The Journal of Technology Transfer
https://doi.org/10.1007/s10961-024-10180-9

Public grants beneficiaries and venture capital-backed firms: a tale of two funding strategies

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Accepted: 10 December 2024

Abstract
Although firm characteristics play a crucial role in predicting future performance, public agencies often overlook these factors in their funding decisions, unlike Venture Capital investors. This oversight may have implications for the pay-offs from publicly allocated funds and the achievement of policy objectives. To explore the role of firm characteristics in receiving public grants and Venture Capital funding, we compare the characteristics of beneficiaries of the SME Instrument—one of the most innovative funding instruments for innovative companies in Europe—with those of VC-backed firms. Our findings reveal different funding strategies: Venture Capitalists tend to fund younger and more innovative firms, while SME Instrument grants lean towards smaller and older companies. These trends persist even when considering factors such as bank indebtedness and profitability. Additionally, firms that are more profitable are more likely to secure public grants than VC-backed counterparts are. The difference in funding strategies may be related to the varying levels of risk tolerance of public agencies and Venture Capitalists, with the public agency potentially being more risk-averse than its private counterparts are. Our study underscores the potential need to refine the selection criteria of the public funding program to align it with the expected role of public funding in de-risking uncertain ventures in their early development phase.

Keywords Venture Capital · Public grants · SME Instrument · Entrepreneurial finance · Finance for innovation

JEL Classification O30 · O38 · L20 · L53 · G20

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Published online: 23 February 2025

1 Introduction

Young and innovative businesses rely on various sources of financing to support their research and innovation (R&I) activities, depending on their stage of development. In the initial phases, research activities are primarily financed through internal and public sources and, when a venture is sufficiently mature and established, private investors come into play (Auerswald & Branscomb, 2003). In the early stages, firms usually try to raise funds through private means, including Venture Capital (VC) financing (Gompers & Lerner, 2001). In this context, public funding is expected to de-risk research and technology development by covering the expenses of necessary failures at the early stages of company development, while private investors tend to support more developed and ready-to-grow enterprises.

Firms' characteristics not only influence funding patterns but also future performance. Young firms tend to benefit more from R&I investments, whereas older firms typically exhibit lower expected growth rates in sales, profits, and productivity, and seem to be less capable of converting employment growth into sales, profits, and productivity growth (Coad et al., 2013, 2016). However, public agencies generally overlook firm characteristics and attributes in their funding decisions. The prevailing method for selecting recipients of public funding involves ranking received proposals based on criteria such as impact, excellence, quality, and efficiency of implementation (EC, 2013). Consequently, they not only neglect the complementarity nature and interactions between private and public funding sources but also fail to consider the role of firm characteristics in the effectiveness of allocated funds. Hence, considering the existence of externalities across many forms of entrepreneurial finance, it is necessary to adopt a portfolio approach to business financing, rather than treating private and public funding sources independently (Cumming et al., 2018).

To bridge this gap, we analyze funding patterns for innovative firms using a portfolio lens, specifically comparing the characteristics of innovative companies supported by the SME Instrument (SMEI)—one of the boldest and most innovative policy instruments for firms designed to facilitate breakthrough innovations in Europe—with those of European firms that received Venture Capital funding. The creation of the SMEI was inspired by the Small Business Innovation Research (SBIR) program, which operates in the United States (Howell, 2017). Introduced in 1982 to strengthen the US high technology sector and support small firms, the SBIR program has supported many young and innovative companies that became large companies creating new industries and markets. Examples included such well-known corporations as Qualcomm, iRobot, and Amgen. Accepting early-stage, risky projects and betting on companies with high growth potential, the SBIR program has become representative of many targeted subsidy programs for high-tech new ventures around the world, including the SMEI (Audretsch, 2003; Cooper, 2003).

Using the SMEI as a case study, our objective is to examine how the selection process of such programs compares to those of the venture capitalists. We select SMEI beneficiaries as a comparison benchmark for VC firms due to its competitive selection process, its focus on supporting high-growth, innovative companies, and its goals of developing and commercializing innovative products, services, and processes, which align with the funding strategies of traditional VC firms.[1]

[1] While this study specifically focuses on the SME Instrument, the characteristics of this program as a public initiative designed to support high-growth, innovative firms may allow for some generalization of the findings to other similar public funding schemes. This is especially relevant since the SME Instrument has

The findings aim to contribute to the debate on the rationale and design of public sector mechanisms intended to de-risk research and technology development at early stages while still managing the consequences of failures. Our results will also interest policymakers, aiding their understanding of how public grants interact with venture capital investments, in light of the potential increase in firms raising both private and public funds. This insight can identify new routes to stimulate SME financing alternatives to bank loans, as proposed by the EU Capital Markets Union Action Plan (Gucciardi, 2022).

The development of entrepreneurship is a primary concern for policymakers globally, and assisting new enterprises often involves providing them with outside financing (Lerner & Nanda, 2020). This concern is particularly relevant in countries with robust economies but without established VC markets, such as European ones (AFME, 2018). As the EU financing system continues to be strongly bank-dependent, equity investments still play a relatively minor role and the EU VC market still lags behind its main international competitors, access to finance remains a significant bottleneck for commercialization and exploitation of innovation in Europe (EC, 2022). Innovative SMEs show a higher probability of being financially constrained than their non-innovative counterparts (Nepelski, 2019; Santos & Cincera, 2022; Zofio et al., 2023). Insufficient collaterals, significantly high interest rates, and excessive administrative burdens represent the most important factors in determining firms' limited access to finance. To address this, policymakers create new funding instruments, allocate larger sums of money to bridge the 'Valley of Death' and secure the necessary financial resources for commercializing new technologies and products (Joshi et al., 2018; Wessner, 2007).

Public funding and support for firms can take many forms. For example, through various forms of policy interventions, the European Union annually supports over 200,000 companies, including sole proprietorships, micro-enterprises, startups, and SMEs, spanning all manufacturing and product sectors (Gampfert et al., 2016). Some of these entities intentionally emulate the private VC industry by selecting companies with high growth potential and providing them with external finance in the form of grants. This trend coexists with the development of private financing instruments and the continuous influx of angel and venture capital funding, despite the recent pandemic shock (Bellucci et al., 2021, 2023a).

This dual approach could result in complementarity or substitution effects between these two categories of instruments. Early resource allocations through public grants may increase the likelihood of firms securing VC funding (Shane & Stuart, 2002). Public grants obtained by high-growth potential and innovative firms may share comparable ambitions and information with VC investments, possibly serving as a firm's first capital injection (Berger & Hottenrott, 2021). Recent studies have notably documented the certification role played by public grants for R&I in signaling the quality of recipient firms to private lenders such as banks and venture capitalists (Bianchi et al., 2019; Schäfer et al., 2023), making them more inclined to invest in grant-backed firms (Lerner, 2000; Howell, 2017; Giraudo et al., 2019; Srhoj & Škrinjarić, 2021; Bellucci et al., 2023b).

However, there is a risk of crowding out investments between public subsidies and VC financing if one source of funding reduces the need for another. As both instruments target high growth potential and innovative firms, they may consider public grants as an

Footnote 1 (continued)
influenced other programs that target high-potential SMEs at the supranational (European Innovation Council Accelerator program) and national, e.g. Spirit Slovenia, RVO, NL, levels (EC, 2017; TAFTIE 2020).

alternative to Venture Capital, and vice versa (Bertoni et al., 2015). Furthermore, venture capitalists may lose interest in firms that have already received public grants, possibly because these firms may have reached a level of development that no longer aligns with the VCs' investment criteria (Alperovych et al., 2020).

As a result, one of the most common recommendations from program assessments is to target the right beneficiaries. For instance, the European Court of Auditors specifically states that, while the SME Instrument promotes enterprises that meet the academic model of high-growth potential firms, it still invests in certain firms that might have received funding from the market (ECoA, 2020). This suggests that, under some circumstances, public authorities may prefer to 'pick the winner' rather than financially intervening in companies not funded by private resources (Cantner & Kösters, 2012).

However, research on R&I subsidies primarily focuses on evaluating public support for innovative firms (Bronzini & Piselli, 2016; Howell, 2017; Lerner, 1999, 2010) and often does not examine whether the selection of beneficiaries for public support is optimal. Furthermore, most empirical papers on financing innovative firms are based on data from a single funding source (Cumming & Vismara, 2017). There are only a few papers that utilize data from various financial sources in the same analysis, with exceptions like Cosh et al. (2009) for the UK, and Robb and Robinson (2014) for the US. Consequently, there is insufficient evidence regarding the primary criteria of selecting firms for public R&I support and how private and public sources of R&I funding interact. Therefore, it is not surprising that findings from studies examining public support for R&I remain unclear (Dimos & Pugh, 2016). One potential explanation for these inconclusive results may be related to the selection process of beneficiaries for public R&I support (Mina et al., 2021), as well as for other forms of direct public financing for innovative firms.

In addition to public grants, public authorities can also directly invest in firms through Government Venture Capital (GVC). GVC involves governments investing in innovative firms with high growth potential by acquiring equity stakes in the companies in exchange for funding rounds, with the expectation of future returns on investment (Bertoni et al., 2015; Colombo et al., 2016). Due to its nature, existing studies on GVC have predominantly focused on comparing the performance of GVC-backed companies with those backed by private VCs (e.g., Alperovych et al., 2015; Grilli & Murtinu, 2014; Munari & Toschi, 2015), examining the motivations behind government intervention in funding innovative firms (e.g., Frenkel et al., 2008), and investigating whether GVC investments serve as signals (e.g., Alperovych et al., 2020; Guerini & Quas, 2016) or potential alternatives (e.g., Leleux & Surlemont, 2003) for private investors.

Despite both being public sources of funding, grants do not involve equity dilution or repayment, as GVC does. This makes grants a favorable option for firms in need of financial assistance without relinquishing ownership shares. While both instruments aim to fund ventures in early stages and can potentially complement or serve as alternatives to private VC, the existing literature has primarily focused on the relationship between GVC and VC, without addressing the link between public grants and Venture Capital investments.

To address these gaps, we empirically analyze the characteristics of firms selected for funding by the SME Instrument and venture capitalists. Our objective is to use a portfolio approach to R&I funding and jointly analyze the two sources of funding to investigate whether the SMEI targets firms similar to those backed by private investors. Our study resembles the analysis of the characteristics of firms financed by corporate and individual venture capitalists (Chemmanur et al., 2014) and a study looking at the effects of public and private funding on firms' innovative performance (Kou et al., 2020). Moreover, our work differs from studies investigating the different investment strategies of GVC versus

private VC by specifically focusing on the comparison between public grants and Venture Capital financing.

To analyze the funding patterns of public and private investors in financing innovative EU-based enterprises with high growth potential in the period 2008–2017, we collect data from various sources. Information on Venture Capital investors and transactions is retrieved from VentureSource, a specialized commercial database by Dow Jones. This dataset is integrated with information on public grants under the Horizon 2020 'SME Instrument' scheme, collected by the European Commission's Executive Agency for Small and Medium-sized Enterprises (EASME).

First, we test whether both venture capitalists and SMEI grants exhibit similar patterns in financing small, young, and innovative enterprises. Second, we investigate potential heterogeneous effects that may drive differential investment behaviors, such as the level of bank indebtedness and firm profitability. We recognize that firms may use bank debt becoming a third way of funding that may potentially substitute or complement both public and private capital. In this respect, we then investigate whether the difference in characteristics appearing for firms supported by SMEI grants versus VC investments varies as a function of their bank debt level. Then, given that the growth of the target companies is the ultimate goal of both private investors and the SMEI, we analyze whether the differences in characteristics emerging for firms financed by SMEI grants or VC investments change as a function of their profitability. Finally, we investigate the potential differential behaviors in the interplay between private and public investment by comparing the early and later stages of private and public funding.

Our analysis reveals that venture capitalists and SMEI target firms with different characteristics, despite sharing a common objective. Firms receiving SMEI grants tend to be smaller and older, while VC-backed companies are on average more innovative. These differences persist even when considering factors like bank debt and profitability. Additionally, there are no substantial behavioral differences between private and public investors across investment stages or rounds. A battery of robustness tests confirms our findings.

The remainder of the paper is structured as follows. Sections 2 and 3 describe the institutional setting of the EU SME Instrument and our hypotheses to be tested regarding its interaction with VC financing. Section 4 presents the data and the empirical strategy. Section 5 explores the findings, including heterogeneous results, while Sect. 6 focuses on a battery of robustness tests. Lastly, Sect. 7 concludes.

2 The SME instrument institutional setting

The SMEI addresses the financing needs of internationally oriented firms, particularly focusing on small, young, and innovative companies, in implementing high-risk and high-potential innovation ideas (EC, 2015). It aims to support projects that lead to major changes in how businesses (products, processes, services, marketing, etc.) are conducted. It assists innovative firms in shaping new markets, fostering growth, and achieving high returns on investment. The expected impacts of the SMEI include enhancing the profitability and growth performance of firms, promoting the market uptake of innovations, and increasing private investment in innovation. The SMEI is sector-neutral and addresses all types of innovative firms to promote growth in all sectors. Introduced in the Horizon 2020 R&I Framework Programme, the SMEI is managed by the EASME.

As discussed earlier, the SMEI introduced to support European high-potential innovative firms, resembles largely the SBIR program. The SMEI does not only share the objectives of the SBIR program but also its set-up. Like the SBIR program, the SMEI consists of three separate phases and a coaching and mentoring service for beneficiaries (EC, 2015).

