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Venture Capital in Europe

Evidence-based insights about Venture Capitalists and venture capital-backed firms

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Contents

Executive summary

Policy context

The purpose of this report is to provide an overview of the recent trends in the **venture capital (VC) market in the European Union (EU).** In particular, it investigates and documents the characteristics of VC transactions, venture capitalists and VC-backed firms in the context of EU small and medium-sized enterprises (SMEs). In recent years, the European Commission has devoted increasing attention to this area through relevant **policy actions** aiming to stimulate the adoption of **different sources of external financing** available to SMEs that face barriers to more traditional financing. In particular, the 2015 capital markets union (CMU) action plan included among its key objectives the financing of innovation, start-ups and non-listed companies, including by supporting new VC investments. Moreover, the new 2020 CMU action plan further incentivises the adoption of alternative sources of funding for SMEs (see, for instance, Action 5).

The increase in VC penetration in the EU market would lead to at least two complementary beneficial effects, i.e. the **diversification of the funding portfolio** of companies and **professional support** in their earlier stages of development to **new and innovative SMEs,** the backbone of the European economy. At the same time, being the target of a VC investment could have implications for the SME status of the VC-backed company. The current **European Commission definition of SMEs** (Recommendation 2003/361/EC) sets size-based thresholds for a company to be considered an SME. If a firm is not autonomous, i.e. it is controlled by a third party, the assessment of the size should also include the figures for other companies within the same group as the assessed firm. Accordingly, if the VC investor acquires more than 50 % of the company's capital or voting rights through its investment, the target company itself and the VC investor are considered as a group and, consequently, these companies may lose their SME status. Besides classifications, this may lead to a concrete impact on the VC-backed firm, which, by losing SME status, would cease to be eligible for the European Commission's dedicated funding programmes (e.g. Horizon 2020).

The report focuses on various aspects of the status of the VC market from 2008 to 2018. In particular, it provides evidence on (i) the **development** of VC investments; (ii) the most significant **features** of VC **transactions;** (iii) **characteristics** of **firms targeted** by VC investments; (iv) the **impact** of VC investments on measures of the **growth** of target companies; (v) **investment strategies** of venture capitalists in targeting firms; and, lastly, (vi) the implications of VC, and potential changes to the 50 % threshold, for the current **definition of SMEs.**

Key conclusions

The evolution of venture capital investments

VC **investments** significantly **increased** between 2008 and 2018, from EUR 30 billion to EUR 380 billion worldwide. However, VC investments are **not homogeneously distributed;** US and Chinese companies stand out as the main targets of VC investments (with approximately 80 % of the world value in 2018). EU firms lag behind them (with less than 10 % of the world value in the same year). Within the EU, most of the deals and volumes invested still remained limited to the top five countries (i.e. the United Kingdom, Germany France, Spain and Sweden), accounting for approximately 80 % of the total. Looking at VC investors, it emerges that the United States remains the main investor worldwide, whereas China replaced the EU as the second global player in 2013–2018. VC investments are **mainly allocated at the domestic level** (two thirds of the total) and just a fifth of all transactions takes place entirely across borders, suggesting that the geographical proximity between venture capitalists and VC-backed firms matters. Conversely, deals with multiple investors based in different countries are on an upward trend worldwide (50 % of total investments). Adding together single and multiple deals, 40 % of EU investments are in Member States other than that of the investor, suggesting that a **good level of integration of VC markets** has already been achieved **within the EU.** VC investment in EU target companies is concentrated in a **few macrosectors** (e.g. research and development, pharma, information and communication technology), and the **euro** is the **most adopted currency** for VC-backed transactions in EU. Focusing on the investment rounds, **VC early and later stages predominate** over the other rounds, although the latter are growing more rapidly. The VC early stages only doubled while the VC other rounds tripled in volume between 2008 and 2018.

Investment strategies of venture capitalists

The analysis shows that, after having received a VC investment, most firms are still independent (between 70 % and 80 % of cases). Only in fewer than 30 % of cases does a different subject own the target company after the VC financing. In particular, the **venture capitalist becomes the ultimate owner of the target company only in fewer than 10 % of cases.** Other investors than the venture capitalist gain ownership in approximately 15–25 % of cases. A sort of inverted U-shaped relationship emerges between the maturity of the investment round and the share of venture capitalists aiming to own the target company. After being negligible in the first rounds, VC-related ownership reaches a peak in the VC seed and earlier stages, fading again in subsequent rounds. These results suggest that VC investors do not seem to include the ownership goal among their reasons to invest. As a consequence, the share of SMEs that would lose their status seems to be limited and concentrated among relatively large and more mature firms that have access to later rounds. Multiple staging of VC investors is also investigated. This analysis shows that a large proportion of firms receive

more than one VC deal, and that VCs seems to invest in companies that have already raised other deals.

Investment strategies of corporate venture capitalists

Corporate venture capital (CVC) is a non-exclusive instrument, which potentially **integrates other forms of VC.** Indeed, approximately half of the firms raising CVC are also the targets of VC. Moreover, CVC seems to be mostly associated with early and later stages of investments. Focusing on firms receiving both CVC and other VC, it emerges that CVC investors increase the median amount of their investment if the firms have already been targeted by other VC. This provides some descriptive evidence of CVC as a quite flexible investment instrument, relatively responsive to the investment history of the target company.

