of business success. In the paper, we use the total equity fundraising as a metric for the performance of the company, accounting for the timing of its incorporation. The decision to adopt fundraising as a metric for business performance is due to the fact in this industry the product development cycle can be very long and hence the use of revenues or profits might be ineffective. Moreover, a non-negligible share of startups in this domain aims to be acquired by other players even before entering the market.

The paper adds to the few recent studies on the rapidly growing and increasingly relevant new space industry (Lamine et al., 2019; Robinson and Mazzucato, 2019; Fiott, 2020; Rodriguez-Donaire et al., 2022; Vittori et al., 2022). In particular, Lamine et al.'s (2021) study examines the entrepreneurial environment in the space industry, focusing on institutional settings, policies, and actions. The research explores how freedom for entrepreneurship is influenced by these factors within the unique context of the space sector. The findings contribute insights into the interplay of institutional elements shaping entrepreneurial activities in the space industry. The study by Robinson and Mazzucato (2019) investigates the evolution of mission-oriented policies, specifically in the US and European space sector. The research explores the dynamics of changing market-creating policies over time, offering insights into the strategic shifts within these regions. The findings provide valuable perspectives on the development of policies shaping innovation and markets in the space industry. Vittori et al.'s (2022) research investigates business model innovation in the transition from the embryonic to the growth stages of the industry lifecycle. The study provides insights into the dynamics and challenges of implementing innovative business models during these critical phases. The findings contribute valuable knowledge for understanding the evolution of business models in the early stages of industry development.

Based on these considerations, this study delves into the role of entrepreneurial team characteristics in navigating and capitalizing on structural changes within the industry and examines how these traits correlate with the performance of new ventures. Our focus is on new ventures, given their inherent characteristics: they typically start with limited resources, lack established internal norms for behavior, and have minimal relationships with external stakeholders such as customers and suppliers (Kazanjian, 1988). Consequently, founders wield significant influence as they lead their new ventures through the entrepreneurial process to establish a viable entity capable of competing in the market (Bruns et al., 2008; Jin et al., 2017). Therefore, it's reasonable to expect that the human capital possessed by founders significantly influences their ability to address the challenges involved in developing a new venture (Davidsson & Honig, 2003; Hashai & Zahra, 2022). Moreover, this type of business is novel within the sector, unburdened by rigid routines, typically encountering fewer organizational coordination challenges, and thus more adaptable and responsive to external and structural industry changes.

The so-called "new space economy" provides an intriguing context to complement existing empirical literature and analyze the correlations among founding team characteristics and performance within an industry undergoing radical transformation, where traditional paradigms on research, innovation, product development, and revenue models are being challenged by new technologies and institutional transformations.

This study aims to assess whether and to what extent the characteristics and backgrounds of founders are associated with the success of a startup in the context of a high-tech industry undergoing such radical transformation. The aerospace industry has historically been characterized by a distinct structure and value chain dominated by a small set of large companies with established networks of suppliers, posing specific challenges for new entrants. Hence, exploring the role of diversity within founding teams, including the presence of members with prior experience in the sector, can offer valuable insights into the determinants of business success. In this paper, we use total equity fundraising as a metric for company performance, accounting for the timing of incorporation. The choice of fundraising as a metric is due to the lengthy product development cycles prevalent in this industry, making revenue or profit metrics ineffective. Moreover, a significant portion of startups in this domain aims to be acquired by other players even before entering the market.

This paper contributes to the limited body of recent research on the rapidly growing and increasingly relevant new space industry (Lamine et al., 2019; Robinson and Mazzucato, 2019; Fiott, 2020; Rodriguez-Donaire et al., 2022; Vittori et al., 2022). Specifically, Lamine et al. (2021) examine the entrepreneurial environment in the space industry, focusing on institutional settings, policies, and actions, shedding light on how entrepreneurship freedom is influenced by these factors within the unique context of the space sector. Robinson and Mazzucato's (2019) study investigates the evolution of mission-oriented policies, particularly in the US and European space sector, providing insights into the dynamics of changing market-creating policies over time and strategic shifts within these regions. Vittori et al.'s (2022) research explores business model innovation in the transition from the embryonic to the growth stages of the industry lifecycle, offering insights into the dynamics and challenges of implementing innovative business models during these critical phases. These studies collectively enhance our understanding of the new space industry's evolution and its implications for entrepreneurship and innovation.