In Phase 1, a feasibility study is developed to verify the practical and economic viability of an innovation with considerable novelty within the industry sector it is presented. Activities may include risk assessment, market study, user involvement, Intellectual Property (IP) management, innovation strategy development, and an assessment of concept feasibility. These activities should demonstrate the high potential of an innovation project. The proposal should also include an initial business plan based on the proposed concept and the success criteria. A successful proposal receives a lump sum of EUR 50,000 and projects should last around 6 months. Given its focus on initial concept and feasibility assessment and the size of grants, the SMEI resembles the seed and early stage of Venture Capital.

In Phase 2, innovation projects demonstrating high potential in terms of company competitiveness and growth underpinned by a strategic business plan are supported. Funded activities are expected to focus on demonstration, testing, prototyping, piloting, and scaling up. They should help bring innovations to industrial readiness and maturity for market introduction. At this stage, firms should address the IP protection issues and provide evidence showing that they have 'freedom to operate' and that their projects are ready for commercial exploitation. In Phase 2, projects are supported with grants between EUR 0.5 and 2.5 million and they are expected to last between 12 and 24 months. As they involve scaling up operations, market expansion, and product development, Phase 2 is akin to the later stage of VC funding.

In Phase 3, the SMEI provides indirect support measures and services as well as access to the financial facilities supported. SMEI beneficiaries are offered dedicated coaching and mentoring services. Throughout the three phases of the instrument, firms receive support in identifying growth potential, developing a growth plan and maximizing it through internationalization; strengthening the leadership and management skills of individuals in the senior management team and developing in-house coaching capacity; developing a marketing strategy, or raising external finance.

Project submissions are selected through several assessment stages, both offline and through face-to-face interviews (mandatory for Phase 2) that are performed to assess both quantitative information such as the expected benefits of the business strategy ('Impact') or the feasibility of the submitted project ('Excellence'), and qualitative elements such as the skills and motivation of the management team to implement the submitted Project ('Implementation').

Since its inception, the Horizon 2020 SME Instrument has become an important source of public funding for European firms, contributing 50% of the total amount of public grants in 2017 (Bellucci et al., 2021). During the first 2 years of operation, the SMEI received 31,377 applications (Phase 1 and 2) in total and it funded 2,457 individual firms participating in 2,344 projects (EC, 2016). The overall success rate was 8.4% for Phase 1 and 5.5% for Phase 2. These rates are similar to those of private acceleration programs, which indicates that the SMEI is highly competitive.

3 Hypotheses development

Public authorities managing grants and venture capitalists face similar challenges when evaluating firms for funding and investment opportunities. The main challenge is the inherent information asymmetry in the evaluation process, which can be particularly pronounced

when dealing with firms that have limited available information (e.g., Cumming & Johan, 2008; Gompers & Lerner, 2001).

However, the risks these two entities bear are different. On the one hand, by taking equity stakes in funded firms, venture capitalists are directly exposed to business risks such as the potential loss of invested funds in the event of a failure or the likelihood that invested money does not provide the projected value over time in exchange for a high expected return (Giraudo et al., 2019). On the other hand, public authorities managing grants also face entrepreneurial risks related to the business activities of the funded firms (Link & Scott, 2010). Although their concern is not only related to the potential lack of profit but rather the suboptimal allocation of public resources that may not lead to the realization of projects with positive economic impacts, financial returns, growth, and scalability are often essential for achieving economic growth, job creation, and competitiveness, which are key objectives of public authorities. By supporting firms that demonstrate these characteristics, public authorities can increase the likelihood of achieving their objectives, such as job creation and economic growth. In general, firms that demonstrate high growth potential and scalability are more likely to contribute to economic growth and competitiveness. Hence, there are compelling reasons to believe that the determinants of Venture Capital financing and Public Grants under the SME Instrument scheme share similarities. As also reported by the European Court of Auditors (ECoA, 2020), the SME Instrument was established with the primary goal of addressing the financing needs of internationally oriented young firms engaged in high-risk, high-potential innovation projects. Its purpose is to support endeavors that lead to radical and disruptive changes in business practices, facilitate a company's expansion into new markets, promote growth, and yield a high return on investment. Companies applying for the SME Instrument are assessed on their business and innovation merit (EC, 2016). The award criteria focus on the commercialization perspective, excellence in innovation, and the capacity of the implementing team. Companies have to demonstrate that there is a market for their innovation and potential customers willing to pay for it. They are thoroughly tested against their knowledge of the market conditions, including the total potential market size and growth rate, their understanding of competitors, and their sales projections. The innovation they are presenting needs to have the potential to scale up the company, which must be proved by a clear commercialization plan and a knowledge protection strategy, including an analysis of 'freedom to operate'. The applicants should show that their idea is a high-risk and high-potential innovation that stands out from the competition and outperforms existing solutions. Finally, the capacity of the company's team to effectively commercialize and scale up the business is assessed. SMEI Phase 2 aims at supporting close-to-market activities, focusing on breakthrough innovations with market-creating potential and not research and innovation activities (A4SMES, 2018). SMEI Phase 2 beneficiaries are expected to know their market and have clearly identified relevant market opportunities, have sound and scalable business models, and feasible implementation plans. All this shows that private venture capitalists and the SMEI seem to target the same types of businesses.

Venture capital investors play a crucial role in fostering entrepreneurship by providing external financing to firms in their early stages of development (e.g., Colombo et al., 2016; Meoli et al., 2013; Puri & Zarutskie, 2012). This type of firms typically exhibits three key characteristics at the financing stage: they are young, small, and innovative (e.g., Galloway et al., 2017; Gompers & Lerner, 2001). VCs are very selective in their decisions with only 1/6 of 1% of new businesses managing to obtain VC funding (Kaplan & Lerner, 2010). Empirical evidence shows that they select companies based on revenue growth, expected returns, trends, sector, and performance and that innovation is an important factor during

the VC selection phase (Bellucci et al., 2023b; Block et al., 2019; Caselli et al., 2009; Chemmanur et al., 2011). In venture capitalists' proposal screening, key criteria include the long-term growth and profitability of the industry in which the proposed business will operate (Hall & Hofer, 1993). In other words, relatively young firms with high growth potential and innovative performance supported with intellectual capital assets and high-quality human capital obtain significantly more VC financing (Behrens et al., 2012; Kim & Lee, 2022; Zhou et al., 2016). At the same time, along with the hard figures underlying the business, venture capitalists base their investment decisions also on relevant qualitative insights such as the quality and the track record of the management team and the entrepreneur(s), the innovative technologies, and the final product (Gompers et al., 2020; Kaplan and Stromberg, 2001; Silva, 2004). These aspects suggest that SMEI grants and venture capital are instruments designed for comparable companies.

Last, in considering the potential alignment of selection criteria between SMEI and venture capitalists, it is essential to acknowledge the underlying policy goal. Another plausible rationale for this alignment is that policymakers behind initiatives like the SMEI aim to emulate the market-driven approach of venture capitalists. By directing funding towards small, young, and innovative enterprises with significant growth potential, SMEI seeks to foster entrepreneurship and innovation, mirroring the objectives of venture capitalists. This alignment is driven by a broader aim to stimulate economic growth and competitiveness by supporting businesses that exhibit traits conducive to innovation and market disruption.

In light of the similarities and distinctions between the selection criteria and evaluation processes of the SME Instrument and VC investors, we have developed a set of hypotheses to investigate how differently public and private investors select firms for financing. These hypotheses aim to explore the companies' attributes and characteristics typically influencing both public and private investors' choices, including the size, age, and level of innovation, and consider further relevant aspects such as the role of bank debt, and the impact of profitability. This approach leads us to formulate the following first hypothesis:

H1: All else being equal, both VC investors and the SME Instrument aim to fund early-stage *(i)* small, *(ii)* young, and *(iii)* innovative enterprises with growth potential.

In addition to the main hypothesis, we also investigate other concurrent hypotheses that help further clarify how SMEI and private investors select the firms to be financed in the presence of other factors that might change their choices (i.e., debt, profitability) or at different stages of firms' life-cycles.

Apart from public and private (venture) capital, bank debt could emerge as a viable third funding source for innovative firms. Despite these enterprises might face specific obstacles when obtaining external financing from banks in the form of debt, due to their inherent riskiness and the difficulty that financial institutions might encounter during their loan assessment (Colombo & Grilli, 2007; Lee et al., 2015), they may still be able to get access to bank funding to cover both short- and long-term commitments in their early months and years of existence. This possibility necessitates the testing of the following hypothesis:

H2: All else being equal, bank debt does not significantly differentiate the funding strategies of VC investors and the SME Instrument.

The level of a firm's profitability could influence investor behavior, potentially leading to alterations in the strategies of both public and private interventions. Indeed, one of the

goals of financial stakeholders, whether in the public sphere (via public grants) or the private sector (through VC investments), is to help financially supported companies become more profitable, either for policy or economic returns (Bronzini et al., 2020). Hence, we need to investigate whether varying levels of profitability might affect the investment decisions of the SMEI and private investors by testing the following hypothesis:

H3: All else being equal, the level of profitability does not constitute a distinguishing factor in the funding strategies of VC investors and SME Instrument.

Lastly, VC transactions exhibit different characteristics based on the investment round, especially concerning the amount granted and, in particular, the distinction between the so-called Early and Later stages of investments. The former targets firms in the very early stages of their life cycle, while the latter is more geared toward more mature firms that have typically already raised other external funds (Davila et al., 2003; Gompers, 2022). Similarly, the two phases of the SME Instrument target firms in the early stage of operations (Phase 1) or at a stage closer to commercialization (Phase 2). This comparison of the different stages of the VC (Early vs. Later stages) and SMEI grant (SMEI Phase 1 vs. SMEI Phase 2) investment process leads us to formulate a new hypothesis:

H4: All else being equal, VC investors and the SME Instrument share a similar funding approach based on the life-cycle stage of the funded enterprise, i.e.

- Horizon 2020 SME Instrument Phase 1 targets firms that resemble to Early-Stage VC-backed enterprises (in terms of size, age, and innovation capability);
- Horizon 2020 SME Instrument Phase 2 targets firms that resemble to Later-Stage VC-backed enterprises (in terms of size, age, and innovation capability).

4 Data and empirical strategy

4.1 Data

To test our research hypotheses, we collected data on EU-based firms raising either Venture Capital financing, public grants under the Horizon 2020 'SME Instrument' scheme, or both in the period 2008–2017. We use a broader sample for VC transactions, which also includes 2008–2013 even though the SME Instrument is active between 2014 and 2017, to capture long-term trends and structural changes in the VC market, thus providing essential context for assessing the impact of the SME Instrument. Specifically, by analyzing the entire 2008–2017 period, we can compare the VC landscape before and after the introduction of SME Instrument, ensuring that any shifts or patterns are taken into account.[2]

Data on VC financing is retrieved from VentureSource, a specialized commercial database by Dow Jones, which includes information on VC investment transactions, as well as

[2] For the sake of robustness, we have also reported the results of the baseline analysis when the sample is limited to the 2014–2017 period. These results, presented in Table 15 of the Appendix, are consistent with the full-sample analysis. Additionally, the other estimations included in this paper show very similar patterns when focusing on the 2014–2017 period. The results of all these estimations are available upon request.

on VC investors and VC-backed companies. VentureSource provides information on VC transactions, VC investors, and VC-backed companies in every region, industry sector, and stage of development throughout the world.[3]

This dataset was then integrated with information on public grants. Specifically, we make use of the SMEI-related data that is collected by the European Commission's Executive Agency for Small and Medium-sized Enterprises. The EASME plans, administers, and monitors the execution of the SME Instrument calls. The information about awarded grants and their beneficiaries is public and can be accessed via the CORDA database, which is the primary source of results from EU-funded R&I projects.

While VentureSource provides financial data related to the VC-backed firms for the year of the VC transaction or of the SMEI grant, it does not include the same information for the years before which, however, should be investigated as potential candidates for the determinants of the VC investment or SMEI grant. Hence, we matched the dataset with ORBIS, a commercial database by Bureau van Dijk, which provides financial and industrial data for each accounting year retrieved from the balance sheets of firms based on information available from several official sources such as business registers, firms' annual report, and credit bureau.

Given that VentureSource and ORBIS do not share a unique reciprocal identifier for an immediate link, the merger was conducted by matching common variables available in both databases, such as the company name, the web and e-mail addresses, and the telephone and fax numbers. The resulting database is then merged with information on patents from PATSTAT. The merger is performed using as key the name and address of the company.

The final matched database contains 4,742 observations, with the identifier being the single transaction (either the VC financing or the SME Instrument grant).[4]

For each observation, the dataset includes information both on the characteristics of the deal and the target company. First, we know when the VC or SMEI transaction was completed, allowing us to chronologically rank transactions for the same company. This data also allows us to implicitly determine the age of the company at the date of the transaction, as the difference between its incorporation date and the transaction date. Second, our dataset includes qualitative and quantitative information on the characteristics of the target

[3] VentureSource has been considered generally more reliable, complete, and less biased than alternative data sources (Kaplan et al., 2002; Retterath and Braun, 2020). Moreover, VentureSource is one of the first and most comprehensive databases that could be adopted for empirical analyses covering our time-frame (2008–2017), given that it was launched in 1987 by Dow Jones, several years before the first year of our sample. Conversely, not many data sources of VC activity have such a long experience prior to 2008 (e.g., Dealroom was founded in 2013). For the sake of robustness, we compared VC investments included in VentureSource and Dealroom for our period of analysis finding that they are close in terms of total amounts and time trend in the analyzed years.