Public grants and venture capital investments

Since its introduction, the **Horizon 2020 SME Instrument has become an important source of public funding for SMEs,** contributing 50 % of the total amount of public grants in 2017. Among the firms analysed, approximately one third receive only public grants. The remaining two thirds receive both grants from public entities and VC investments, showing that European companies seeking external funding frequently make use of both public and private sources of financing. For firms receiving public grants between 2008 and 2017, early stages represent the most important source of VC funding, followed by VC later stages. Moreover, there seem to be strong **qualitative differences between firms receiving private and public financing,** in terms of size and age of the firms at the date of the funding.

The impact of venture capital on target companies

This report investigates the **impact of VC investments on three measures of growth of the target company** common in the empirical literature, i.e. total assets, total sales and number of employees. The main findings suggest that the first **VC investment positively affects the growth of target companies,** in terms of both total assets and number of employees, while mixed results emerge when looking at total sales depending on the empirical specification. Exploring the potential heterogeneity of this impact, based on relevant features of the transaction (i.e. round and type of the investment) and of the target company (i.e. its age), this analysis confirms that **results are heterogeneous and depend upon the features of target companies** (age) **and transactions** (round and type). First, younger firms benefit more than older ones from VC transactions in terms of total assets, total sales and number of employees. The effect on older companies is still positive but smaller. Second, CVC investments affect the growth of only total assets, while investments from other VCs also have a positive impact on

total sales and number of employees. Lastly, later rounds of VC investments show less impact on the growth of target companies than early stages.

The definition of small and medium-sized enterprises and venture capital investments

The definition of SMEs varies between international organisations and countries, and in the economic literature. At the same time, **the definition of SME adopted by the European Commission** is an **established reference for EU-based companies.** This analysis proposes a methodological approach to quantify to what extent the change in the threshold related to the VC exception may have an impact on VC investments. Conditional on all limitations of the analysis, findings suggest that a lower threshold for VC investments would affect a limited number of firms.

1. Introduction and motivations

Small and medium-sized enterprises (SMEs) are often referred to as the backbone of the European economy, being an important source of jobs and economic growth. At the same time, **SMEs' growth may be influenced by existing constraints on access to finance,** in particular in their earlier stages of development. For these reasons, the European Commission has been working to stimulate the adoption of different sources of external financing available to SMEs.

One of the identified policy actions included in the 2015 capital markets union action plan consists in support to venture capital (VC). **VC** investments could constitute an **important alternative instrument for young and innovative firms that encounter barriers to more traditional financing** (e.g. bank loans) to have access to external funding. Despite its fast growth in recent years, the European VC industry is still small, especially compared with the United States (AFME, 2018). As also documented in the action plan, the limited role of equity in the funding structure of firms may put Europe at a disadvantage with respect to economies with more diversified funding portfolios, especially in the context of the needs for financial restructuring after the COVID-19 pandemic (European Commission, 2020a).

At the same time, **the fact that a European company raises VC may have implications for its SME status.** The current European Commission definition sets a threshold of 50 % (of a company's capital or voting rights) on investment by a single venture capitalist for this company to be considered autonomous (Recommendation 2003/361/EC). In other words, in the event of an investment by a single venture capitalist above 50 %, the company itself, the venture capitalist and all the other companies in which the venture capitalist is the majority investor are considered as a group and, consequently, these companies may lose their SME status. The application of this definition has implications when assessing which enterprises may benefit from EU competitive funding programmes aimed at promoting SMEs' growth (e.g. Horizon 2020 (H2020)).

Given the increasing policy relevance of SMEs and VC, this report aims to provide an overview of various aspects of the status of the VC market, particularly in the context of EU SMEs, based on a dataset presented in Section 2. After giving an overview of the development of VC investments in the last decade, Section 3 **explores some relevant features of VC transactions,** including the geographical distribution of investors and target companies, the currency, the amounts and the duration, and also presents some heterogeneous evidence based on different rounds of investments. Moreover, **it analyses European firms raising VC investments,** focusing on relevant characteristics, such as size and the sector in which they operate. Section 4 investigates the VC investors' side, by focusing on how they **set up their investment strategies.** In particular, this section tests whether or not venture capitalists invest in companies by exchanging financing for equity stakes to gain ownership of them (i.e. more than 50 % of the shares), to quantify the proportion of SMEs that could lose their status as a

result of VC investments. In addition, it analyses the patterns of public and private funding of firms by comparing VC investments with public grants (including the H2020 SME Instrument). Section 5 investigates the **impact of VC investments on three measures of growth** of the target companies, i.e. total assets, total sales and number of employees, leveraging on an empirical analysis.

Lastly, Section 6 presents and **discusses the current definition of SMEs provided by the European Commission.** Specifically, this analysis compares it with similar definitions adopted by the economic literature or by international organisations. Based on recent work by Crehan (2020), this section discusses some possible limitations of the current SME definition and proposes a methodological approach, complemented by a case study, to quantify to what extent the change in the threshold related to the VC exception may have an impact on VC investments.

2. Description of the database

The highlights of this section are presented in Box 2.1.

Box 2.1. – Highlights of Section 2

Highlights	
	▪ This section introduces and describes the **dataset behind the analyses of the whole report.** ▪ We present the **descriptions of different funding instruments** included in the database, on which we build our **definition of VC.** ▪ We provide some **descriptive statistics** and some preliminary evidence on the development of VC in the last decade.

2.1. VentureSource database

The analyses of VC in the EU build on the Dow Jones VentureSource, a commercial database that provides a comprehensive source of information on VC-backed companies, VC investors and VC investment transactions, in every country, industry, sector and stage of development. The analysis focuses on the period 2008–2018, in order to investigate the development of more recent trends in VC.