Based on these considerations, this work explores the role of entrepreneurial teams' characteristics in facing and exploiting structural changes in the industry and investigates how those characteristics are linked to new venture's performance. We focus on new ventures considering their nature, in fact they typically start with limited resources, lack established internal norms for appropriate behaviors, and have few established relationships with external stakeholders such as customers and suppliers (Kazanjian, 1988). Consequently, founders wield significant influence as they guide their new ventures through the entrepreneurial process to establish a legitimate entity capable of competing in the market (Bruns et al., 2008; Jin et al., 2017). Therefore, it is to be expected that the human capital possessed by founders significantly influences the ability to tackle the challenges involved in leading and developing a new venture (Davidsson & Honig, 2003; Hashai & Zahra, 2022). Moreover, this type of business is new to the sector, free from rigid routines, usually with fewer difficulties in organizational coordination, and therefore more agile and responsive to external and structural changes in the industry.

The so called "new space economy" represents an interesting setting to complement extant empirical literature and analyze the correlations among the characteristics of founding teams and the performance in the context of a changing industry, in which the traditional paradigms

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contribute valuable knowledge for understanding the evolution of business models in the early stages of industry development.

Our empirical analysis is based on a novel dataset created using multiple data sources at the company level and individual entrepreneur level, using Dealroom.com, LinkedIn and company websites as primary data sources. These data allow a general overview of the dynamics of entrepreneurship in the new space industry in Europe. We contribute the literature on entrepreneurship mapping the presence of four main types of competencies based on previous experiences (generic previous entrepreneurial experience, previous work experience in other companies in the aerospace sector, previous academic experience, and technical experience based on educational curricula) and correlating them with fundraising performance, controlling for the domain of application (whether upstream or downstream). The paper is structured as follows. In Section 2, we discuss the key economic features of the new space industry and we introduce our research hypothesis. The sample and variables description are provided in Section 3. The econometric are presented in Section 4. In Section 5 we provide discussion of findings and related implications by a managerial perspective.

2. Theory and Research hypothesis

2.1. New Space industry

The Space Economy, as defined by the OECD, encompasses a broad spectrum of activities and resource utilization aimed at exploring, understanding, managing, and utilizing space to create value and benefits for humanity. It includes public and private actors involved in various aspects such as research and development, manufacturing and utilization of space infrastructure (e.g., ground stations, launch vehicles, satellites), space-enabled applications (e.g., navigation equipment, satellite phones, meteorological services), and the scientific knowledge derived from these activities. Moreover, the space economy extends beyond the space sector itself, encompassing the diverse and continually evolving impacts of space-derived products, services, and knowledge on the economy and society (OECD, 2012).

In economic terms, the space economy surpassed $469 billion in 2022, according to the latest estimation by the Space Foundation (2022). The Bureau of Economic Analysis (BEA) of the

U.S. Department of Commerce reported that the gross output related to the Space Economy Industry grew from $203.6 billion in 2020 to $211.6 billion in 2021. Growth estimates for the space economy are positive, with forecasts projecting an industry value of over 1 trillion by 2040 (Morgan Stanley, 2020).

The sector has undergone significant structural changes since the early 2000s, driven by advancements in product and process technologies, as well as the influx of new private players into the market (Fiott, 2020). Factors such as the reduction in space access costs, increased availability of new satellite platforms for earth observation or telecommunications, miniaturization of space assets, advancements in manufacturing techniques, development of in-orbit servicing solutions, and application of AI software for space operation automation have created new opportunities for innovative product and service development, underpinned by novel business models in both the upstream and downstream sectors.

This evolving global context of the space economy presents challenges to traditional large companies operating in the sector, while simultaneously offering new opportunities for SMEs and startups, fueled by the anticipated expansion of the market in the coming years.

The European Parliament underscores the pivotal role of the space sector in the EU economy, asserting that investments in space capabilities are crucial for the EU's overarching objective of achieving strategic autonomy in space. Without sustained investment in ambitious space initiatives and cutting-edge space technologies, alongside concerted efforts to reduce the EU's industrial dependence on critical resources, the broader goal of EU strategic autonomy will remain highly challenging to attain (Fiott, 2020). Both NASA and ESA acknowledge the importance of future space exploration and the essential role that private enterprises will play in the future development of the space economy. Consequently, both agencies are actively fostering support for startups and companies within their respective spheres of influence (Bell, 2013). Recent technological advancements and evolving market dynamics have indeed opened up new avenues for conducting business within the space industry, giving rise to a new generation of companies. In the traditional space economy, the market structure was highly concentrated, primarily relying on government procurement to address major aerospace firms. The emergence of the New Space paradigm involves private companies sharing both the risks and potential rewards associated with space investments (Achenbach, 2013). This shift has seen agencies such as NASA relinquish some control and expand their boundaries to collaborations with private entities (Weinzierl, 2018). As institutional entities actively facilitate the

involvement of private players in the space sector through financial support and partnerships, the pace of innovation has significantly accelerated (Vittori et al., 2022).