[4] Section A "Database construction and description" in the Appendix includes the entire process that we followed to construct the database used in this work. Specifically, Table 9 describes the process step-by-step, while indicating the share of matched transactions with respect to the original data sources. We also provide evidence of the representativeness of our sample by showing that the geographical distribution of VC and SME Instrument transactions of our final sample is comparable to that of the original data source (as shown in Table 10). Notably, the number of matched observations is comparable with previous analyses investigating the relationship between VC and SMEI transactions in the EU for the same period (Bellucci et al., 2021; Mina et al., 2021). In particular, the number of matched firms winning an SMEI is equal to 1,695 in our database compared to 1,585 of Mina et al. (2021). In the robustness section, we also re-estimate the baseline analysis by sequentially excluding companies from each country to further address potential over- or under-representation issues, and we find that the results remain consistent with the baseline ones.

company, such as a proxy for its size (expressed in terms of total assets) and for its ability to innovate (in terms of number of registered patents). For the sake of robustness, in some estimates, we use alternative variables as proxies for size (e.g., number of employees, total sales) and for innovation (e.g., R&D expenditure). In the latter case, this is to account for the varying propensity to patent of companies in different sectors, for example, Biotech vs. ICT (see, e.g., Amoroso & Link, 2021; Anand & Khanna, 2000; Cohen et al., 2000; Levin et al., 1987).[5]

4.2 Empirical model specification

To investigate the relationship between SMEI grants and Venture Capital, we adopt the following Probit model specification:

$$Pr(SMEI) = \beta_0 + \beta_1 Assets_{t-1} + \beta_2 Patents_{t-1} + \beta_3 Age_{t-1} + \phi_t + \phi_s + \phi_c + \epsilon_i \qquad (1)$$

where our dependent variable, *Pr(SMEI)*, is a binary indicator that takes the value of one if the firm receives an SME Instrument grant under the Horizon 2020, and zero if it receives Venture Capital financing in the analyzed year. To proxy for the company's size, we include $Assets_{t-1}$ computed as the natural logarithm of the total assets reported in the balance sheet by the firm for the year before raising a Venture Capital investment or an SMEI grant. To account for the innovation capability, we include $Patents_{t-1}$, an indicator that takes the value of 1 for firms having applied for the filing of a patent in the year before raising a Venture Capital investment or an SMEI grant, and 0 otherwise.[6] Age_{t-1} is the natural logarithm of the age of the firm the year before raising a Venture Capital investment or an SMEI grant. Our model also includes yearly fixed effects, φ_t, to capture common shocks related to every transaction in each year. We also incorporate sector, φ_s, and country, φ_c, fixed effects to control for systematic differences in the characteristics of financed firms across sectors and countries. Lastly, ϵ_i is the error term, clustered at the firm level.[7]

To test hypothesis H1, we are firstly interested in the significance of the coefficients β_1, β_2, and β_3, alongside their associated marginal effects. If the hypothesis is confirmed, we should indeed find that the three coefficients are not statistically significant, i.e., there would be no systematic difference between the characteristics of VC- or SMEI grant-backed companies. Should the hypothesis be (only partially) confirmed, we should instead find that at least one of the coefficients is significant. Then, the sign of the significant coefficients would determine the differences in the characteristics of the publicly or privately financed enterprises. In particular, a positive and significant sign would imply that an

[5] Section B "Preliminary statistical analyses" of the Appendix includes the summary statistics and the test on the difference of means, for all variables used in the analysis, reported in Tables 12 and 13, respectively. The correlation matrix for all the variables used in the analysis, reported in Table 14 of the Appendix, documents that the indicators that are simultaneously included in the estimations show limited correlation (with coefficients always lower than 0.5), thus indicating a low risk of collinearity in our estimations. At the same time, as expected, the variables that we use as alternatives for the robustness tests (e.g., total assets, total sales, and number of employees) show larger coefficients.

[6] In the robustness section, we also adopt different alternative definitions of size and innovation capability to acknowledge possible heterogeneity in the companies' characteristics across industries and business models.

[7] The variables used in the empirical analyses, along with their descriptions and sources, are detailed in Table 11 in the Appendix.

SMEI grant-backed enterprise is more likely to exhibit the specific characteristic associated with the given coefficient, and vice versa in the case of a negative and significant sign.

5 Results

5.1 Baseline results

Table 1 reports the coefficient estimates (Panel A) and the associated marginal effects (Panel B). Column (1) reports the benchmark specification that includes only the three variables accounting for the size, age, and innovation ability of VC/SMEI grant-backed firms, while in the specifications in columns (2)-(4) we progressively add different sets of fixed effects. Specifically, year fixed effects control for common time-varying shocks that might affect the probability of raising SMEI grants with respect to VC investments, sector fixed effects allow us to consider time-invariant unobservables correlated with financing that are sector-specific, while country fixed effects account for time-invariant unobservables correlated with financing that are specific to the country, respectively.

We find that the coefficient for the *Assets* indicator is negative and highly statistically significant across the specifications of the model. The magnitude of the associated marginal effects is stable, with the coefficients ranging between −0.037 and −0.060. Moreover, when we look at *Patents* we get that, again, the coefficients are negative and statistically significant, with the marginal effects materially varying across the specifications. Lastly, we find the *Age* of target companies being positively correlated—and with a high level of statistical significance—with the probability of raising an SMEI grant (vs a VC). In this case, the coefficients of the marginal effects range between 0.126 and 0.240.

These findings seem to confirm H1 and suggest that, despite being moved by a similar ex-ante ultimate goal, venture capitalists and public investors target quite different types of firms. In particular, firms receiving SMEI grants are on average smaller, less innovative, and older than those raising a VC investment. This result is noteworthy when compared with the spirit of the SMEI, which aims to finance high-potential and innovative young firms. Indeed, it seems that private financing reaches more innovative firms at an earlier stage than public investors. On the other hand, the distinct outcome of public investors compared to private investors is the funding of smaller and less capitalized firms. This seems to be linked to the lower marketability of such companies funded by SMEI which can be attributed to the differing objectives of EU grants. Specifically, as noted, Phase 2 of SMEI emphasizes "demonstration, testing, prototyping, piloting, and scaling-up" rather than prioritizing marketability.

Overall, these results corroborate the view that public and private investors, despite being guided by a similar spirit, pursue distinct investment strategies with respect to firms' attributes. In particular, venture capitalists demonstrate a preference for financing more innovative and younger firms, whereas public investors focus on smaller companies.[8] Similar patterns were identified in a study analyzing firms financed by corporate and independent venture capitalists (Chemmanur et al., 2014). In a direct comparison, corporate VCs tend to fund more innovative, younger, and riskier—though less profitable—firms than

[8] This result is consistent with previous findings indicating qualitative differences in startups raising public versus private funds (Alperovych et al., 2020; Bellucci et al., 2021; Colombo et al., 2016).

Table 1 Baseline Results

Panel A—Probit				
	SMEI grant			
Dependent variable	(1)	(2)	(3)	(4)
Assets $_{t-1}$	−0.197***	−0.205***	−0.223***	−0.196***
	(0.014)	(0.016)	(0.018)	(0.019)
D_Patents $_{t-1}$	−0.811***	−0.384***	−0.625***	−0.458***
	(0.079)	(0.094)	(0.104)	(0.108)
Age $_{t-1}$	0.794***	0.799***	0.646***	0.668***
	(0.032)	(0.036)	(0.041)	(0.045)
Observations	4,742	4,742	4,742	4,742
Year Fixed Effects	No	Yes	Yes	Yes
Sector Fixed Effects	No	No	Yes	Yes
Country Fixed Effects	No	No	No	Yes
Panel B—Marginal Effects				
	SMEI grant			
Dependent variable	(1)	(2)	(3)	(4)
Assets $_{t-1}$	−0.060***	−0.049***	−0.046***	−0.037***
	(0.004)	(0.003)	(0.003)	(0.003)
D_Patents $_{t-1}$	−0.245***	−0.093***	−0.129***	−0.086***
	(0.023)	(0.022)	(0.021)	(0.019)
Age $_{t-1}$	0.240***	0.193***	0.133***	0.126***
	(0.007)	(0.007)	(0.008)	(0.008)
Observations	4,742	4,742	4,742	4,742
Year Fixed Effects	No	Yes	Yes	Yes
Sector Fixed Effects	No	No	Yes	Yes
Country Fixed Effects	No	No	No	Yes

The analysis covers Venture Capital and SMEI grants raised in the period between 2008 to 2017 by firms operating in the European Union. The table reports regression results of the Probit estimation of Eq. (1) on the full sample (Panel A) and its marginal effects (Panel B). SMEI grants is a categorical variable which takes the value of 1 if the firm raises an SMEI grant and 0 if the firm raises a Venture Capital investment in the analyzed year. *Assets* $_{t-1}$ is the natural logarithm of the total assets reported in the balance sheet by the firm for the year before raising a Venture Capital investment or an SMEI grant. *Patents* $_{t-1}$ is an indicator that takes the value of 1 for firms having applied for the filing of patent in the year before raising a Venture Capital investment or an SMEI grant, and 0 otherwise. *Age* $_{t-1}$ is the natural logarithm of the age of the firm the year before raising a Venture Capital investment or an SMEI grant. The table reports coefficients of a Probit estimation followed by standard errors, clustered at the firm level, in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively

The table presents the estimation results from regressions based on Eq. (1), which investigates how company size (*Assets*), innovation (*D_Patents*), and experience (*Age*) affect the probability of obtaining an SMEI grant versus Venture Capital investment. The basic regression (Column 1) is progressively expanded to include year (Column 2), sector (Column 3), and country (Column 4) fixed effects

independent VCs. In the context of this study, SMEI beneficiaries resemble the profile of firms backed by independent rather than corporate VCs.[9]

5.2 Heterogenous effects

Our baseline estimations consider three among the most relevant aspects that both private and public investors examine when financing firms. In this section, we investigate potential heterogeneous effects arising from two relevant factors that can influence differential investment behaviors: the level of bank indebtedness and the profitability of firms. In a subsequent analysis, we also explore the potential divergent behaviors in the interplay between private and public investment by comparing early and later VC stages with SME Instrument Phase 1 and Phase 2, respectively.

5.2.1 Debt and profitability

Startups and innovative enterprises encounter substantial challenges in securing bank funding (Colombo & Grilli, 2007; Lee et al., 2015), due to the inherent riskiness of the concept and the lack of or limited availability of information—particularly formal data (e.g., financial statements)—that banks need for loan assessments. However, we cannot dismiss a priori the possibility that these companies may be able to obtain bank financing, allowing them to leverage funds for both long-term debt and current operations in the early months and years of their existence. Hence, from this perspective, bank debt emerges as a third avenue for accessing funding for these companies, potentially substituting for or complementing both public and private capital in the form of equity.

In this spirit, we then investigate whether the difference in characteristics observed between firms supported by public subsidies and those with venture capital investments vary as a function of their levels of bank debt. If the results align with those of the baseline analysis, we could infer that bank debt per se does not constitute a distinguishing factor in the investment strategies of venture capitalists and public investors, thereby confirming H2.

To test this effect, we estimate an augmented version of Eq. (1) now incorporating three different variables in two distinct estimates. First, we introduce two binary indicators for short-term and long-term bank debt. This allows us to control for the level of bank debt and distinguish between its use for current activities or investments. In the second estimation, we introduce the leverage ratio indicator, computed as the debt-to-total-assets ratio. This allows us to assess the relevance of bank debt while parametrizing it to the equity size of the company.

Table 2 (Columns 1 and 2) displays the estimation results, with Panel (A) including the coefficient estimates and Panel (B) the associated marginal effects. Findings reveal

[9] A potential concern might be that these results are influenced by "style drifts" (see, e.g., Koenig and Burghof, 2022), which occur when an investment strategy (particularly for VCs) deviates from what is stated in the fund's mandate. This could involve, for example, a shift from financing seed-stage companies to later-stage companies. On the one side, public grants have consistently adhered to their mandates, with Phase 1 deals set at 50 K euros and Phase 2 deals within the expected funding limits, targeting EU-based SMEs as defined by European regulations. On the VC side, while VentureSource does not provide information on fund mandates, we conducted an analysis to check for potential style drifts following the introduction of the SME Instrument. Among the 2,201 VC investors in our sample, 23% made multiple investments, with only 6% shifting from early-stage to later-stage from 2008–2013 to 2014–2017. The related 67 transactions represent just 1% of the total sample. Even when excluding these 67 transactions or all transactions from investors who changed strategy, our results remained consistent, confirming that style drift did not impact our baseline findings. For the sake of synthesis, we have not reported the results of this analysis, which are available upon request.