Previous studies (Kaplan et al., 2002; Nepelski et al., 2016) have already provided a detailed overview of VentureSource and a comparison with other commercial databases (e.g. Thomson Venture Economics and Crunchbase) for a purpose similar to that of the current investigation. At the time of their analyses, those authors showed that data from VentureSource were generally more reliable and complete, and less biased, than similar databases. In particular, they found that VentureSource was a more comprehensive data source, offering longitudinal and standardised information on VC deals, with more detailed information on financed and financing entities. Along these lines, Kuckertz et al. (2019) state that VentureSource is a comprehensive data source, particularly when looking at VC deals completed in the United States and Europe ([1]). For these reasons, we opted for VentureSource although alternative databases are claimed to cover some particular types of investment better. For example, Crunchbase has been considered more comprehensive than VentureSource for smaller deals (Kaminski et al., 2019) and, particularly, for business angel investments (Gvetadze et al., 2020).

([1]) More recently, alternative databases have been adopted for analyses at the worldwide level, for instance Zephyr from Bureau van Dijk (Bellucci et al., 2020a,b), Dealroom (Kraemer-Eis et al., 2020) and CB Insights (Howell et al., 2020) which recently acquired VentureSource from Dow Jones. See further details at the following link: https://www.cbinsights.com/research/team-blog/dow-jones-venturesource-valuations/. For a comparative analysis of commercial databases on venture capital, we refer to Retterath and Braun (2020).

VentureSource clusters the available data into three groups of information: (i) the venture-backed company's name, contact details (i.e. address, geographical location, website, email, telephone, fax number, contact points within the company), sector of activity and some financial variables at the date of the deal such as the number of employees, the total assets, the total turnover and the total liabilities; (ii) the name and contact information of the investor entity (i.e. address, geographical location, telephone, fax number), the type of entity and co-investors, if any; (iii) the VC deal ([2]) (i.e. the amount, the deal date, the type of investment, the currency and currency exchange rates). Hence, full information on each transaction can be obtained by merging the information sets available for the three entities separately.

For the purpose of this study, we exploit the VentureSource database considering VC-backed companies as the primary target of analysis. Depending on the focus of investigation, we alternatively conduct the analysis by aggregating the information about companies at a point in time and at the level of country, sector or type/round of investment.

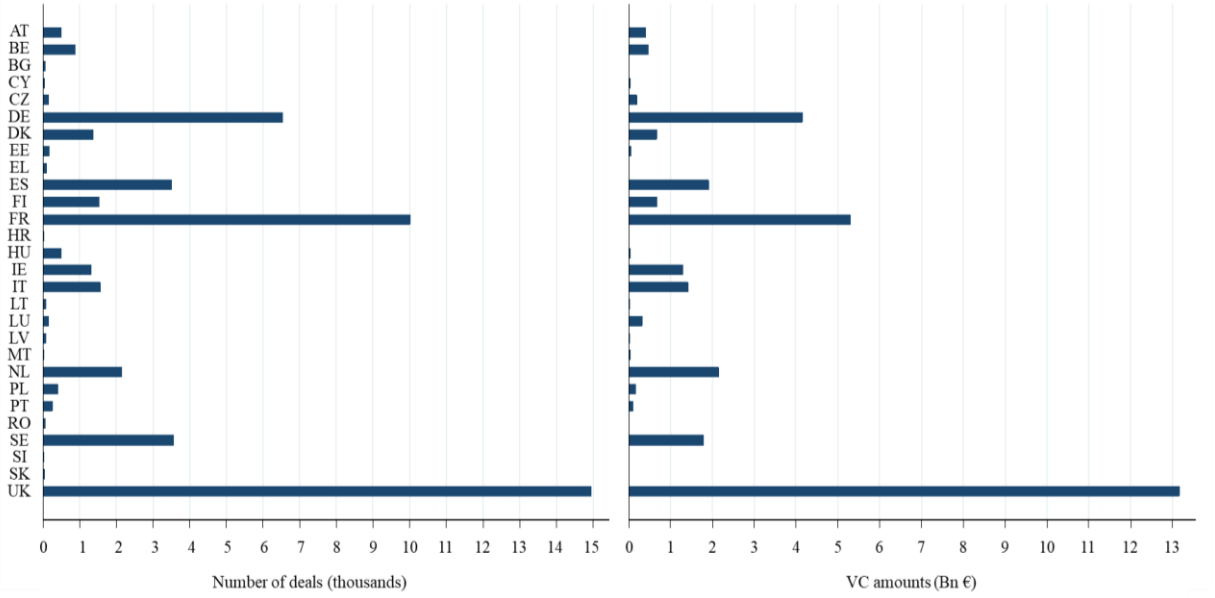
The geographical coverage of the current analysis focuses on VC-backed companies located in the EU (see Figure 2.1). To complement the analysis, the development of European VC investments is compared with the most important extra-EU countries in terms of volumes and numbers of deals (i.e. Canada, China, India and the United States).

One of the limitations of VentureSource is its definition of industrial sectors, which does not correspond to any other official statistical classification of economic activities, such as the Statistical Classification of Economic Activities in the European Community (NACE) codes ([3]). Furthermore, VentureSource provides limited financial information on target firms and related to only the year of the VC investment. The historical series covering data before and after the transaction is not available, with a considerable impact on any investigation of the impact of VC investments on targeted firms.