2.2. Upstream and downstream segments

The New Space industry can be broadly categorized into two main sectors. The first, known as the upstream sector, encompasses activities related to the creation of space infrastructure. This includes tasks such as research and development, manufacturing of spacecraft, satellites, and launch systems, as well as their deployment and management. The second sector, referred to as the downstream sector, primarily involves activities that utilize the data generated by the space infrastructure (OECD, 2012, 2020). These activities include functions such as broadcasting, telecommunications, navigation, and earth observation, as described by the European Space Policy Institute (2015). The target markets for services enabled by space data range from environmental monitoring to precision agriculture, insurance, and logistics systems.

The upstream technology mainly involves hardware components, is more science-based, and typically requires higher investments over a longer time period. Consequently, upstream projects are expected to be more capital-intensive. A subset of upstream startups has focused on developing new technologies and solutions with potential dual-use applications, offering exploitation opportunities beyond the space industry. Historically, numerous technologies and inventions initially created for the space industry have found applications in other contexts. For example, solar panels developed for space missions led to the development of high-efficiency solar panels used in terrestrial applications. Flame-retardant fabrics originally used in space suits to protect astronauts from high temperatures during re-entry into the atmosphere were later adopted in areas such as fire protection and the aerospace industry. Aerogel, initially used in space missions to capture comet and asteroid particles, now finds applications in thermal and acoustic insulation in construction and buildings[1].

A specific challenge for startups operating in the upstream segment is related to developing a business model with recurring revenue streams, primarily due to the high product specificity

[1] The phenomenon of the dual use of inventions from the space sphere to others continues to occur. There are currently energy solutions for high-performance instrument batteries designed for spacecraft, which could also find application in other areas. A further example is Rea Space (https://reaspazio.com), the start-up company that produces spacesuits capable of stimulating the musculoskeletal system to prevent the atrophy of astronauts' muscles, which could also be used in hospital rehabilitation. Inventions destined for space could improve some already established practices on Earth, such as the one proposed by Space V (https://www.spacev.bio), which is at the forefront of designing and studying state-of-the-art equipment for growing plants in orbit.

and long sales cycle. Upstream ventures rely heavily on market demand associated with space programs and missions financed by government space agencies.

In terms of scalability, upstream ventures tend to exhibit lower scalability on average, as their business often revolves around the development of highly specific components or solutions, catering to a limited number of companies in the space industry. Consequently, entrepreneurial projects in the upstream segment are closely linked to technology development activities undertaken by key industry players and require significant integration. As a result, founders must possess a deep understanding of product development dynamics within the industry and the roles played by different large companies. Therefore, previous work experience of founders in the industry emerges as a significant positive factor for the success of an upstream startup.

Conversely, downstream innovations are predominantly service-oriented, with a greater emphasis on software and operational aspects. This orientation typically entails relatively lower capital investment. Downstream ventures generally have higher scalability potential, owing to larger target markets. For downstream entrepreneurial projects, innovations often stem from a knowledge and skills base not exclusively tied to the aerospace industry (e.g., data processing). These ventures frequently involve the combined utilization of space-derived data and data from other sources (i.e., satellite data and in-situ data). The success of innovations in this segment often relies on interdisciplinary expertise, with founders' direct industry experience being less critical. Startups in the downstream segment may encounter fewer challenges in establishing a business model, enabling them to explore various revenue streams and adapt to shorter product life cycles. Table 1 summarizes the main differences between upstream and downstream segment companies, outlining variations in required capital, scalability, revenues, and dependence on the market and the "traditional" space sector.