Table 2 Heterogenous Effects—Debt and Profitability

Panel A—Probit					
	SMEI grant				
Dependent variable	(1)	(2)	(3)	(4)	(5)
Assets $_{t-1}$	−0.248***	−0.160***	−0.308***	−0.297***	−0.301***
	(0.027)	(0.031)	(0.047)	(0.034)	(0.047)
D_Patents $_{t-1}$	−0.699***	−0.616***	−0.460*	−0.546***	−0.453*
	(0.150)	(0.155)	(0.273)	(0.180)	(0.271)
Age $_{t-1}$	0.773***	0.812***	0.983***	0.905***	0.976***
	(0.059)	(0.068)	(0.097)	(0.070)	(0.097)
ST debt $_{t-1}$	0.259***	0.186**			
	(0.083)	(0.091)			
LT debt $_{t-1}$	−2.821***	−3.114***			
	(0.368)	(0.334)			
Leverage (ln) $_{t-1}$		0.381***			
		(0.133)			
EBIT $_{t-1}$			0.011***		
			(0.002)		
ROE $_{t-1}$				0.002***	
				(0.000)	
Profit Margin $_{t-1}$					0.011***
					(0.002)
Observations	2,666	2,340	1,165	1,808	1,139
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Sector Fixed Effects	Yes	Yes	Yes	Yes	Yes
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes
Panel B—Marginal effects					
	SMEI grant				
Dependent variable	(1)	(2)	(3)	(4)	(5)
Assets $_{t-1}$	−0.043***	−0.026***	−0.049***	−0.058***	−0.048***
	(0.004)	(0.005)	(0.007)	(0.006)	(0.008)
D_Patents $_{t-1}$	−0.121***	−0.100***	−0.073*	−0.106***	−0.072*
	(0.025)	(0.024)	(0.043)	(0.034)	(0.042)
Age $_{t-1}$	0.133***	0.131***	0.156***	0.175***	0.155***
	(0.009)	(0.010)	(0.014)	(0.012)	(0.014)
Observations	2,666	2,340	1,165	1,808	1,139
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Sector Fixed Effects	Yes	Yes	Yes	Yes	Yes
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes

The analysis covers Venture Capital investments and SMEI grants raised by firms operating in the European Union in the period between 2008 to 2017. The table reports regression results of the Probit estimation of Eq. (1) on the full sample (Panel A) and its marginal effects (Panel B). SMEI grants is a categorical variable which takes the value of 1 if the firm raises an SMEI grant and 0 if the firm raises a Venture Capital investment in the analyzed year. The table reports coefficients of a Probit estimation followed by standard errors, clustered at the firm level, in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively

Table 2 (continued)

The table presents the estimation results from regressions based on Eq. (1), which includes several indicators to investigate the role of companies' debt (*ST debt*, *LT debt*, *Leverage*) and profitability (*EBIT*, *ROE*, *Profit Margin*) in affecting the probability of obtaining an SMEI grant versus Venture Capital investment. The basic regression (Column 1) is progressively expanded to include year (Column 2), sector (Column 3), and country (Column 4) fixed effects

that when controlling for bank debt, the differences in characteristics of enterprises (size, innovation, and age) between those financed by public subsidies and venture capitalists do not change considerably, confirming H2. These results align with the baseline, showing a higher probability that companies financed by SMEI grants are, on average, smaller (probability between 2 and 4%), less innovative (10–12%), and older (13–17%). Notably, companies receiving SMEI grants are, on average, more indebted—even compared to their capital size (*Leverage*)—but this debt is mainly driven by short-term or current activities. In contrast, companies raising VC are, on average, less indebted and, when financed by a bank, are more oriented to finance long-term investments. The observation that VCs tend to target companies with lower levels of debt can be explained by the fact that high debt levels might signal a risky investment, which does not align with the VC strategy of minimizing risk while maximizing investment profitability.

The profitability of the financed companies is the ultimate goal of financial players, whether they are public (via grants) or private (via VC investments). Policymakers often aim to strengthen financed companies, while venture capitalists seek an increase in the value of the acquired shares and a profitable exit option (Bronzini et al., 2020). In this perspective, the level of profitability of companies could influence investor behavior by modifying the strategy of public and private interventions. Testing H3 examines whether differences in characteristics exist between firms financed by SMEI grant or VC investments, and whether these differences vary based on profitability.

Hence, we augment Eq. (1) with three indicators in three separate estimations, proxying profitability with Earnings Before Income and Taxes (*EBIT)*, Return on Equity (*ROE)*, and *Profit Margin* indicators, respectively. Should we find no changes in the signs of the coefficients related to the size, innovation, and age, we can conclude that current profitability does not act as a distinctive factor in the investment strategies of SMEI grant and VC investors.

Table 2, Columns 3 through 5, shows the coefficient estimates in Panel (A) and the associated marginal effects in Panel (B). Results confirm what already emerged from the baseline estimations; controlling for past profitability of VC/SMEI grant-backed firms does not affect the differential probability of raising one or the other based on size, level of innovation, and age, confirming H3. At the same time, we find that more profitable firms have a larger probability of receiving a public subsidy than VC-backed firms. One possible explanation is that older firms are more likely to generate profits.

5.2.2 Investment rounds and SMEI phases

As already anticipated, companies seeking for the SME Instrument can apply for either a Phase 1 instrument, directly for a Phase 2, or for both. The Phase 1 instrument is a lump sum of 50,000 euros that companies use to establish their initial operations, such as feasibility studies and business ideas. In other terms, this instrument seems to mimic the early

stages of VC funding, sharing similar objectives. On the other hand, the Phase 2 contribution is based on a proposal, providing resources ranging from EUR 500,000 and EUR 2.5 million. Applying firms have to demonstrate high potential in terms of corporate competitiveness and growth, supported by a strategic business plan. Given the objectives, the Phase 2 instrument seems more comparable to later-stage VC investments.[10] Different objectives may lead to different investment behaviors, affecting the characteristics of firms that are more likely to receive private or public investment.[11]

Our results so far have not considered this difference. We now test H4 by controlling for such a potential heterogeneous behavior, by estimating Eq. (1) on two subsets of firms: the first limited to firms that have raised either an SMEI Phase 1 or an Early-Stage VC investment (or both), and the second limited to those that have received either an SMEI Phase 2 or a Later Stage VC investment (or both).[12]

Table 3 shows the results, with Columns 1 and 2 focusing on the first and second subsets of firms, respectively. Interestingly, we find no substantial differences in behaviors between private and public investors based on the investment stage or round, confirming H4. Indeed, we observe negative signs for *Assets* and *Patents*, as well as a positive one for *Age*, corroborating our baseline results.

5.3 Complementarity between VC and SMEI grants

So far, our empirical strategy has been binary, i.e. useful for testing the characteristics of entities that raise either VC or SMEI grants, regardless of whether they have potentially already obtained the other form of financing. In the robustness section, we will test the robustness of our baseline results by excluding from the sample transactions related to firms that raised both types of funding to reduce concerns that the overall results could be driven by firms with 'mixed' characteristics, having raised both VC funds and SMEI grants. In this section, we address two other related aspects: testing whether the determinants identified for VC and SMEI grant individually are different for firms that received both forms of financing in the sample, and testing whether there is complementarity/substitution between SMEI grant and VC.

[10] Table 16 in the Appendix provides descriptive evidence of the main (baseline) regressors by type of SMEI (i.e., Ph. 1 and Ph. 2) and VC (i.e., Early and Later Stages), offering insights into the comparability of SMEI and VC investments by stage.

[11] We define Early Stage financing as transactions categorized by VentureSource as Seed or Early (Nepelski et al., 2016), consistent with studies like Davila et al. (2003) and Bellucci et al.(2023a). This includes seed-stage operations and the first two VC rounds. Later Stage VC is defined as transactions from the third round onward. Acknowledging that Early Stage definitions can vary, we conducted a robustness analysis by reclassifying the first two VC rounds from Early to Later Stage. This adjustment refined Early Stage to include only the initial financing stages (VC Seed, Accelerator, Angel Investments), while the reclassified rounds were compared against SMEI Phase 2. The results were consistent with our original analysis, confirming that our baseline findings are robust to this change. These additional results are available upon request.

[12] We always compare the characteristics of firms in the year before they secure either an Early-stage or Later-stage VC investment, or an SMEI from Phase 1 or Phase 2. This means that if a firm initially secures an Early-stage VC and then a Later-stage VC, it will be included in the former sample with reference to the year it received the Early-stage VC, and in the latter sample with reference to the year it received the Later-stage VC. Likewise, the same attribution to both samples applies to firms that have received both SMEIs from both Phase 1 and Phase 2.

Table 3 Heterogeneous effects—Early Stages vs SMEI Phase 1, Later Stages vs SMEI Phase 2

Panel A—Probit		
	SMEI Ph.1	SMEI Ph.2
Dependent variable	(1)	(2)
Assets $_{t-1}$	−0.213***	−0.258***
	(0.024)	(0.045)
Patents $_{t-1}$	−0.597***	−0.503***
	(0.169)	(0.164)
Age $_{t-1}$	0.805***	0.169*
	(0.057)	(0.101)
Observations	3,697	1,045
Year Fixed Effects	Yes	Yes
Sector Fixed Effects	Yes	Yes
Country Fixed Effects	Yes	Yes
Panel B—Marginal effects		
	SMEI Ph.1	SMEI Ph.2
Dependent Variable	(1)	(2)
Assets $_{t-1}$	−0.035***	−0.058***
	(0.004)	(0.009)
Patents $_{t-1}$	−0.097***	−0.113***
	(0.027)	(0.036)
Age $_{t-1}$	0.131***	0.038*
	(0.008)	(0.022)
Observations	3,697	1,045
Year Fixed Effects	Yes	Yes
Sector Fixed Effects	Yes	Yes
Country Fixed Effects	Yes	Yes

The analysis covers Venture Capital investments and SMEI grants raised by firms operating in the European Union in the period between 2008 to 2017. The table reports regression results of the Probit estimation of Eq. (1) on the full sample (Panel A) and its marginal effects (Panel B). SMEI Phase 1 is a categorical variable which takes the value of 1 if the firm raises an SMEI Phase 1 and 0 if the firm raises an Early stage of Venture Capital investments in the analyzed year. SMEI Phase 2 is a categorical variable which takes the value of 1 if the firm raises an SMEI Phase 2 and 0 if the firm raises a Later stage of Venture Capital investments in the analyzed year. *Assets* $_{t-1}$ is the natural logarithm of the total assets reported in the balance sheet by the firm for the year before raising a Venture Capital investment or an SMEI grant. *Patents* $_{t-1}$ is an indicator that takes the value of 1 for firms having applied for the filing of patent in the year before raising a Venture Capital investment or an SMEI grant, and 0 otherwise. *Age* $_{t-1}$ is the natural logarithm of the age of the firm the year before raising a Venture Capital investment or an SMEI grant. The table reports coefficients of a Probit estimation followed by standard errors, clustered at the firm level, in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively

The table presents the estimation results from regressions on a modified version of Eq. (1), where the original dependent variable SMEI grant is replaced with SMEI Ph.1 and SMEI Ph.2. This modification limits the comparison to SMEI Phase 1 vs. VC Early Stage and SMEI Phase 2 vs. VC Later Stage, respectively. The basic regression (Column 1) is progressively expanded to include fixed effects for year (Column 2), sector (Column 3), and country (Column 4)

To address the first part of the question, we adapt Eq. (1) to perform a multinomial probit analysis using a categorical dependent variable with three potential outcomes, reflecting whether firms in the sample secured only SMEI grant, only VC, or both. The goal is to examine whether the characteristics of firms receiving both types of financing differ from those receiving just one. In the analysis, we use the VC + SMEI grant scenario as the baseline outcome and compare it with SMEI grant-only and VC-only cases. We then estimate marginal effects to assess the significance of factors like size, experience, and innovation across the three scenarios. The results of the multinomial probit analysis, along with the marginal effects, are presented in Table 4.

The findings indicate that compared to companies that secured both VC and SMEI grant, those with only VC backing are generally younger, consistent with the idea that additional funding takes more time, and are larger in size, but they show lower levels of innovation, as evidenced by their reduced patenting activity. On the other hand, firms that received only SMEI grant, when compared to those that received both types of funding, tend to have smaller asset values, less patenting activity, and secure funding at a later stage. In summary, firms in our sample that obtained both VC and SMEI grant exhibit distinct characteristics from those that secured only VC or only SMEI grant. Specifically, the likelihood of receiving only VC funding increases by 5.5% for companies with higher asset growth, while the likelihood of receiving both VC and SMEI grant rises by 0.5% for firms with higher asset growth. Conversely, the likelihood of obtaining only SMEI grant funding decreases by 6% for companies with higher asset growth. Regarding innovation, patenting activity is associated with a 27% greater probability of receiving only VC funding, a 12% higher probability of receiving both types of funding, and a 39% lower probability of receiving only SMEI grant. Additionally, higher firm age correlates with a decreased likelihood of receiving only VC funding (−22%), a slight reduction in the likelihood of receiving both VC and SMEI grant (−0.9%), and a significant increase in the likelihood of receiving only SMEI grant (+23%).

We then investigate the complementarity or substitution between VC and SMEI grant by modifying Eq. (1) using two different empirical approaches. First, we introduce a new binary variable, *VCFirst*, which equals 1 if the deal involves a firm that had already received a VC before obtaining an SMEI grant in our sample, and zero otherwise, while keeping the dependent variable unchanged. Second, we add another binary variable, *SMEIFirst*, which equals 1 if the deal involves a firm that had already received an SMEI grant before securing a VC in our sample, and zero otherwise, but this time we adjust the dependent variable to *Pr(VC)*, which equals 1 if the transaction is a VC investment and zero if it is an SMEI grant (note that in this case, the time frame is limited to 2014–2017 because the SME Instrument was not available before 2014). If the coefficient for *VCFirst* (or *SMEIFirst*) is positive and significant, it would indicate that the two financial instruments are complementary, as having a VC (SMEI grant) increases the likelihood of receiving an SMEI grant (VC). Conversely, if the coefficient is negative, we would infer that the two instruments act as substitutes. It is important to highlight that these two estimations are not directly comparable because the order in which the two financial instruments are received is crucial. For instance, the presence of a VC might be a positive signal for awarding an SMEI grant, suggesting complementarity between SMEI grants and existing VCs. However, the reverse might not hold true; an SMEI grant may not necessarily be a strong signal for attracting a VC. For the sake of thoroughness, we estimate both models in their complete form, including all fixed effects, but similar results emerge also for the other versions of the model.