([2]) Throughout the report, we refer to the number of deals (and related amounts) including both disclosed and undisclosed transactions. We alternatively refer to VC deals as VC transactions.

([3]) In Section 3, we overcome this issue by assigning the economic activities based on the NACE codes of target companies extracted from Orbis. An alternative reclassification of VentureSource sectors has recently been adopted by Flachenecker et al. (2020).

Figure 2.1. – Comparison of deals/volume by *EU countries*: number of deals (left), VC investment raised (right), total 2008–2018



Source: JRC elaborations of VentureSource data.

2.2. Venture capital investment types

Venture capitalists provide financing at various stages of companies' life cycles through different investment types – also defined as investment stages or funding rounds – generally calibrated to the stage of growth of the targeted company. This analysis applies the classification of investment types provided by VentureSource ([4]). As a result, it considers as VC investments the following funding types: accelerator, business angel, VC seed, VC early stages, VC later stages, recapitalisation, corporate equity or CVC, and venture leasing. At the same time, we have not included within the VC category all the deals that do not fit the standard definition of VC ([5]). Nevertheless, we exploit the presence of deals such as mergers and acquisitions (M&A), initial public offerings (IPOs) and buyouts as signals of an exit strategy ([6]) occurring in the company analysed at a certain date. Lastly, our dataset also includes public grants, which are used for a dedicated analysis ([7]). Box 2.2 provides concise definitions of the VC funding instruments considered in this report.

([4]) Strictly speaking, there is no one classification of funding rounds common to all specialised alternative databases. The differences are mainly attributable to alternative categorisations of funding rounds (e.g. VC 1st, VC 2nd) into different categories of investment stages (e.g. VC early stage, VC later stage).

([5]) For instance, investments focused on the scaling-up of more established companies (e.g. private equity or debt).

([6]) Specifically, we assume that deals signalling that a company went public (through an IPO) or changed its ownership (through a merger or acquisition or a buyout) constitute possible exits from a VC investment with a cashout for the venture capitalist (Isaksson, 2007).

([7]) A definition of public grants based on the VentureSource database is presented in Section 4.

Box 2.2. – Definitions of funding instruments

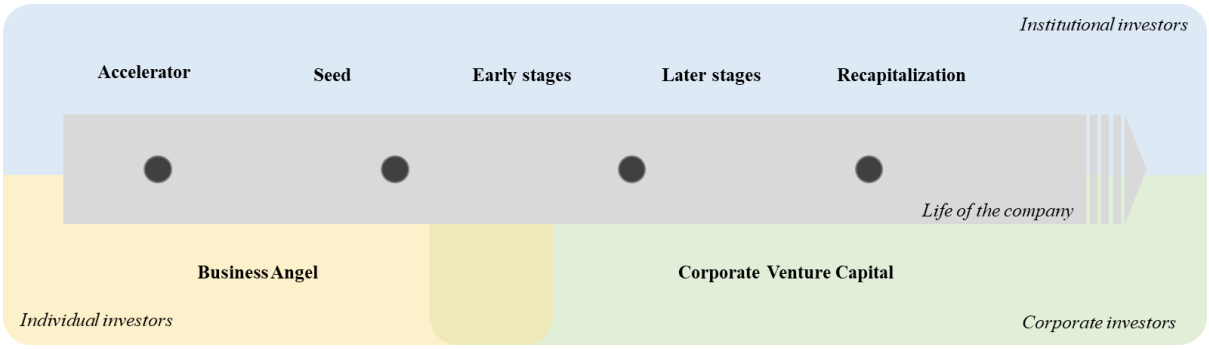
Funding instrument	Definition
Accelerator	It generally provides capital financing and mentorship to new start-ups for a predetermined period of time in exchange for seed equity. Accelerators typically operate by inviting several early-stage start-ups to a cohort-based programme, in order to develop their technologies and products with the aim of helping them to kick off their productive and commercial activities.
Business angel	Unlike most of the other funding instruments, this instrument is typically adopted by individual investors, who allocate their own private funds in the initial development phase of a start-up. These investments help new start-ups to transform ideas into viable companies, kick off the production or launch the proposed service. Business angels tend to invest in businesses or sectors they have experience with, and they generally provide mentoring to the entrepreneurs together with funds.
Seed	Seed rounds provide financing for research activities, or for the assessment and development of an initial concept before the business reaches the start-up phase, usually within 1 year from the incorporation of the company. Typically, in this phase, both the founders and the product developers sit on the board of the company and a complete management team is not yet in place.
Early stages	This refers to the financing of companies in the first and second rounds, after the seed phase. Start-ups are provided with this type of financing for the development of products and the definition of market strategies and sales channels. Companies may be in the process of being set up or may have been in business for a short period of time but have not started the commercialisation of their products or services. In the venture capital jargon, these rounds are also known as Series A and Series B.
Later stages	This refers to all financing rounds subsequent to the second round. Later stages financing is provided by venture capitalists for the expansion of more established and operating companies, which may or may not be breaking even or trading profitably. Generally, later stages are rounds used by venture capitalists to finance already VC-backed companies. In the VC jargon, these rounds are also known as Series C and Series D.
Recapitalisation	These venture funding rounds (recap 1st, recap 2nd, recap 3rd, recap later and recapitalisation) are granted to start-ups with still high growth potential after a restart activity. Venture capitalists make use of these rounds to exclude existing investors who do not participate

	in restart rounds, unless they intend to invest further, leading to important changes in the firm's business strategy.
Corporate venture capital	CVC, sometimes also called corporate equity, is an investment made by a corporate company, rather than an institutional venture capitalist, in another company, such as a start-up. The investment might take the form of a transfer of funds or of know-how. This kind of investment is not necessarily done for the purpose of forming strategic partnerships but might aim at acquiring access to prospectively disruptive technologies, which could guarantee entry to new emerging markets.
Venture leasing	This refers to the leasing of technical equipment by a venture-leasing broker to pre-profit start-ups funded by VC investors. The aim of this kind of investment is to help young companies to acquire all the technical equipment necessary for their growth.