Table 1 *Upstream and downstream ventures features*

Upstream	***Downstream***

Knowledge base	• More science-based; • Focused on aerospace domain	• Diversified knowledge domains • service-oriented
Capital required	• higher investments over a long time period; • more capital-intensive;	• lower investments over a smaller time period; • less capital-intensive
Scalability	• lower scalability; • Need of integration in the industry supply chain • good understanding of the dynamics related to product development;	• higher scalability; • combined use of space-derived data and data from other sources; • interdisciplinary knowledge and expertise
Revenue model	• not recurring revenue streams often based on the sales of technological components	• revenue streams based on the sale of services
Market demand	• Influenced by international space programs	• Based on specific industrial sector

2.3. Research hypotheses on entrepreneurial teams' characteristics and funding

The study delves into how human and social capital influence the success of startup ventures and their ability to attract investors, particularly within the context of industry change and reconfiguration (Bernstein et al., 2017). The presence of diverse knowledge, skills, and expertise among individuals involved in startups, along with their network of relationships and connections, profoundly impacts the startup's capacity to surmount challenges, establish themselves as new entities in the industry, gain the trust of investors, and ultimately secure funding (Bosma et al., 2004; Unger et al., 2011).

In our analyses, we utilize startup fundraising as the dependent variable. Our research hypotheses aim to elucidate the associations between team characteristics and fundraising capability, while also considering the structural characteristics of the industry, particularly the distinction between upstream and downstream segments.

Below, we introduce and substantiate the set of hypotheses that will be explored in our empirical analyses.

Considering the typical activities of the upstream segment, characterized by orbit launches and satellite manufacturing, the outputs of this segment are significantly expensive, possess long life cycles, and demand considerable design capabilities for space access vehicles, all of which necessitate intensive capital investment (Rodriguez-Donaire et al., 2022).

Hypothesis 1. *Startups operating within the upstream segment are inherently more capital-intensive, necessitating greater financial resources for their operations. As a result, they typically exhibit a higher average amount of funding compared to startups in other segments.*

Existing literature on human capital has extensively analyzed the role of founders of startups who have prior experience working for companies in the same industry, including spinouts (Agarwal et al., 2004; Dahl & Sorenson, 2014; Wennberg et al., 2011). The type of founders' prior work experience can significantly influence their knowledge and skills, whether acquired within the same industry or in different industries (Dahl & Reichstein, 2007; Furr, 2019; Grilli et al., 2020; Honore, 2015; Shane, 2000). The knowledge and connections that founders bring from their previous work experience within the industry, including relationships with suppliers, competitors, and investors, can play a crucial strategic role for the emerging startup. This supports the development of products and services that are more adept at addressing the current and future needs of client companies (Agarwal et al., 2004; Furr, 2019; Reese et al., 2021), thereby enhancing the startup's competitiveness and facilitating access to substantial funding (Baptista et al., 2014; Hashai & Zahra, 2022; Wennberg et al., 2011).

A positive association between the presence of experience in the space sector and the amount of funds received can be explained by the unique characteristics of the industry (Chandler et al., 2005; Marvel et al., 2016). The space industry is highly specialized, demanding domain-specific skills and knowledge intricately linked to the sector (OECD, 2022). Therefore, the presence of founders with experience in this sector within startups is expected to be positively evaluated by investment funds. Hence, we posit that:

Hypothesis 2a. *The presence of team members with past work experience in the space sector is positively correlated with the startup's ability to attract investment funds.*

In this context, a different consideration arises. While founders' backgrounds from the same industry may offer a competitive advantage to the startup by providing insights into the industry, it could also introduce a bias towards less disruptive innovations. Founders' prior work in the same industry might lead to rigidity (Wadhwa et al., 2011), potentially entrenching competencies (Dencker et al., 2009) that hinder the startup's development (Hashai & Zahra, 2021).

A negative association between experience in the space sector and fundraising performance may reflect the dynamics of the new space sector compared to the traditional aerospace industry. Investors typically seek disruptive businesses with high growth potential. A significant presence of team members from the aerospace industry may be associated with relatively traditional projects still embedded in the old aerospace industry paradigm. Consequently, these projects may have less scalable business models and be less attractive to investors (Bernstein et al., 2017). Therefore, a higher incidence of members from the same industry may be linked to lower capabilities to identify and pursue disruptive innovations that challenge operational routines and business models in the industry (Gustafsson et al., 2016). These considerations lead to the following hypothesis:

Hypothesis 2b. *The presence of team members with past work experience in the space sector is negatively correlated with the startup's ability to attract investment funds.*