Table 4 Heterogeneous Effects: a comparison of companies receiving both SMEI grants and Venture Capital with those backed by only SMEI grants or only Venture Capital

Panel A—Multinomial Probit				
	Categorical variable			
Dependent variable	(1)	(2)	(3)	(4)
	Outcome: "Only VC" vs. "VC + SMEI grant"			
Assets $_{t-1}$	0.056**	0.058**	0.038*	0.030
	(0.022)	(0.022)	(0.024)	(0.024)
D_Patents $_{t-1}$	−0.365***	−0.532***	−0.369***	−0.428***
	(0.088)	(0.093)	(0.099)	(0.101)
Age $_{t-1}$	−0.296***	−0.292***	−0.165**	−0.208***
	(0.053)	(0.057)	(0.065)	(0.062)
	Outcome: "Only SMEI grant" vs. "VC + SMEI grant"			
Assets $_{t-1}$	−0.251***	−0.281***	−0.158***	−0.140***
	(0.024)	(0.026)	(0.034)	(0.022)
D_Patents $_{t-1}$	−2.202***	−1.895***	−0.830***	−0.764***
	(0.145)	(0.158)	(0.188)	(0.115)
Age $_{t-1}$	0.900***	0.972***	0.691***	0.718***
	(0.056)	(0.063)	(0.085)	(0.051)
Observations	4,742	4,742	4,742	4,742
Year Fixed Effects	No	Yes	Yes	Yes
Sector Fixed Effects	No	No	Yes	Yes
Country Fixed Effects	No	No	No	Yes

Panel B—Marginal effects			
	VC	VC + SMEI grant	SMEI grant
Dependent Variable	(1)	(2)	(3)
Assets $_{t-1}$	0.055***	0.005*	−0.060***
	(0.004)	(0.002)	(0.003)
D_Patents $_{t-1}$	0.269***	0.116***	−0.386***
	(0.024)	(0.010)	(0.026)
Age $_{t-1}$	−0.222***	−0.009*	0.231***
	(0.007)	(0.005)	(0.006)
Observations	4,742	4,742	4,742
Year Fixed Effects	No	No	No
Sector Fixed Effects	No	No	No
Country Fixed Effects	No	No	No

The analysis covers Venture Capital investments and SMEI grants raised by firms operating in the European Union in the period between 2008 to 2017. The dependent is a Categorical Variable which takes the value of 2 if the firm raises an SMEI grant only, 1 if it raises both a Venture Capital investment and an SMEI grant, 0 if the firm raises a Venture Capital investment only in the analyzed period. *Assets* $_{t-1}$ is the natural logarithm of the total assets reported in the balance sheet by the firm for the year before raising a Venture Capital investment or an SMEI grant. *Patents* $_{t-1}$ is an indicator that takes the value of 1 for firms having applied for the filing of patent in the year before raising a Venture Capital investment or an SMEI grant, and 0 otherwise. *Age* $_{t-1}$ is the natural logarithm of the age of the firm the year before raising a Venture Capital investment or an SMEI grant. Panel A reports coefficients of a Multinomial Probit estimation followed by standard errors, clustered at the firm level, in parentheses. ***, **, and * indicate statistical significance at

Table 4 (continued)

the 1%, 5%, and 10% level, respectively. Panel B reports the marginal effects of the Multinomial Probit estimation (model in Panel (A) col (1)) followed by standard errors, clustered at the firm level, in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively

The table presents the estimation results from multinomial probit regressions (Panel A) and related marginal effects (Panel B) on a modified version of Eq. (1), where the original dependent binary variable SMEI grant is replaced with a categorical variable: 2 for companies raising only SMEI grants, 1 for companies raising both SMEI grants and VC, and 0 for companies raising only VC investments. The basic regression (Column 1) is progressively expanded to include fixed effects for year (Column 2), sector (Column 3), and country (Column 4)

The results from the first estimation, along with the associated marginal effects—shown in Table 5, column 1—indicate that the probability of obtaining an SMEI grant increases by 9% for firms that have already secured a VC. Notably, the coefficients for the three determinants used in our baseline model (assets, patents, and age) remain significant, with the same sign and similar magnitude, further supporting our baseline conclusions. When examining the reverse scenario (Table 5, column 2), we observe a 5% probability of securing a VC after receiving an SMEI grant, at the 10% statistically significant level. In this scenario, the interpretation of the coefficients for the three determinants should be read in the opposite direction to our baseline estimate. Overall, these findings provide evidence of the complementarity of the two financial instruments, despite the magnitude of their complementarity depends on the sequence in which the funding is received.[13]

6 Robustness tests

6.1 Alternative definitions of the dependent variables

In previous sections, we explored how the size, innovation ability, and age of firms are differently associated with their probability of obtaining an SMEI grant compared to a Venture Capital investment. We also observed that firms receiving both types of funding—albeit at different times—exhibit distinct characteristics compared to those that secured only VC or only SMEI grant, which could potentially lead to a misinterpretation of our baseline findings if based on just two categories. This raises the possibility that the results obtained from the entire sample might be at least partially influenced by companies that received both instruments.

To rule out this possibility and confirm our previous findings, we replicated the model presented in Eq. (1), this time restricting the sample to companies that exclusively received either VC or SMEI grants during the analyzed period. The results, shown in Table 6, confirm the robustness of our main findings. Excluding enterprises that received both types

[13] We should also acknowledge that the highlighted result could be influenced by the fact that the SME Instrument was only introduced in 2014, and there may not have been enough time for VCs to fund these startups by 2017, so an extension of the time series could increase the level of significance of this signal as well. Moreover, we should also recognize that the presence of more years of VC data compared to SME Instrument data in our sample introduces heterogeneity in the two analyses. To mitigate the latter problem, we have re-estimated the model in column 1 by restricting the period from 2014 to 2017 and obtained aligned results (available upon request), albeit with reduced significance (at 10%), confirming VC as a signal for SMEI grant.

Table 5 Heterogeneous Effects: Assessing the complementarity and substitution between Venture Capital and SMEI grants

Panel A—Probit		
	SMEI grant	VC
Dependent variable	(1)	(2)
VCFirst	0.513***	
	(0.106)	
SMEIFirst		0.231*
		(0.131)
Assets $_{t-1}$	−0.206***	0.240***
	(0.020)	(0.024)
Patents $_{t-1}$	−0.531***	1.128***
	(0.110)	(0.143)
Age $_{t-1}$	0.683***	−0.800***
	(0.046)	(0.055)
Observations	4,742	3,154
Year Fixed Effects	Yes	Yes
Sector Fixed Effects	Yes	Yes
Country Fixed Effects	Yes	Yes
Panel B—Marginal effects		
	SMEI grant	VC
Dependent variable	(1)	(2)
VCFirst	0.095***	
	(0.019)	
SMEIFirst		0.051*
		(0.028)
Assets $_{t-1}$	−0.038***	0.052***
	(0.003)	(0.005)
Patents $_{t-1}$	−0.099***	0.246***
	(0.020)	(0.030)
Age $_{t-1}$	0.127***	−0.175***
	(0.008)	(0.011)
Observations	4,742	3,154
Year Fixed Effects	Yes	Yes
Sector Fixed Effects	Yes	Yes
Country Fixed Effects	Yes	Yes

The analysis covers Venture Capital investments and SMEI grants raised by firms operating in the European Union in the period between 2008 to 2017. The table reports regression results of the Probit estimation of Eq. (1) on the full sample (Panel A) and its marginal effects (Panel B). To assess the complementarity and substitution between VC and SMEI grant, we introduce two binary variables: *VCFirst*, which equals 1 if the firm received VC before SMEI grant, and *SMEIFirst*, which equals 1 if the firm received SMEI grant before VC, modeling the probability of VC investment (Pr(VC)) for the 2014–2017 period. *Assets* $_{t-1}$ is the natural logarithm of the total assets reported in the balance sheet by the firm for the year before raising a Venture Capital investment or an SMEI grant. *Patents* $_{t-1}$ is an indicator that takes the value of 1 for firms having applied for the filing of patent in the year before raising a Venture Capital investment or an SMEI grant, and 0 otherwise. *Age* $_{t-1}$ is the natural logarithm of the age of the firm the year before raising a Venture Capital investment or an SMEI grant. This table reports coefficients of a Probit estimation followed by standard

Table 5 (continued)

errors, clustered at the firm level, in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively

In this table, we show the results of two empirical approaches: (1) introducing the binary variable *VCFirst* to identify firms receiving VC before SMEI grant, and (2) introducing *SMEIFirst* and modeling the probability of VC investment *(Pr(VC))* for firms receiving SMEI grant before VC within the 2014–2017 period

of financing does not alter the signs or significance of the estimated coefficients, which remain fairly consistent in magnitude with those of the baseline model. These findings hold across different model specifications, regardless of the fixed effects incorporated, further reinforcing the robustness of our baseline results.

6.2 Alternative definitions of explanatory variables

In this section, we test the robustness of our results adopting alternative definitions of the innovation and size of the analyzed firms. We do not conduct a similar robustness analysis on age, given that it is inherently defining the firm stage of development.

6.2.1 Innovation

In our baseline model, we adopted patents as the indicator signaling the presence of technological innovations. This approach aligns with the developed literature on innovation (e.g., Eaton & Kortum, 1996, 1999; Griliches, 1998; Kanwar & Evenson, 2003; Kortum, 1997). In particular, we used a binary variable as a regressor, indicating the presence of new patents the year before the firm receives either VC financing or an SMEI grant.

To assess the robustness of these findings, we replicate the baseline model of Eq. (1), replacing this indicator with two alternative proxies. On one side, we use a binary variable, $D\_Patent\ ever_{t-1}$, indicating whether the firm has ever filed a patent before receiving private or public financing. This approach allows us to control for the fact that the beneficial effects of innovation—proxied by the presence of patents—may materialize after more than 1 year from the filing. On the other side, we adopt a continuous variable, $Patent\ count_{t-1}$, which provides quantitative information on the number of registered patents. This approach allows us to test whether the intensity of innovation—rather than only its presence—differently determines how private and public financing is raised. The results of these analyses are presented in Table 7, Col. (1) and (2), showing that the marginal effects associated with the probability of raising VC versus an SMEI grant are significantly higher also when patents were registered some years before financing (−0.137) and when the intensity of innovation is higher (−0.027).

Patents are not always equally applicable to all types of industries and business models (Anand & Khanna, 2000). For instance, VCs could fund ICT firms that are far less able to patent than a biotech firm would be (see, e.g., Levin et al.,; 1987; Cohen et al.,; 2000). Hence, as a further test, we also estimate a new version of the baseline model using a different proxy for innovation, often adopted to investigate the macro-economic determinants of equity financing—expenditure in Research and Development (e.g., Cherif & Gazdar, 2011; Gompers & Lerner, 1998; Pradhan et al., 2017). R&D expenditure can be also considered as one of the best proxies for the total number of innovations (Arundel & Kabla, 1998). In detail, we use a binary indicator, $R\&D_{t-1}$, equal to 1 if the firm has a positive

Table 6 Robustness test—Alternative definitions of the dependent variable: Exclusion of the mixed category

Panel A—Probit				
	SMEI grant			
	Mixed excluded			
Dependent variable	(1)	(2)	(3)	(4)
Assets $_{t-1}$	−0.222***	−0.251***	−0.268***	−0.237***
	(0.016)	(0.019)	(0.024)	(0.026)
D_Patents $_{t-1}$	−1.443***	−1.026***	−1.371***	−1.133***
	(0.127)	(0.164)	(0.190)	(0.196)
Age $_{t-1}$	0.867***	0.940***	0.801***	0.828***
	(0.036)	(0.043)	(0.052)	(0.057)
Observations	4,282	4,282	4,282	4,282
Year Fixed Effects	No	Yes	Yes	Yes
Sector Fixed Effects	No	No	Yes	Yes
Country Fixed Effects	No	No	No	Yes
Panel B—Marginal effects				
	SMEI grant			
	Mixed excluded			
Dependent Variable	(1)	(2)	(3)	(4)
Assets $_{t-1}$	−0.062***	−0.054***	−0.046***	−0.036***
	(0.004)	(0.004)	(0.004)	(0.004)
D_Patents $_{t-1}$	−0.405***	−0.222***	−0.237***	−0.172***
	(0.034)	(0.033)	(0.029)	(0.027)
Age $_{t-1}$	0.243***	0.203***	0.138***	0.126***
	(0.007)	(0.007)	(0.008)	(0.008)
Observations	4,282	4,282	4,282	4,282
Year Fixed Effects	No	Yes	Yes	Yes
Sector Fixed Effects	No	No	Yes	Yes
Country Fixed Effects	No	No	No	Yes

The analysis covers Venture Capital investments and SMEI grants raised by firms operating in the European Union in the period between 2008 to 2017. The table reports regression results of the Probit estimation of Eq. (1) on the full sample (Panel A) and its marginal effects (Panel B). The dependent variable, *SMEI grant – Mixed excluded* (Columns (1) to (4)), is a binary variable which takes the value of 1 if the firm raises an SMEI grant only, and 0 if the firm raises a Venture Capital investment only in the analyzed period (firms raising both SMEI grants and Venture Capital investments are excluded from the sample). The dependent variable, *SMEI grant – Mixed only* (Column (5)), is a binary variable which takes the value of 1 if the firm raises an SMEI grant, and 0 if the firm raises a Venture Capital investment, limitedly to firms raising both SMEI grants and Venture Capital investments in the analyzed period. *Assets* $_{t-1}$ is the natural logarithm of the total assets reported in the balance sheet by the firm for the year before raising a Venture Capital investment or an SMEI grant. *Patents* $_{t-1}$ is an indicator that takes the value of 1 for firms having applied for the filing of patent in the year before raising a Venture Capital investment or an SMEI grant, and 0 otherwise. *Age* $_{t-1}$ is the natural logarithm of the age of the firm the year before raising a Venture Capital investment or an SMEI grant. This table reports coefficients of a Probit estimation followed by standard errors, clustered at the firm level, in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively

The table presents the estimation results from regressions of Eq. (1) by excluding companies raising both VC and SMEI in the sample period

R&D expenditure the year before financing, and zero otherwise. The result of this estimation is shown in Table 7, Col. (3), and confirms our previous findings. Specifically, firms that have spent financial resources on research and development in the past year have a higher probability of raising VC instead of an SMEI grant.