Source: JRC elaborations from Nepelski et al. (2016).

Altogether, these types of investment might be clustered based on two elements: the nature of the investor (i.e. individual, corporate or institutional ([8])), and the phase of the life cycle of the company in which the investment is typically raised. This exercise is depicted in Figure 2.2.

Figure 2.2. – Relationship between types of VC investors and stages of company's life



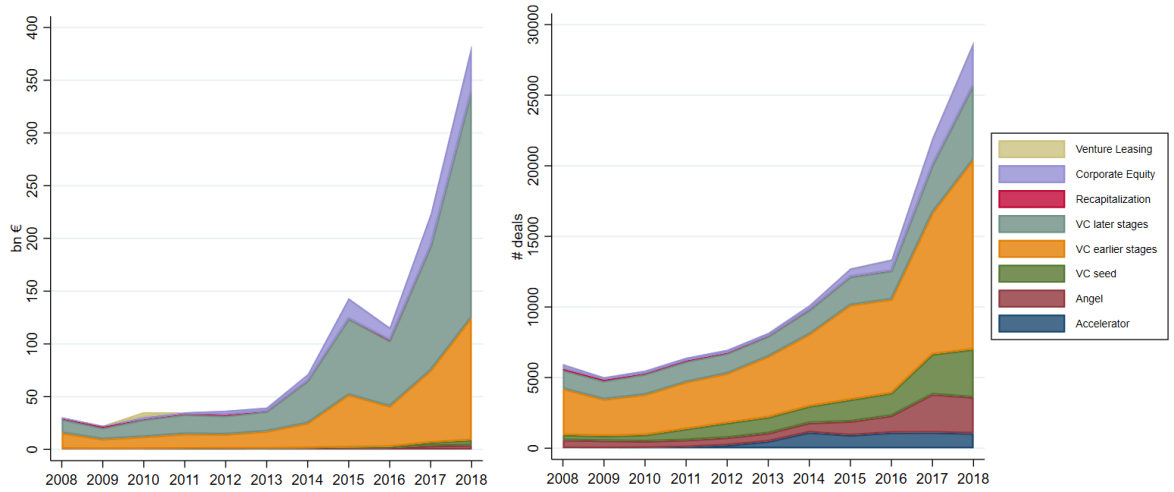
Some important aspects should be considered and clarified. First, this graphical exemplification does not imply that any VC-backed company receives each of the investment rounds and types. For instance, it may be the case that a company raises only one of these deals. Moreover, typically only a fraction of firms raising early-stage investments get access to subsequent rounds. Second, each company follows its own story. While this is the typical

([8]) In this report, we follow the definition of Gompers et al. (2020), who distinguish between institutional and corporate VC. Institutional VC corresponds to all professional VC firms whose core activity is the management of funds to be invested in companies with high growth potential. Institutional venture capitalists differ from individual investors in their legal nature (i.e. firm vs individual), and from corporate venture capitalists in their entrepreneurial goals (i.e. VC investments are not the core activity of corporate venture capitalists). Based on an alternative definition, Maula et al. (2005) refer to institutional VC as independent VC.

chronological order of VC investments, it may be the case that, for instance, some firms receive first CVC and then an accelerator investment. Third, for institutional investors the link between the round and the phase of company's stage of development is more direct. Conversely, business angel and CVC investments are more likely to be received at different stages, although usually the first precedes the second.

Figure 2.3 presents the contributions of different VC investments worldwide in terms of volumes and numbers of deals. The figure shows that the investment volumes of worldwide VC-backed companies significantly increased in the most recent years of the sample. VC early and later stages are predominant over the other forms of investments. However, looking at the growth rate, it emerges that VC later stages tripled their volumes whereas VC early stages only doubled theirs from 2008 to 2018. At the same time, when looking at the number of deals, the percentage contribution of later stages is lower, while it is conversely higher for early stages. A substantial increase is also visible for VC seed and business angel investments.

Figure 2.3. – Contributions of different VC-backed instruments to the total at the worldwide level, 2008–2018 (billion EUR (left) and number of deals (right))



Source: JRC elaborations on VentureSource data.