Numerous empirical studies have analysed academic entrepreneurship (Agarwal & Shah, 2014; Lazar et al., 2020; Rasmussen, 2011; Rasmussen & Borch, 2010; Rothaermel et al., 2007). An academic entrepreneur operates within a scientific context and plays a crucial economic role in translating research-based innovations from universities, national laboratories, or scientific institutions into commercial goods and services (Agarwal & Shah, 2014). Founders originating from the university context can effectively leverage the networks within their academic institutions to access highly specialized competencies. Given the high-tech nature of the solutions proposed by startups in the new space industry, we hypothesize that:

Hypothesis 3. *The presence of team members with university experience is positively associated to capital fund raising.*

The presence of entrepreneurial competencies within the founding team of a startup ensures the skills and knowledge necessary to identify new opportunities (Brown et al., 2019; Gruber et al., 2015; Reese et al., 2021). Furthermore, these competencies are crucial for determining how to realize these opportunities in a new or evolving context, where established structures or consolidated knowledge may be lacking. Having founders with entrepreneurial competencies within the team helps the startup navigate the challenges that a new venture must face and create the right synergies for success. We suggest that having at least one serial entrepreneur within the founding team will be positively evaluated by investment funds, thus facilitating the financial raising of startups (Westhead et al., 2005).

Hypothesis 4. *The presence of entrepreneurial skills is positively associated to capital raising.*

In literature, it's acknowledged that the characteristics of founders, hypothesized to promote the success of new ventures, may not be sufficient to fully explain the processes underlying the formation of startups. Previous research has highlighted the importance of considering not only entrepreneurial and industry-specific skills but also more narrowly technical and technological skills (Gruber et al., 2015; Reese et al., 2021). Individuals with functional experiences in the technology field offer a unique perspective when evaluating the attractiveness of business opportunities (Arvanitis & Stucki, 2012; Conti & Roche, 2021; Savage & Ziedonis, 2024).

A strong background in technology, coupled with specific cognitive and thought structures, equips founders predominantly with technological skills and provides them with suitable methods and tools for problem-solving in a technical context. Consequently, technical skills facilitate the development of the business across its life stages, enabling founders to address the numerous challenges and difficulties that startups inevitably encounter (Reese et al., 2021).

Hypothesis 5. *The presence of technical competencies among founders is positively associated to capital raising.*