6.2.2 Size

In economic literature, the size of a firm is typically proxied by three main indicators (Doğan, 2013): total assets (e.g., Isik et al., 2017; Nanda & Panda, 2018), total sales (e.g., Isik et al., 2017; Rajan & Zingales, 1995), and the number of employees (e.g., Isik et al., 2017).[14] While in most cases the choice of which indicator to use is not discussed (Dang et al., 2018) or is mainly motivated by constraints on data availability (Hart & Oulton, 1996), a few more recent studies suggest that the choice of the size indicator could, in principle, affect the results of estimated models (Vijh & Yang, 2013). Hence, similarly to Didier et al. (2014), we test the robustness of our baseline model specification by alternatively substituting total assets—our main indicator—with total sales and the number of employees as proxies for the firm's size. If the results are consistent with those obtained using total assets, we may confirm that the company size is one of the predictors of VC financing regardless of how it is defined.

Table 7, Columns (4) and (5), show the results of the robustness test, replicating the estimation of the model in Eq. (1) but substituting total assets with total sales and number of employees, respectively. We find that in both cases the probability of raising an SMEI grant with respect to VC-backed firms is higher for smaller firms, as evidenced by the negative and statistically significant coefficient associated with total sales (−0.259) and the number of employees (−0.042), with the related estimated marginal effects equal to −5.3% and −0.8%, respectively. Hence, our baseline results are reassuringly robust to alternative definitions for the firm's size.

6.3 Endogeneity issues

In the previous sections, we investigated which characteristics of the companies could be considered potential determinants for public and private investors. To achieve this, we examined size, innovation, and age indicators in the year before the VC investment or the SMEI grant. This choice allows us to reduce the risk of possible endogeneity issues in the estimated models, given that the characteristics of the firms may not be influenced by the subsequent private or public financing under investigation. At the same time, obtaining a VC investment or an SMEI grant frequently necessitates a lengthy period of negotiation and evaluation by the investors. In certain circumstances, this period might also be longer than 1 year, potentially confounding our results due to endogeneity concerns.

To overcome this potential issue and further test the robustness of our results, we replicate the estimations of Eq. (1), anticipating the lag of the regressors from one to 2 years ahead of the year of the VC investment or the SMEI grant. Reassuringly, the results shown in Table 8 are in line with what we obtained in the baseline estimations, irrespective of the inclusion of different sets of fixed effects.

[14] If the firms under investigations are listed, the market value of equity is also often chosen as a relevant indicator to proxy the size (Dang et al., 2018). Since firms raising a VC investment or a SMEI grant are typically unlisted, we have not used this indicator in our analysis.

Table 7 Robustness test—Alternative definitions of the explanatory variables: Innovation and Size

Panel A—Probit					
	SMEI grant				
Dependent variable	(1)	(2)	(3)	(4)	(5)
Assets $_{t-1}$	−0.185***	−0.201***	−0.211***		
	(0.019)	(0.019)	(0.019)		
Employees $_{t-1}$				−0.259***	
				(0.037)	
Sales $_{t-1}$					−0.042**
					(0.017)
D_Patent $_{t-1}$				−0.538***	−0.562***
				(0.121)	(0.134)
D_Patent ever $_{t-1}$	−0.746***				
	(0.087)				
Patent count $_{t-1}$		−0.143**			
		(0.058)			
R&D $_{t-1}$			−0.436**		
			(0.203)		
Age $_{t-1}$	0.663***	0.669***	0.681***	0.663***	0.584***
	(0.046)	(0.045)	(0.045)	(0.054)	(0.052)
Observations	4,742	4,742	4,742	2,723	2,528
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Sector Fixed Effects	Yes	Yes	Yes	Yes	Yes
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes
Panel B—Marginal effects					
	SMEI grant				
Dependent variable	(1)	(2)	(3)	(4)	(5)
Assets $_{t-1}$	−0.034***	−0.038***	−0.040***		
	(0.004)	(0.003)	(0.004)		
Employees $_{t-1}$				−0.053***	
				(0.007)	
Sales $_{t-1}$					−0.008**
					(0.003)
D_Patent $_{t-1}$				−0.110***	−0.109***
				(0.024)	(0.025)
D_Patent ever $_{t-1}$	−0.137***				
	(0.015)				
Patent count $_{t-1}$		−0.027**			
		(0.011)			
R&D $_{t-1}$			−0.083**		
			(0.039)		
Age $_{t-1}$	0.122***	0.127***	0.129***	0.136***	0.113***
	(0.008)	(0.008)	(0.008)	(0.010)	(0.009)
Observations	4,742	4,742	4,742	2,723	2,528

Table 7 (continued)

Panel B—Marginal effects					
	SMEI grant				
Dependent variable	(1)	(2)	(3)	(4)	(5)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Sector Fixed Effects	Yes	Yes	Yes	Yes	Yes
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes

The analysis covers Venture Capital investments and SMEI grants raised by firms operating in the European Union in the period between 2008 to 2017. The table reports regression results of the Probit estimation of Eq. (1) on the full sample (Panel A) and its marginal effects (Panel B). The dependent variable, *SMEI grant*, is a binary variable which takes the value of 1 if the firm raises an SMEI grant, and 0 if the firm raises a Venture Capital investment in the analyzed period. This table reports coefficients of a Probit estimation followed by standard errors, clustered at the firm level, in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively

The table presents the estimation results from regressions based on Eq. (1), which investigates how company size, innovation, and experience affect the probability of obtaining an SMEI grant versus Venture Capital investment, using alternative indicators vis-à-vis the baseline. The basic regression (Column 1) is progressively expanded to include year (Column 2), sector (Column 3), and country (Column 4) fixed effects

6.4 Exclusion of single countries and sectors

We assess whether our findings are impacted by the presence of a particular country or sector. Although our models account for fixed effects related to both countries and sectors, we further investigate this by re-estimating Eq. (1) while sequentially excluding one country (Fig. 1) and one sector (Fig. 2) at a time. For each iteration, we document the coefficients for Assets, Patents, and Age, and plot the resulting 90 coefficients along with their 90% confidence intervals in the two figures. The results remain robust, as all estimates consistently exhibit statistical significance, maintaining the same sign and comparable magnitude relative to the baseline model. This analysis highlights that the observed differences in determinants between SMEI grants and VC are not solely driven by any single country or sector. Additionally, this robustness check ensures that our baseline findings hold true even in the case of potential over- or under-representation of specific countries or sectors within our sample compared to the original data sources.

7 Conclusions and policy implications

Motivated by prior research that examined the characteristics of firms financed by corporate and individual venture capitalists, as well as the impact of public and private funding on firms' innovative performance (Chemmanur et al., 2014; Kou et al., 2020), we compare the characteristics and attributes of European firms supported by public and private sources in early-stage financing. Our goal is to examine whether these two types of funding target firms with different characteristics in terms of age, size, and innovation.

Using a portfolio approach based on firms raising either Venture Capital financing, public grants under the Horizon 2020 SME Instrument scheme, or both, we empirically test whether: (i) both venture capitalists and public authorities responsible for awarding SMEI

Table 8 Robustness test—Endogeneity

Panel A—Probit				
	SMEI grant			
Dependent variable	(1)	(2)	(3)	(4)
Assets $_{t-2}$	−0.188***	−0.199***	−0.199***	−0.166***
	(0.014)	(0.016)	(0.019)	(0.020)
D_Patents $_{t-2}$	−0.795***	−0.432***	−0.716***	−0.563***
	(0.082)	(0.100)	(0.116)	(0.120)
Age $_{t-2}$	0.671***	0.744***	0.568***	0.587***
	(0.031)	(0.037)	(0.041)	(0.047)
Observations	4,264	4,264	4,264	4,264
Year Fixed Effects	No	Yes	Yes	Yes
Sector Fixed Effects	No	No	Yes	Yes
Country Fixed Effects	No	No	No	Yes
Panel B—Marginal effects				
	SMEI grant			
Dependent variable	(1)	(2)	(3)	(4)
Assets $_{t-2}$	−0.060***	−0.049***	−0.042***	−0.032***
	(0.004)	(0.004)	(0.004)	(0.004)
D_Patents $_{t-2}$	−0.253***	−0.107***	−0.153***	−0.109***
	(0.025)	(0.024)	(0.024)	(0.022)
Age $_{t-2}$	0.214***	0.185***	0.121***	0.113***
	(0.008)	(0.007)	(0.008)	(0.008)
Observations	4,264	4,264	4,264	4,264
Year Fixed Effects	No	Yes	Yes	Yes
Sector Fixed Effects	No	No	Yes	Yes
Country Fixed Effects	No	No	No	Yes

The analysis covers Venture Capital and SMEI grants raised by firms operating in the European Union in the period between 2008 to 2017. The table reports regression results of the Probit estimation of Eq. (1) on the full sample (Panel A) and its marginal effects (Panel B). SMEI grants is a categorical variable which takes the value of 1 if the firm raises an SMEI grant and 0 if the firm raises a Venture Capital investment in the analyzed year. *Assets* $_{t-2}$ is the natural logarithm of the total assets reported in the balance sheet by the firm two years before raising a Venture Capital investment or an SMEI grant. *Patents* $_{t-2}$ is an indicator that takes the value of 1 for firms having applied for the filing of patent two years before raising a Venture Capital investment or an SMEI grant, and 0 otherwise. *Age* $_{t-2}$ is the natural logarithm of the age of the firm two years before raising a Venture Capital investment or an SMEI grant. The table reports coefficients of a Probit estimation followed by standard errors, clustered at the firm level, in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively

The table presents the estimation results from regressions based on Eq. (1), which investigates how company size (*Assets*), innovation (*D_Patents*), and experience (*Age*) affect the probability of obtaining an SMEI grant versus Venture Capital investment. To further address endogeneity issues, 2-year-lagged indicators are used instead of 1-year-lagged ones. The basic regression (Column 1) is progressively expanded to include year (Column 2), sector (Column 3), and country (Column 4) fixed effects

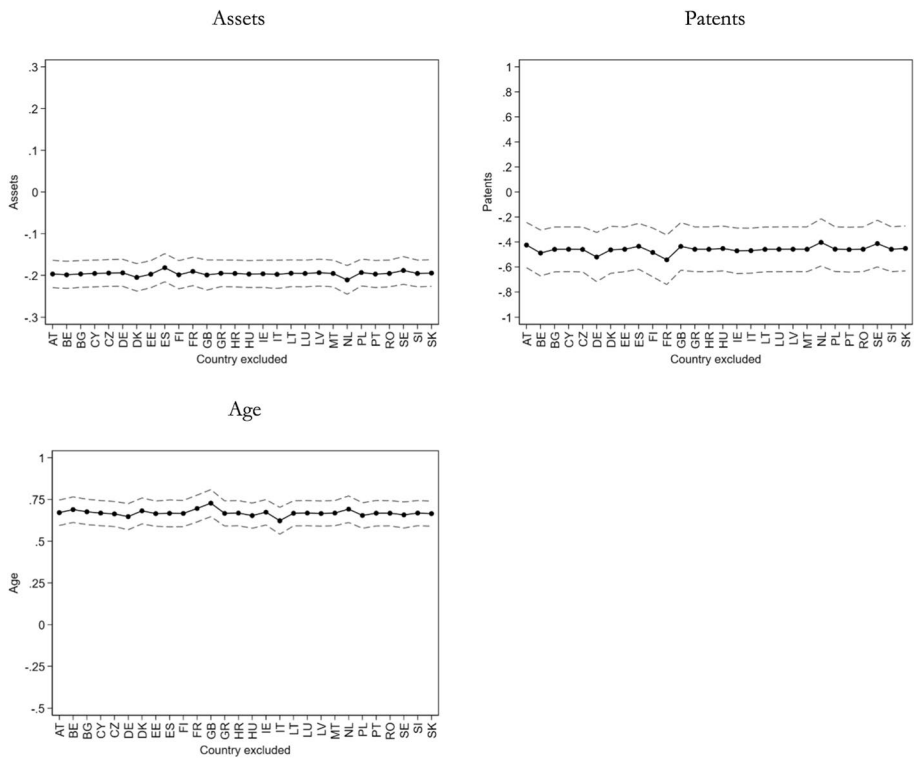

Fig. 1 Country excluded. These figures show the estimated coefficients for Assets (top left), Patents (top right), and Age (bottom left) for 28 versions of Eq. (1) each excluding one country at a time. *Note* The label in the horizontal axis indicates the country excluded in each of the 28 estimations of Eq. (1) where one country is excluded at a time. The darker dots indicate the estimated coefficients and the dashed lines delimitate the 10% confidence interval

grants exhibit a similar pattern in financing small, young, and innovative enterprises; (ii)/(iii) potential heterogeneous effects that may drive differential investment behaviors in terms of the level of bank indebtedness and profitability of firms; (iv)/(v) the potential differential behaviors in the interplay between private and public investment by comparing early and later stages of private and public funding and the complementarity between VC ad SMEI grants.