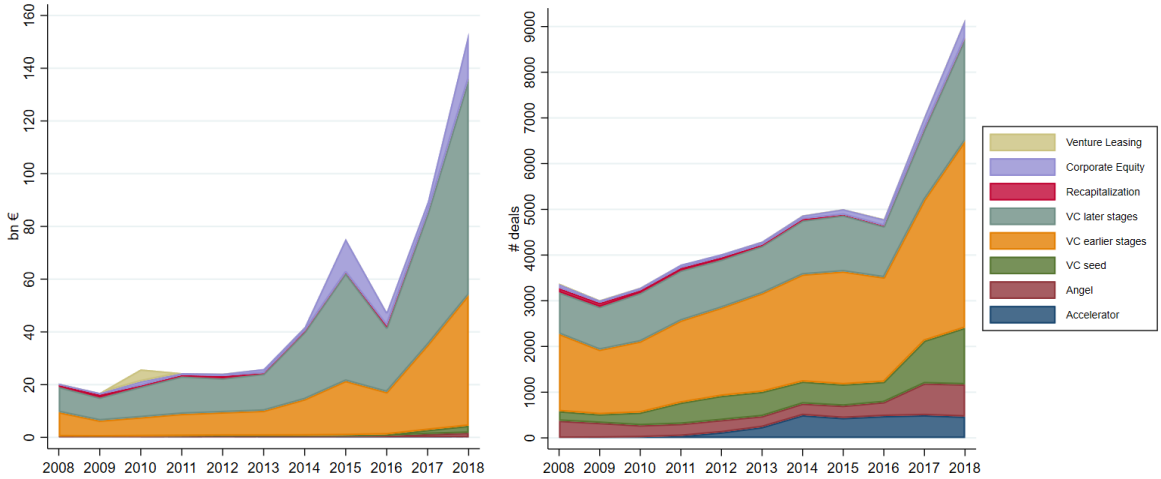
The joint interpretation of these results suggests that **companies that have access to seed, business angel and early stages of VC investments participate in significantly more deals than those receiving only later stages of VC investments.** At the same time, the latter type of companies receives significantly larger financing volumes, suggesting that investors are moving their portfolios' investments towards more consolidated businesses that require further capital injections to reinforce their development and growth ([9]).

([9]) Another possible interpretation is that investors are moving towards less risky investments.

Figures 2.4 and 2.5 show the contribution of different VC investments in terms of volumes and number of deals for the United States and China, respectively, the two biggest countries hosting VC deals.

Figure 2.4 displays the contributions of different VC investments in the United States in terms of volumes and number of deals. The figure shows a similar dynamic to that depicted in Figure 2.3. In terms of volumes, the investments in VC-backed companies significantly increased in the most recent years. VC early and later stages are still the predominant forms of investment. However, when looking at the number of deals the contribution of early stages is sharply growing compared with the others.

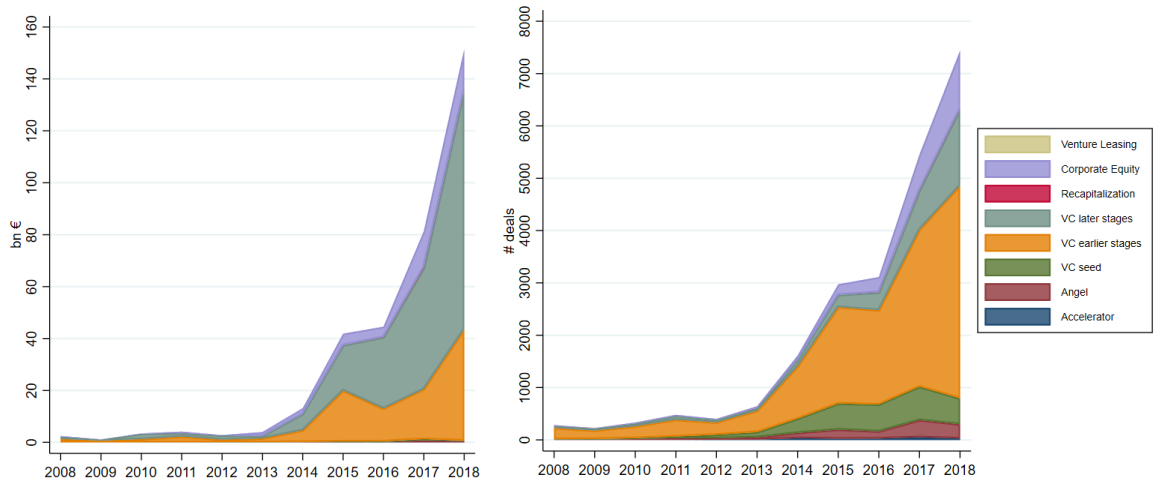
Figure 2.4. – Contributions of different VC investment instruments to the total, United States, 2008–2018 (billion EUR (left) and number of deals (right))



Source: JRC elaborations on VentureSource data.

Figure 2.5 depicts the contributions of different VC investments in China in terms of both volume and number of deals. The dynamic of China in terms of absolute volumes of investments is comparable to that of the United States since 2016. In relative terms, VC early stages and later stages are still the predominant forms of investment, although the latter experienced a sharper increase in volume than the other forms of investment. At the same time, when looking at the number of deals, the percentage contribution of early stages of investments is greater, while it is lower for later stages despite growing at a faster rate. The interpretation of these results suggests that Chinese companies that attract early and later stages of VC investments participate in significantly more deals and higher volumes than those that receive other types of instruments. However, later stages seem to attract investment volumes at a faster rate than other instruments. This finding may suggest a reorganisation of the portfolios' investors towards businesses that require incremental capital investments to consolidate their growth.

Figure 2.5. – Contributions of different VC-backed instruments to the total, China, 2008–2018 (billion EUR (left) and number of deals (right))



Source: JRC elaborations on VentureSource data.

2.3. The match between Orbis and VentureSource

Besides VentureSource (used in Section 3), the report builds on a matched database (hereafter, the matched DB), mainly aiming to analyse in greater detail the investment strategies adopted by venture capitalists (Section 4) and the impact of VC investments on targeted companies (Section 5) in the period 2008–2017 ([10]).