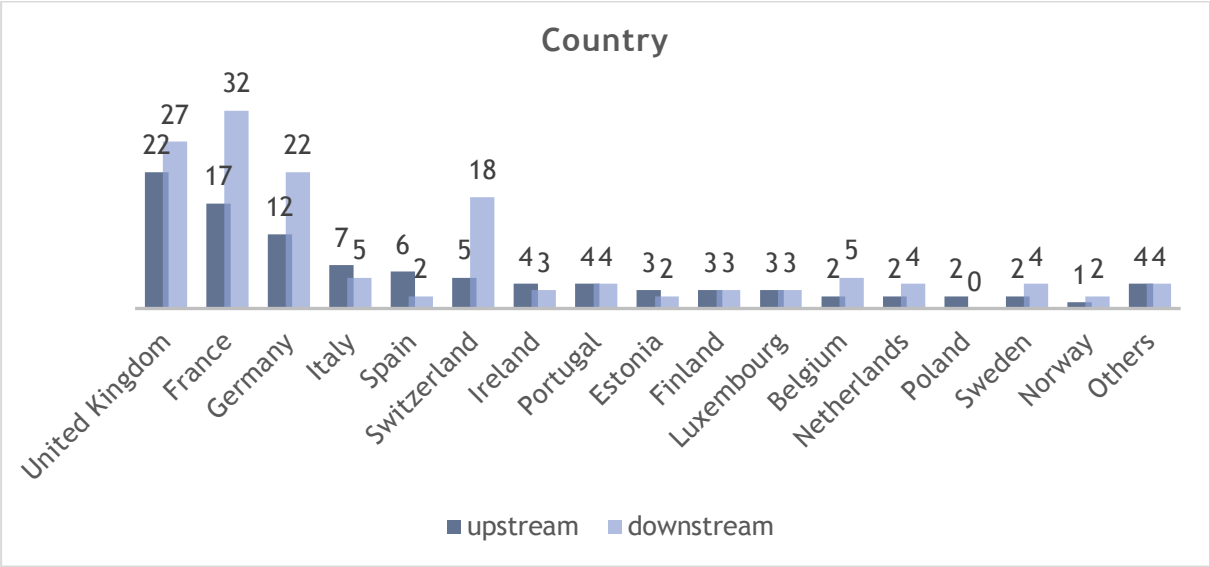
3. Sample and variables

The analyzed sample of European startups was compiled using the Dealroom.com database as the primary data source. To be included in our analysis, startups had to meet four specific criteria. Firstly, we exclusively considered startups based in the EU operating within the NewSpace economy sector. This was determined using the industry classification provided by Dealroom, supplemented by the inclusion of startups that have been incubated in European business incubation centers affiliated with the European Space Agency (ESA BICs). Secondly, we limited the sample to companies founded since 2013 that had raised at least 1 million Euro in equity by 2023. Startups meeting this criterion had demonstrated a certain level of validation and undergone an initial evaluation process by investors, providing a richer and more readily expandable information set. Finally, in line with our research objectives, we excluded startups founded by a single individual entrepreneur, as they would not allow for the analysis of entrepreneurial team composition.

Applying these criteria resulted in a final sample of 239 companies. For each startup, we collected detailed data on the type of product or service offered to classify them as operating in the upstream or downstream segment of the new space industry. The sample comprises 103 companies operating in the downstream segment and 136 in the upstream segment. Additionally, we gathered data on the geographical location of headquarters, equity fundraising activity (including the number of investment rounds and details of investors), and a range of descriptors about the founding teams. Specifically, information was collected from DealRoom.com, LinkedIn, and companies' websites regarding the work and educational backgrounds and experiences of each founding team member.

Figure I illustrates the geographical distribution of startups based on their headquarters, with France, the United Kingdom, and Germany having the highest numbers of both upstream and downstream startups.

Figure 1 *Startups headquarter by country.*



All the startups analyzed have raised at least 1 million Euro in one or more investment rounds. For each round, we collected data on the investors involved. Table 2 illustrates the incidence of different types of investors among the upstream and downstream subsamples. Interestingly, approximately 47% of upstream startups and 59% of downstream startups have received investments from other companies, highlighting the significance of open innovation practices by larger firms in the sector. Additionally, angel investors appear to play a role for a non-negligible fraction of startups in both the upstream and downstream segments.

Table 2 *Number and incidence of startups in the sample that have received funding by different typologies of investors.*

	Upstream startups		**Downstream startups**	
Investor type	**Freq**	**%**	**Freq**	**%**
Angel Investor	43	31.62	75	36.95
Business Accelerators	94	69.12	149	73.40
Corporate	64	47.06	119	58.62
Venture Capital Funds	122	89.71	185	91.13

The following table summarize the definition of the variables used in our analyses. Variables are defined at entrepreneurial team level by adding the contribution of each team member.

Table 3 *Definition of independent variables.*

Variable	Definition	Reference
Location	European country where the startup was incorporated	(Chatterji et al., 2017a; Dahl & Sorenson, 2012)
Year of foundation	Year in which the start-up has been founded	(Chatterji et al., 2017a)
Funding	Amount of total equity funding collected by the start-up since the foundation to year 2022 (Log of Euros)	(Camuffo et al., 2019)
Number of founders	Number of persons in the original founding team	(Lechler, 2001)
Space experience	Number of founders per each startup team having a previous working experience in other established companies in the aerospace sector	(Chatterji et al., 2017)
Entrepreneurial experience	Number of founders per each start-up having already founded a startup	(Chatterji et al., 2017)
Academic experience	Number of founders per each startup having university experience (research activity as PostDoc, Research Fellow or Professorship)	(Baum & Silverman, 2004)
Technical experience	Number of founders per startup having a technical academic background (STEM master or PhD)	(Gimmon & Levie, 2010)
Work experience	Number of total work experiences for different employers of the team members	(Der Foo et al., 2005)
Upstream	Dummy variable that equals one for the startups operating in the upstream segment	

Table 4 presents the descriptive statistics of the variables for the sample startups, divided between upstream (40% of the sample) and downstream (60% of the sample) segments. Although not statistically significant in the sample, the average total funding received by downstream startups is lower than that of startups in the upstream segment. There are notable differences in team backgrounds, with a higher incidence of entrepreneurs having previous work experience in the aerospace industry among upstream startups. Startups in the upstream segment require extensive industry knowledge and diverse skills to develop upstream solutions. The incidence of founding members with past entrepreneurial experience is equal for both segments. In Annex A, we provide the correlation matrix for all the variables.