Our analyses reveal that, despite having very similar ex-ante goals, private and public investors target very different types of firms. Firms that receive SMEI grants are generally smaller, less innovative, and older than those receiving Venture Capital funding. Furthermore, VC reaches more innovative enterprises earlier than SMEI grants. On the other hand, public investors seem to be more prone to fund smaller and less capitalized firms. When bank debt and profitability are considered, the differences in the attributes and characteristics of enterprises between those financed by public subsidies and those financed by venture capitalists are not significant. Firms receiving public subsidies are more indebted in the short term, whereas firms funded by VCs are less indebted and more oriented to long-term bank debt financing. Moreover, profitable firms are more likely to receive SMEI grants than VC-backed firms are. In terms of the financing stage, there are no significant differences in behaviors between private and public investors based on the investment round. A focus on firms raising both SMEI grants and VC in subsequent

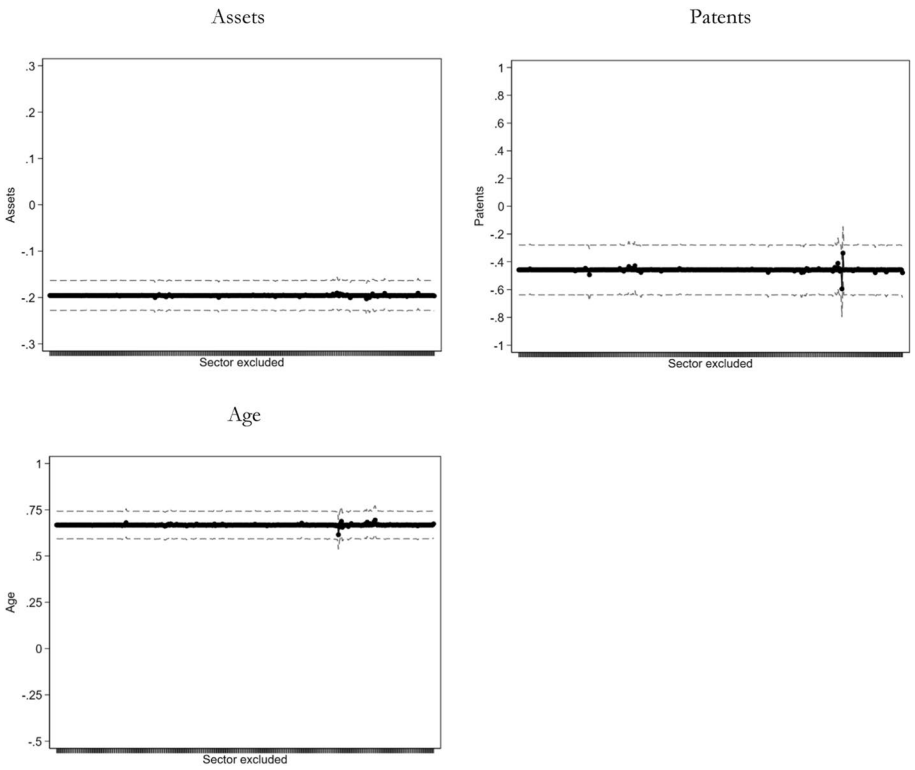

Fig. 2 Sector excluded. These figures show the estimated coefficients for Assets (top left), Patents (top right), and Age (bottom left) for 381 versions of Eq. (1) each excluding one sector (NACE 4-digit) at a time. *Note* The label in the horizontal axis indicates the country excluded in each of the 381 estimations of Eq. (1) where one sector (NACE 4-digit) is excluded at a time. The darker dots indicate the estimated coefficients and the dashed lines delimitate the 10% confidence interval

financing provides evidence of the complementarity of the two instruments, despite the magnitude of their complementarity depending on the sequence in which the funding is received.

All findings remain robust when subject to several tests, such as using alternative definitions of innovation and firm size, removing firms that received both types of financing from the analysis, or excluding certain countries or sectors.

These results come with some limitations. Our analysis aims to test which characteristics of firms are more likely to attract VC investments rather than SMEIs by looking at completed transactions. We are unable to verify, with the available data, how much these results are influenced by the demand for such funds rather than the supply side and, specifically, whether firms self-select into one of the two types of financing. In particular, we lack access to information on the application for VC support for the entire sample. One possible avenue to partially address this topic would be to conduct qualitative research on VC applications, gathering information through interviews with entrepreneurs and VC investors (similarly, e.g., to Cosh et al., 2009), with the likely limitation of not gaining insight into the entire VC and SMEI markets. In any case, this strategy goes beyond the scope of this study and we leave it for future research.

Another potential limitation may concern the generalizability of the results obtained from this analysis. Geographically, the distinctive characteristics of the EU market, underscored

by the policy significance of the European Commission and a relatively advanced VC market compared to other regions such as the U.S., may influence the transferability of our findings to non-European markets. Nevertheless, our study suggests that examining a comparable scenario within the U.S. market, given the parallels between SMEI and the SBIR program, could corroborate the outcomes. Furthermore, the very nature of SMEI as a transnational policy tool might differ from the public programs of individual countries, both within Europe and beyond. National programs, in contrast to SMEI, might exhibit less propensity for risk-taking concerning financial allocations, institutional capabilities, and network resources, thereby raising the potential for divergent outcomes in comparison to SMEI.

Our results also carry some relevant policy implications. First, the SMEI might have only partially succeeded in financing the most innovative companies. The reason for this might be the fact that when supporting less innovative, older, and smaller companies compared to venture capitalists, it demonstrates higher risk aversion than private investors. Anecdotal evidence supports this possibility. Thus, even though it shares similar objectives to venture capitalists, the final result of public intervention might be job preservation rather than job creation and promoting cohesion rather than focusing on high-growth, high-risk ventures. This might be partly due to the type of innovation required: the first two research Framework Programs (FWPs) of SMEI (between 2014 and 2017, the period under study) sought to finance innovations that might emerge in the market and spur growth, though they did not necessarily 'generate' new markets. Fostering incremental rather than radical innovation ensures that smaller businesses remain competitive. However, it can also be seen as a potential inefficiency, as these firms may not contribute as significantly to innovation-driven economic growth as their high-growth counterparts. Policymakers could therefore focus on high-growth, market-creating, and breakthrough innovations that require higher risk tolerance, which requires higher risk tolerance than supporting incremental innovation. This has been partially addressed by modifications to the objectives of the SMEI. The new editions seem to put more emphasis on 'market-creating' innovations rather than just incremental innovations in already existing markets. It is not clear yet, however, if this has been reflected in funding patterns. The changes in the objectives create also a problem of a lack of a solid and long-lasting framework and moving targets on selection criteria. This might discourage potential target firms from applying. New studies will be able to determine if the consequences of these policies would encourage or deter the public funding of more innovative enterprises.

Second, in contrast to expectations, the SME Instrument has primarily supported older businesses than those financed by VCs. This phenomenon could be related to the fact that participating in public calls requires some administrative effort, dedicated personnel and resources, and knowledge gained from previous applications for public funds. Younger businesses typically lack the administrative experience and capability to participate in public calls, and if they do not start, they may never participate. Therefore, a reduction or simplification of the administrative procedures for obtaining funds, more in line with what private operators do, may result in a younger population of target businesses. Along these lines, the European Commission has introduced some simplifications in the application and assessment processes since the 2018 FWPs, including the possibility to apply independently of a specific set of predetermined topics and the reduction in the number of administrative steps required to obtain funds. However, if policymakers wish to focus their efforts on a specific policy action in line with a broader framework, eliminating pre-established subjects could become burdensome, especially considering the possibility of rapid changes due to unforeseen exogenous events. Future research will be necessary to assess the impact of these potentially conflicting effects on public funds granted during the pandemic.

Appendix

Section A: Database construction and description

See Tables 9, 10, 11

Table 9 Construction of the database

Step	Activity	Source	Number of VC transactions	Number of SME Instruments	Total transactions	% matching
1	Collect VC data	VentureSource	11,056	n.a	11,056	100%
2	Collect SME Instrument data	CORDA	n.a	2,441	2,441	100%
3	Append VC and SME instrument databases	VentureSource + CORDA	11,056	2,441	13,497	100%
4	Merge with balance sheet information	VentureSource + CORDA + ORBIS	5,790	2,267	8,057	60%
5	Merge patent information	VentureSource + CORDA + ORBIS + PATSTAT	5,790 *with patents: 884*	2,267 *with patents: 136*	8,057 *with patents: 1,020*	60% *with patents: 13%*

The table reports the five steps used to construct the database underlying this paper's analyses. The first column enumerates the steps in sequence, the second column summarizes the activities performed, the third column details the data sources, the fourth through sixth columns show the number of involved VC transactions, SME Instrument transactions, and their sum. The last column presents the percentage of successful matches relative to the first step of the process. The term "n.a." is used when any of the input is not applicable. While the matching process allows us to achieve approximately 67% coverage for VC/SMEI investments by companies for which we found a correspondence in the ORBIS database (i.e., we have some balance sheet data), there may still be cases where certain indicators obtained from ORBIS are missing. As a result, when estimations are performed that concurrently include all the regressors (i.e., Assets, Patents, and Age), the number of observations decreases to 4,742. This figure represents the number of transactions for which we have complete balance sheet information (3,047 VC transactions and 1,695 SME Instruments)

This table includes all the necessary steps from the original data sources to the final database, as well as the percentage of matched transactions with respect to the original data

Table 10 Representativeness of the database

Panel A—Venture capital						
Sample	Venture source		Matched with orbis		Final sample	
Country	Nr Transactions	% Total	Nr Transactions	% Total	Nr transactions	% Total
AT	120	1.09	120	2.07	87	2.86
BE	176	1.59	114	1.97	72	2.36
BG	11	0.10	2	0.03	2	0.07
CY	15	0.14	0	0.00	0	0.00
CZ	22	0.20	17	0.29	13	0.43
DE	2,040	18.45	1,646	28.43	654	21.46
DK	365	3.30	210	3.63	121	3.97
EE	33	0.30	19	0.33	12	0.39
ES	729	6.59	572	9.88	325	10.67
FI	386	3.49	225	3.89	153	5.02
FR	1,897	17.16	933	16.11	528	17.33
GB	3,140	28.40	622	10.74	350	11.49
GR	30	0.27	14	0.24	5	0.16
HR	5	0.05	1	0.02	1	0.03
HU	31	0.28	28	0.48	11	0.36
IE	371	3.36	72	1.24	49	1.61
IT	308	2.79	204	3.52	144	4.73
LT	28	0.25	12	0.21	1	0.03
LU	26	0.24	10	0.17	6	0.20
LV	19	0.17	7	0.12	6	0.20
MT	7	0.06	4	0.07	2	0.07
NL	416	3.76	326	5.63	198	6.50
PL	74	0.67	38	0.66	18	0.59
PT	71	0.64	37	0.64	27	0.89
RO	10	0.09	2	0.03	2	0.07
SE	706	6.39	548	9.46	254	8.34
SI	12	0.11	1	0.02	1	0.03
SK	8	0.07	6	0.10	5	0.16
Total	**11,056**	**100**	**5,790**	**100**	**3,047**	**100**
Panel B—SME Instruments						
Sample	CORDA		Matched with orbis		Final sample	
Country	Nr Transactions	% Total	Nr Transactions	% Total	Nr Transactions	% Total
AT	71	2.91	60	2.65	50	2.95
BE	50	2.05	41	1.81	30	1.77
BG	6	0.25	6	0.26	5	0.29
CY	2	0.08	2	0.09	0	0.00
CZ	9	0.37	9	0.40	7	0.41
DE	200	8.19	196	8.65	77	4.54
DK	89	3.65	93	4.10	43	2.54
EE	36	1.47	36	1.59	32	1.89

Table 10 (continued)

Panel B—SME Instruments						
Sample	CORDA		Matched with orbis		Final sample	
Country	Nr Transactions	% Total	Nr Transactions	% Total	Nr Transactions	% Total
ES	530	21.71	522	23.03	402	23.72
FI	109	4.47	96	4.23	76	4.48
FR	136	5.57	126	5.56	78	4.60
GB	270	11.06	189	8.34	133	7.85
GR	13	0.53	13	0.57	9	0.53
HR	0	0.00	0	0.00	0	0.00
HU	44	1.80	44	1.94	41	2.42
IE	28	1.15	25	1.10	19	1.12
IT	402	16.47	405	17.87	379	22.36
LT	14	0.57	14	0.62	5	0.29
LU	0	0.00	0	0.00	0	0.00
LV	9	0.37	9	0.40	9	0.53
MT	4	0.16	4	0.18	1	0.06
NL	163	6.68	115	5.07	94	5.55
PL	32	1.31	32	1.41	22	1.30
PT	49	2.01	46	2.03	43	2.54
RO	4	0.16	4	0.18	4	0.24
SE	119	4.88	128	5.65	85	5.01
SI	44	1.80	44	1.94	44	2.60
SK	8	0.33	8	0.35	7	0.41
Total	**2,441**	**100**	**2,267**	**100**	**1,695**	**100**

The first column reports for each transaction the country in which the VC-backed or SME Instrument-granted company operates. The following six columns report the number of transactions (and % contribution) of each country to the total for the original sample (VentureSource or CORDA), the matched sample (VentureSource or CORDA with ORBIS), and final sample used for estimation (excluding missing values)

This table reports the distribution of Venture Capital transactions (Panel A) and SME Instrument grants (Panel B) by country in the original source (i.e. VentureSource or CORDA), in the sample obtained at the end of the five steps of database construction (see Table A.1), and in the final sample used for the estimations (excluding missing values)