The matched DB links two commercial databases, i.e. VentureSource (described in Section 2.1) and the Bureau van Dijk Orbis database (hereafter, Orbis). Whereas VentureSource provides information on the contract terms of the VC financing, Orbis supplies financial and industrial figures taken from balance sheets gathered from business registers, credit bureaux, statistical offices and company annual reports for each accounting year. Evidence of the advantage of using Orbis over similar commercial databases has been described by Kalemli-Ozcan et al. (2015). In particular, they state that Orbis provides harmonised balance sheets and profit and loss data with significant coverage of private companies, together with a more detailed industry classification (NACE four-digit codes). For each VC-backed company the matched DB associates the contract terms of the deal (i.e. the amount, the deal date, the type of investment or the funding round, the currency, and the name and geographical location of the venture capitalist(s)) with the financial information about the VC-backed company available from the balance sheet in Orbis (e.g. total assets, total debt, turnover, number of employees, sector). Orbis and VentureSource do not cover exactly the same firms. In addition, despite its large coverage, Orbis does not provide financial statements for some new companies and SMEs included in VentureSource. Indeed, many SMEs do not disclose a financial report on their business in the first stages of activity, and some of them may end their business after

([10]) The series ends in 2017 because of data availability constraints at the time of the merger of the VentureSource and Orbis datasets.

having received early-stage financing. Hence, the matched DB is a subset of the information available in VentureSource. Below, a brief illustration of the procedure to obtain the matched DB is presented. For a more exhaustive description we refer to Annex 1.

VentureSource and Orbis do not provide unique identifiers for an immediate reciprocal direct link of the data. Consequently, we merged the data from Orbis (txt/flat files) with those from VentureSource by matching common variables to both databases containing other univocal company information, i.e. web address, telephone number, email address, fax number and later company name ([11]).

The matched DB has been converted into a panel database, where the identifier refers to the VC-backed company with financial information for each year of the sample period (2008–2017) and with information on the VC investment in the year of the deal. Table 2.1 provides descriptive statistics about the main variables.

Table 2.1. – Descriptive statistics about the main variables

Variable	Observations	Mean	Median	Standard deviation	Minimum	Maximum
Total assets (thousand EUR)	113 736	70 132	3 932	952 975	0	88 500 000
Total sales (thousand EUR)	84 767	42 160	3 856	346 313	0	28 600 000
Employees (number)	88 517	226	27	2 374	0	162 650
Total debt (thousand EUR)	107 884	21 434	296	282 783	0	30 700 000
VC amount (thousand EUR)	92 710	11 600	1 657	85 900	0	3 310 000

Source: JRC elaborations on the matched DB.

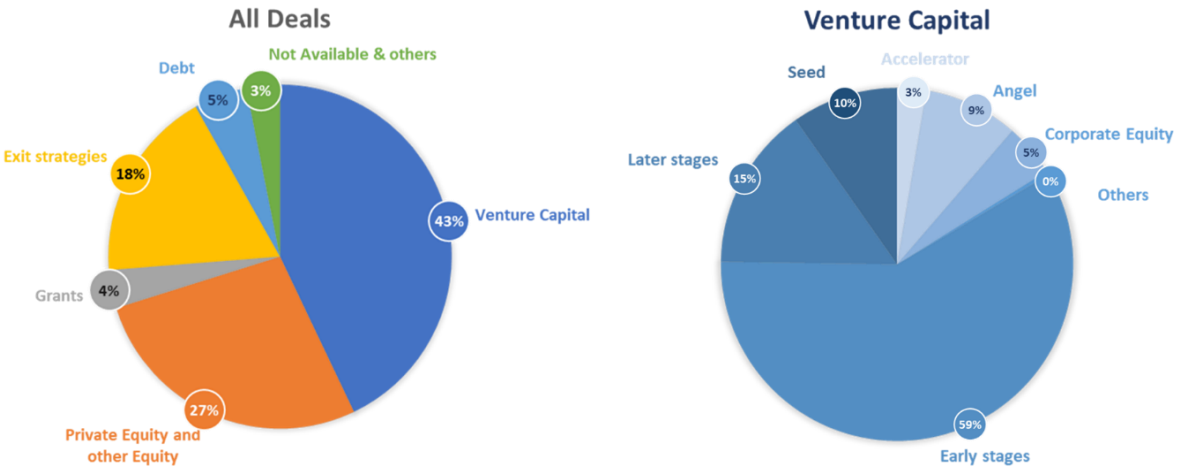
The matched DB contains 207 050 observations overall (20 705 yearly observations). Figure 2.6 provides information on the frequency of different investment types in the database.

As shown in the left panel of Figure 2.6, the largest number of the deals (43 %) can be categorised within our definition of VC. Other major categories include private equity and other equity investments (27 %), all the possible exit strategies (18 %) and grants (4 %). As expected, most of the analyses included in this report will be based on the deals included in

([11]) For a more exhaustive overview of the database, summary statistics about Orbis txt/flat files and the success rates of linking VentureSource and Orbis, we refer to Tables A.1.1 and A.1.2 in Annex 1.

the VC category. At the same time, other sections of the database are explored for ad hoc inquiries (i.e. exit strategies) or investigations (i.e. public grants). Lastly, within the VC subcategory (see the right panel of Figure 2.6), most deals are concentrated in the early (59 %) and later (15 %) stages.