Table 4 *Summary statistics*

	Downstream startups		Upstream startups	
Variables	**Average**	**St. dev.**	**Average**	**St. dev.**
Funding (Log M €)	1,70	1,24	2,03	1,39
Number of Founders	2,97	1,14	2,73	1,21
Space Experience	0,35	0,71	1,06	1,50
Entrepreneurial Experience	0,52	0,90	0,53	0,81
Academic Experience	0,79	0,95	0,92	0,86
Technical Experience	1,22	1,01	1,13	1,08

4. Analysis

Our analysis aims to investigate the correlation between the characteristics of the entrepreneurial team the startup's ability to attract investment, which in turn can be interpreted as a signal of the potential of the technology and business model developed by the company.

We employ cross-section OLS model specifications to assess such relationship.

In particular, the analyses compare the startups in the different domains and technologies (e.g., upstream vs downstream application domains). Several controls are introduced at the startup level in order to control for factors that can affect the fundraising opportunity of the startup and single-out the marginal contribution of teams' characteristics.

In order to control for heterogeneity of the financial ecosystem for startups located in different geographic areas, we have included country dummies. We also include the year of foundation of the startup in order to control for the fact that younger firms had comparatively lower opportunities to raise funds. The following Table 5 presents the result of regression analysis with different model specifications. Model I is our baseline model in which we consider only the main industry segment through the Upstream dummy variable, the size of the team, the general previous work experiences of the team members and firm-level controls. Model II adds explanatory variables that accounts for previous experience among team members in the space industry, former experience as entrepreneurs, previous academic work experiences and team technical background. As expected, the control variable "Year of foundation" has a negative and significant coefficient as more recently founded companies had, all else equal, fewer chances to collect capital.

In both model specifications I and II the variable Upstream is significant and positive, indicating that upstream startups, on average receive higher funding. This confirms our H1 that start-ups

in the upstream segment are capital-intensive, require more financial resources, and, therefore, need a higher amount of funding. The previous work general work experiences of the team members (Team work experience) although being often adopted as a proxy of human capital in our analysis turns to be non-significant. This might be linked to the peculiar industry framework under scrutiny. In model II the variable that accounts for the presence of serial entrepreneurs in the founding team (Team entrepreneurial experience) is positive but not significant. This might be interpreted as an indication of the absence of a specific certification effect of the quality of the entrepreneurial project conveyed to the investors by the presence of a former entrepreneur. Therefore, our hypothesis H4 is not confirmed, as it seems that the presence of serial entrepreneurs within the founding team does not influence fundraising capabilities in this specific domain.

As expected, new ventures with a strong technical background of the founders are correlated in this industry to higher chances of collecting higher amount of equity investments. The variable "Team academic experience" in model II suggests that an increase in team academic experience is associated with a decrease in the dependent variable. This evidence might reflect that projects carried out by teams that include academic researchers are likely to be more science-based and to face higher technological uncertainties.

Interestingly, in Model II the variable that captures the presence among founders of persons with previous work experience in other companies of the aerospace industry turns to be negative and significant. This observation contradicts conventional expectations, which would suggest that a greater presence of space-related expertise should enhance investments, to the extent that teams with deeper knowledge of business dynamics in the sector should be more effective in dealing with the risk related to the new product and service development and commercialization. On the contrary, this finding appears support our hypothesis H2b, which states that teams with a higher incidence of members from the aerospace industry are more likely to carry on entrepreneurial projects that are less attractive to investors. In order to further address such dynamic, in Model 3 we introduce an interaction effect between the segment focus of the startup (upstream vs. downstream) and the past work experience of the founding members in the space industry. The interaction term has a negative and significant coefficient, indicating the negative association between past experience in the traditional aerospace sector and fundraising is driven by the subset of upstream ventures. These findings seem to indicate that a higher concentration within the team of people from the traditional aerospace industry might be associated with less disruptive innovations and less scalable business models, more closely aligned with established practices in the traditional space industry. Indeed, this is more likely

to be the case in the upstream segment where new companies are more likely to propose incremental technological innovations with a potential role of technology suppliers for larger incumbents adopting traditional business models, more in line with the development dynamics of SMEs rather than the high-growth potential that is required by equity investors. In the case of new services based on satellite data this much less the case. The core competences of the new startups in the downstream segment are linked to software development and the capability to identify new market opportunities. The related business models are more scalable and do not suffer from the risk of non-recurrent revenues as in the case of upstream startups. In this industry segment, we suggest that the risk of "lock-in" in business logics and rationales of the traditional aerospace industry is less relevant, and this is why the negative effect of the Team Space Experience variables is associated with the Upstream startups.