Table 11 Variables description

Variable	Description	Source	Measure
SMEI grants	Presence of an SMEI grant (=1) or a VC (=0)	VentureSource	Binary indicator
Assets	Total assets	Orbis (BvD)	Natural logarithm
D_Patents	Presence (absence) of patents at funding	Patstat	Binary indicator
Age	Difference between the year of funding and the incorporation year	Orbis (BvD)	Natural logarithm
ST debt	Presence (absence) of short-term debt	Orbis (BvD)	Binary indicator
LT debt	Presence (absence) of long-term debt	Orbis (BvD)	Binary indicator
Leverage	Debt-to-total-assets	Orbis (BvD)	Natural logarithm
EBIT	Earnings Before Interest and Taxes	Orbis (BvD)	Value
ROE	(Net income / Shareholder funds) * 100	Orbis (BvD)	Index (%)
Profit Margin	(Profit before tax / Operating revenue) * 100	Orbis (BvD)	Index (%)
Employees	Number of employees	Orbis (BvD)	Natural logarithm
Sales	Total sales	Orbis (BvD)	Natural logarithm
D_Patents ever	Presence (absence) of patents in the whole company's history	Patstat	Binary indicator
Patents count	Number of filed patents	Patstat	Natural logarithm
R&D	Presence (absence) of R&D expenditure	Orbis (BvD)	Binary indicator

In most of the estimations, we use the 1-year lagged version of the variable as independent regressors, except in one estimation where we use the 2-year lagged version. This means, for example, that *Assets* refers to a firm's total assets in the year before the financing. This is also indicated by time subscripts in all the tables reporting estimation results

This table presents the name, measure, source, and related metrics of the variables included in the dataset

Section B: Preliminary statistical analyses

See Tables 12, 13, 14

Table 12 Summary Statistics

Variables	Obs		Mean		Std. Dev		Min		Max	
	VC	SMEI grant	VC	SMEI grant	VC	SMEI grant	VC	SMEI grant	VC	SMEI grant
$Assets_{t-1}$ *(ln)*	3,047	1,695	6.997	6.721	1.948	2.039	0.000	0.001	13.762	12.899
$D\_Patents_{t-1}$	3,047	1,695	1.956	0.049	0.397	0.216	0.000	0.000	1.000	1.000
Age_{t-1} *(ln)*	3,047	1,695	1.389	2.070	0.702	1.069	0.000	0.000	4.533	4.745
$ST\ debt_{t-1}$	1,770	1,555	0.411	0.537	0.492	0.499	0.000	0.000	1.000	1.000
$LT\ debt_{t-1}$	1,770	1,555	0.998	0.758	0.047	0.429	0.000	0.000	1.000	1.000
$Leverage_{t-1}$ *(ln)*	2,911	1,294	0.231	0.217	0.372	0.259	0.000	0.000	4.251	2.634
$EBIT_{t-1}$	700	1,000	− 28.986	0.267	34.185	25.086	− 99.968	− 98.590	67.536	98.196
ROE_{t-1}	1,206	1,190	− 87.310	− 17.289	145.195	106.616	− 919.655	− 963.023	206.549	593.390
$Profit\ Margin_{t-1}$	690	995	− 29.783	− 0.849	33.856	25.177	− 99.183	− 97.508	71.090	98.196
$Employees_{t-1}$ *(ln)*	1,941	1,266	2.547	2.416	1.237	1.180	0.000	0.000	7.952	5.805
$Sales_{t-1}$ *(ln)*	1,873	1,247	5.365	5.771	2.858	2.750	0.000	0.000	12.659	11.194
D_Patents ever	3,047	1,695	0.326	0.080	0.469	0.272	0.000	0.000	1.000	1.000
$Patents\ count_{t-1}$ *(ln)*	3,047	1,695	0.351	0.088	0.829	0.436	0.000	0.000	4.942	3.920
$R\&D_{t-1}$	3,047	1,695	0.018	0.009	0.134	0.097	0.000	0.000	1.000	1.000
$Assets_{t-2}$ *(ln)*	2,683	1,581	6.993	6.655	1.977	2.116	0.000	0.000	13.762	13.007
$D\_Patents_{t-2}$	2,683	1,581	0.196	0.048	0.397	0.214	0.000	0.000	1.000	1.000
Age_{t-2} *(ln)*	2,683	1,581	1.465	2.051	0.737	1.106	0.000	0.000	4.522	4.736

The table includes summary statistics (number of observations, mean, standard deviation, minimum, and maximum) for all variables in the database, divided by Venture Capital and SMEI grants transactions

Table 13 Test on the difference of means

Variables	All firms		Venture Capital		SMEI grants		Mean Differences	
	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Difference	p-value
$Assets_{t-1}$ *(ln)*	6.900	1.985	7.000	1.948	6.721	2.039	0.276	0.000
$D\_Patents_{t-1}$	0.143	0.351	0.196	0.397	0.049	0.216	0.147	0.000
Age_{t-1} *(ln)*	1.633	0.912	1.389	0.702	2.070	1.069	−0.681	0.000
$ST\ debt_{t-1}$	0.470	0.499	0.411	0.492	0.537	0.499	−0.126	0.000
$LT\ debt_{t-1}$	0.885	0.319	0.998	0.048	0.758	0.429	0.240	0.000
$Leverage_{t-1}$ *(ln)*	0.226	0.341	0.231	0.372	0.217	0.259	0.011	0.224
$EBIT_{t-1}$	−11.779	32.530	−28.986	34.185	0.267	25.086	−29.253	0.000
ROE_{t-1}	−52.533	132.197	−87.310	145.195	−17.289	106.616	−70.022	0.000
$Profit\ Margin_{t-1}$	−12.697	32.337	−29.723	33.856	−0.849	25.177	−28.934	0.000
$Employees_{t-1}$ *(ln)*	2.495	1.217	2.547	1.237	2.416	1.180	0.131	0.003
$Sales_{t-1}$ *(ln)*	5.527	2.822	5.365	2.858	5.771	2.750	−0.406	0.000
D_Patents ever	0.238	0.426	0.326	0.469	0.080	0.272	0.246	0.000
$Patents\ count_{t-1}$ *(ln)*	0.257	0.725	0.351	0.829	0.088	0.436	0.262	0.000
$R\&D_{t-1}$	0.015	0.122	0.018	0.134	0.009	0.097	0.009	0.016
$Assets_{t-2}$ *(ln)*	6.868	2.036	6.993	1.977	6.655	2.116	0.338	0.000
$D\_Patents_{t-2}$	0.141	0.348	0.196	0.397	0.048	0.214	0.148	0.000
Age_{t-2} *(ln)*	1.682	0.935	1.465	0.737	2.051	1.106	−0.586	0.000

The first two columns show the mean value for each variable followed by its standard deviation in parentheses. Columns (3) and (4) show the mean and standard deviation (in parentheses) of each variable for the subsample of VC-backed firms. Columns (5) and (6) show the same statistics for the subsample of SMEI grant-backed firms. The last two columns show the difference of the means and the p-values of a t-test of equality of the means of each variable across the two subsamples

The table reports the test results for the difference of means between Venture Capital and SMEI grants transactions

Table 14 Correlation Matrix

	$Assets_{t-1}$ (ln)	$D\_Patents_{t-1}$	Age_{t-1} (ln)	ST $debt_{t-1}$	LT $debt_{t-1}$	$Leverage_{t-1}$ (ln)	$EBIT_{t-1}$	ROE_{t-1}	Profit $Margin_{t-1}$	$Employees_{t-1}$ (ln)	$Sales_{t-1}$ (ln)	D_Patents ever	Patents $count_{t-1}$ (ln)	$R\&D_{t-1}$
$Assets_{t-1}$ (ln)	1.000													
$D\_Patents_{t-1}$	0.188	1.000												
Age_{t-1} (ln)	0.449	0.023	1.000											
ST $debt_{t-1}$	0.241	−0.024	0.217	1.000										
LT $debt_{t-1}$	0.118	0.105	−0.124	0.097	1.000									
$Leverage_{t-1}$ (ln)	−0.128	0.058	−0.018	0.209	0.210	1.000								
$EBIT_{t-1}$	0.006	−0.109	0.266	0.022	−0.162	−0.015	1.000							
ROE_{t-1}	0.115	−0.028	0.191	0.059	−0.088	−0.066	0.495	1.000						
Profit $Margin_{t-1}$	−0.007	−0.106	0.256	0.001	−0.174	−0.023	0.984	0.490	1.000					
$Employees_{t-1}$ (ln)	0.729	0.082	0.445	0.200	0.111	−0.041	0.026	0.074	0.019	1.000				
$Sales_{t-1}$ (ln)	0.598	−0.049	0.491	0.237	0.071	0.008	0.136	0.142	0.134	0.700	1.000			
D_Patents ever	0.171	0.695	−0.001	−0.006	0.141	0.061	−0.134	−0.041	−0.143	0.028	−0.089	1.000		
Patents $count_{t-1}$ (ln)	0.210	0.868	0.032	−0.036	0.092	0.028	−0.108	−0.028	−0.103	0.120	−0.025	0.606	1.000	
$R\&D_{t-1}$	0.140	0.097	0.086	0.006	0.013	0.020	−0.021	−0.027	−0.028	0.147	0.077	0.072	0.107	1.000

The table reports Pearson's correlation coefficients between all pairs of variables for companies included in the dataset

Section C: Further analyses

See Tables15, 16

Table 15 Baseline Results limited to the period from 2014 to 2017

Panel A—Probit				
	SMEI grant			
Dependent variable	(1)	(2)	(3)	(4)
Assets $_{t-1}$	−0.247***	−0.247***	−0.273***	−0.235***
	(0.019)	(0.019)	(0.023)	(0.024)
D_Patents $_{t-1}$	−0.880***	−0.860***	−1.205***	−1.075***
	(0.117)	(0.120)	(0.142)	(0.144)
Age $_{t-1}$	0.922***	0.908***	0.771***	0.705***
	(0.042)	(0.042)	(0.050)	(0.055)
Observations	3,154	3,154	3,154	3,154
Year Fixed Effects	No	Yes	Yes	Yes
Sector Fixed Effects	No	No	Yes	Yes
Country Fixed Effects	No	No	No	Yes
Panel B—Marginal Effects				
	SMEI grant			
Dependent variable	(1)	(2)	(3)	(4)
Assets $_{t-1}$	−0.077***	−0.073***	−0.067***	−0.051***
	(0.006)	(0.005)	(0.005)	(0.005)
D_Patents $_{t-1}$	−0.273***	−0.257***	−0.297***	−0.235***
	(0.035)	(0.035)	(0.033)	(0.030)
Age $_{t-1}$	0.286***	0.271***	0.190***	0.174***
	(0.009)	(0.009)	(0.011)	(0.011)
Observations	3,154	3,154	3,154	3,154
Year Fixed Effects	No	Yes	Yes	Yes
Sector Fixed Effects	No	No	Yes	Yes
Country Fixed Effects	No	No	No	Yes

The analysis covers Venture Capital and SMEI grants raised in the period between 2014 (first year of the SME Instrument) to 2017 by firms operating in the European Union. The table reports regression results of the Probit estimation of Eq. (1) on the full sample (Panel A) and its marginal effects (Panel B). SMEI grants is a categorical variable which takes the value of 1 if the firm raises an SMEI grant and 0 if the firm raises a Venture Capital investment in the analyzed year. *Assets* $_{t-1}$ is the natural logarithm of the total assets reported in the balance sheet by the firm for the year before raising a Venture Capital investment or an SMEI grant. *Patents* $_{t-1}$ is an indicator that takes the value of 1 for firms having applied for the filing of patent in the year before raising a Venture Capital investment or an SMEI grant, and 0 otherwise. *Age* $_{t-1}$ is the natural logarithm of the age of the firm the year before raising a Venture Capital investment or an SMEI grant. The table reports coefficients of a Probit estimation followed by standard errors, clustered at the firm level, in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively

The table presents the estimation results from regressions based on Eq. (1), which investigates how company size (*Assets*), innovation (*D_Patents*), and experience (*Age*) affect the probability of obtaining an SMEI grant versus Venture Capital investment, limited to the period 2014 and 2017 (in which both VC and SME Instrument grants were active). The basic regression (Column 1) is progressively expanded to include year (Column 2), sector (Column 3), and country (Column 4) fixed effects

Table 16 Summary statistics comparing VC (Early Stages and Later Stages) and SMEI grants (SMEI Phase 1 and SMEI Phase 2)

Panel A—VC Early Stages vs SMEI Phase 1										
Variables	Obs		Mean		Std. Dev		Min		Max	
	VC Early	*SMEI Ph 1*	*VC Early*	*SMEI Ph 1*	*VC Early*	*SMEI Ph 1*	*VC Early*	*SMEI Ph 1*	*VC Early*	*SMEI Ph 1*
$Assets_{t-1}$ *(ln)*	2,371	1,326	6.578	6.543	1.833	2.047	0	0.001	13.762	11.813
$D\_Patents_{t-1}$	2,371	1,326	0.157	0.028	0.364	0.166	0	0	1	1
Age_{t-1} *(ln)*	2,371	1,326	1.245	2.053	0.677	1.083	0	0	4.533	4.745
Panel B—VC Later Stages vs SMEI Phase 2										
Variables	Obs		Mean		Std. Dev		Min		Max	
	VC Later	*SMEI Ph 2*	*VC Later*	*SMEI Ph 2*	*VC Later*	*SMEI Ph 2*	*VC Later*	*SMEI Ph 2*	*VC Later*	*SMEI Ph 2*
$Assets_{t-1}$ *(ln)*	676	369	8.467	7.358	1.594	1.877	0.001	0.001	13.149	12.899
$D\_Patents_{t-1}$	676	369	0.331	0.125	0.471	0.331	0	0	1	1
Age_{t-1} *(ln)*	676	360	1.945	2.132	0.536	1.016	0	0	3.434	4.718

The table includes summary statistics (number of observations, mean, standard deviation, minimum, and maximum) for all variables in the database, divided by Venture Capital and SMEI grants transactions by stage

Declarations

Disclaimer The contents of this article do not necessarily reflect the position or opinion of the European Commission.

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