Table 5 *OLS regression models. Dependent variable total equity investments of analyzed startups.*

VARIABLES	**Model 1**	**Model 2**	**Model 3**
Upstream	0.356*	0.651***	0.838***
	(0.205)	(0.221)	(0.251)
Team space experience		-0.273***	-0.0279
		(0.0797)	(0.150)
Upstream* Team space experience			-0.334*
			(0.173)
Team entrepreneurial experience		0.0548	0.0380
		(0.103)	(0.104)
Team academic experience		-0.200*	-0.215*
		(0.112)	(0.111)
Team technical experience		0.248***	0.249***
		(0.0914)	(0.0897)
Team work experience	0.165	0.180	0.173
	(0.199)	(0.225)	(0.225)
Number of founders	-0.178*	-0.136	-0.114
	(0.0984)	(0.107)	(0.109)
Year of foundation	-0.119***	-0.126***	-0.141***
	(0.0446)	(0.0436)	(0.0443)
Constant	244.2***	257.9***	287.1***
	(90.15)	(88.09)	(89.44)
Observations	239	239	239
R-squared	0.207	0.267	0.279
Country FE	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

5. Conclusion

Recent years have witnessed substantial structural shifts in the global aerospace industry, driven by advancements in technology, changes in the roles of international space agencies, and shifts in geopolitical dynamics. These transformations have resulted in a notable reduction in space access costs and the emergence of innovative satellite platforms, creating new entrepreneurial opportunities across space infrastructure and data-based services. Additionally, the proliferation of novel public-private partnerships and the adoption of market-creating innovation policies by space agencies have further accelerated the growth of new ventures in the sector.

The evolution of space technology relies heavily on the integration of diverse knowledge domains, spanning advanced software solutions, materials science, electronics, quantum communication systems, manufacturing processes, and robotics. Strategic entrepreneurship theory emphasizes how managing innovation projects within evolving industries, characterized by novel business models, is significantly influenced by the varied educational and professional backgrounds of founding team members. Within the human capital paradigm, founders' competencies are seen as fundamental for addressing the challenges of startup formation and development, highlighting the importance of combining team members' skills, knowledge, and expertise for venture success.

In this study, we delve into the influence of founding team characteristics on the fundraising performance of startups in the emerging space economy. This sector, undergoing significant transformation, presents a unique empirical landscape. Specifically, the development of new space applications in the upstream segment necessitates the integration of diverse scientific and technical expertise. Simultaneously, the evolution of satellite platforms and the rise of new private actors are expanding entrepreneurial opportunities in the downstream segment.

Our analysis, based on data from 239 European startups founded since 2013, unveils several key insights. Firstly, companies operating in the upstream segment tend to secure higher capital amounts to support investments in infrastructure and product development, consistent with expectations. Secondly, we observe a positive correlation between the technical experience of founding team members and their ability to raise capital, while teams with academic

backgrounds encounter challenges in fundraising. Particularly notable is the negative correlation between founders' past aerospace industry experience and their ability to attract venture capital (VC) investments. While one might expect a positive correlation due to industry knowledge and established networks, this phenomenon is predominantly evident among upstream startups.

We propose that entrepreneurs from the aerospace sector may be inclined to develop startups influenced by traditional industry paradigms, resulting in less scalable and attractive business models for investors. Disrupting established business practices may prove challenging for individuals with extensive experience in an industry undergoing structural change. Our findings have implications for investment fund managers tasked with identifying potential target companies. Moreover, while our study focuses on a specific industrial domain and a limited sample size, it contributes to the literature on the role of startups in industry transformation. Startups with predominantly technically adept founding teams, rather than extensive industry experience, are more likely to secure significant capital for market growth.

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Annex

Annex A *Correlation Matrix*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) Funding	1								
(2) Upstream	0.1242*	1							
(3) Space experience	-0.1507*	0.3006*	1						
(4) Space experience	0.0183	0.0012	0.0150	1					
(5) Academic experience	-0.0770	0.0734	0.0662	0.0681	1				
(6) Technical experience	0.0880	0.0009	0.2208*	0.0248	0.3853*	1			
(7) Work experience	-0.0076	-0.1262	0.2212*	0.4206*	0.2114*	0.3070*	1		
(8) Number of founders	-0.0706	-0.1009	0.3126*	0.2655*	0.2933*	0.3842*	0.4609*	1	
(9) Date of foundation	-0.1190	-0.0215	-0.0609	0.0020	0.0584	0.0780	0.1070	-0.0221	1