Figure 2.6. – Distribution of instruments in the matched DB



Source: JRC elaborations on the matched DB.

2.4. Key takeaways

The key takeaways of Section 2 are brought together in Box 2.3.

Box 2.3. – Key takeaways of Section 2

Key takeaways	▪ **The report builds on two datasets:** the first (based on Dow Jones VentureSource) used for broader descriptive analyses (Chapter 3), and the second (based on a match between VentureSource and Orbis) used to investigate the relationship between VC investors and target firms (Chapters 3 to 6). ▪ Our **definition of VC** includes the following funding instruments available in VentureSource: accelerator, business angel, seed, early stages, later stages, recapitalisation, venture leasing and CVC. ▪ **Most of the transactions** included in the matched DB may be classified as **VC investments** (43 %) according to our definition, while the others mainly fall into the private equity (27 %), debt (5 %) and grants (4 %) categories. ▪ **Most of the VC transactions** in the database fall into the **early stages (59 %) and later stages (15 %)** categories, while seed, business angel, CVC and accelerator investments account for about 10 %, 9 %, 5 % and 3 %, respectively.

3. Overview of venture capital

This section describes the main features of VC investments, both on a worldwide scale and with a focus on the EU. Specifically, the analysis of VC is conducted on the two datasets described in Section 2. The first is VentureSource, which collects information on VC investments (e.g. seed, early stages, later stages), the geography of VC-backed firms and the country of origin of venture capitalists on a worldwide scale, with data up to 2018. The second is the matched DB, which focuses on VC-targeted firms located in the EU Member States ([12]) in the period 2008–2017. The matched DB allows us to investigate other relevant aspects of VC-backed firms, on which the analyses in the subsequent sections are built.

The analyses are conducted at the levels of both the VC-backed firms and the VC investors (venture capitalists). In several cases, whenever relevant, findings are aggregated at the country level ([13]). In this case, for the sake of clarity, we identify as 'target country' the aggregate of all firms based in that country that are targets of VC investments. At the same time, 'investor country' is defined as the aggregate of all investors (i.e. the venture capitalists) based in such country.

The highlights of this section are reported in Box 3.1.

Box 3.1. – Highlights of Section 3

Highlights	
	▪ This section is an **overview** of **VC** investments at the **worldwide** level, and with a focus on the **EU** Member States. ▪ It explores some relevant **characteristics** of the **VC transactions,** including their **geographical** distribution (on the parts of both the investor and the target company), **currency, amounts** and **duration,** and presents some heterogenous evidence based on **different types/rounds** of investments. ▪ It proposes a first **identikit** of the **European companies** raising VC investments, based on their **industry** and **dimensions** in the year of the transaction.

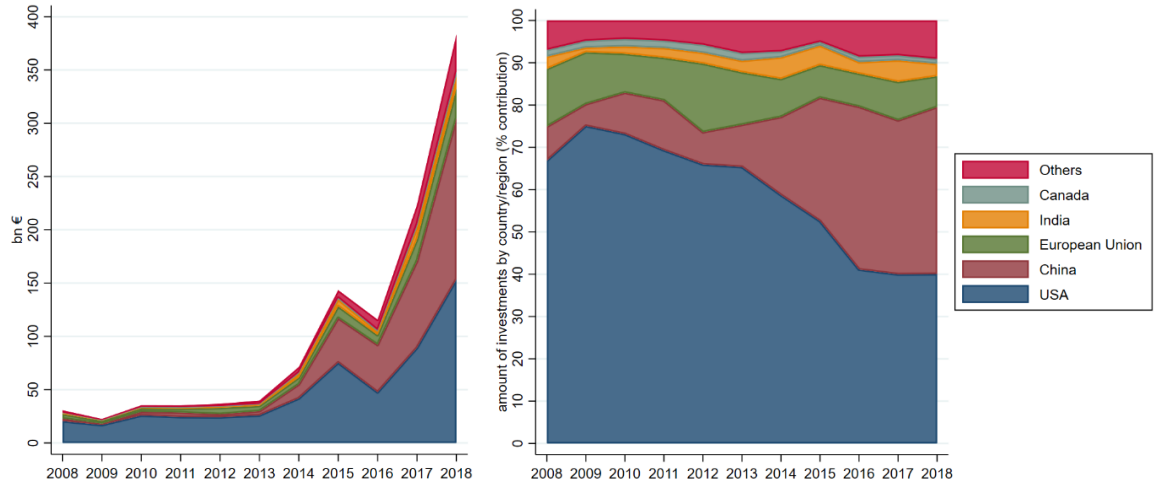
([12]) All the analyses conducted on the EU (as an aggregate and by Member State) also include the United Kingdom, which was a Member State in the period analysed.

([13]) We use information from VentureSource to determine the place of origin of both the investors and targets. However, the place of origin of the VC investor completing the transaction may not coincide with the place of origin of its global ultimate owner (GUO), which is not extensively available in our dataset. This may be a potential source of bias in the geographical attribution of transactions for those investors that are not independent (i.e. the GUO is not the VC investor completing the transaction). For example, we would consider European any transaction completed by a legally registered EU subsidiary of an extra-EU VC investor. A similar disclaimer applies to target firms.

3.1. The worldwide venture capital market

Figure 3.1 shows the development of VC investments at the worldwide level, broken down by target country. A number of comments are in order.

Figure 3.1. – Worldwide distribution of VC activity by target country (volumes and percentages), 2008–2018



Source: JRC elaborations on VentureSource data.

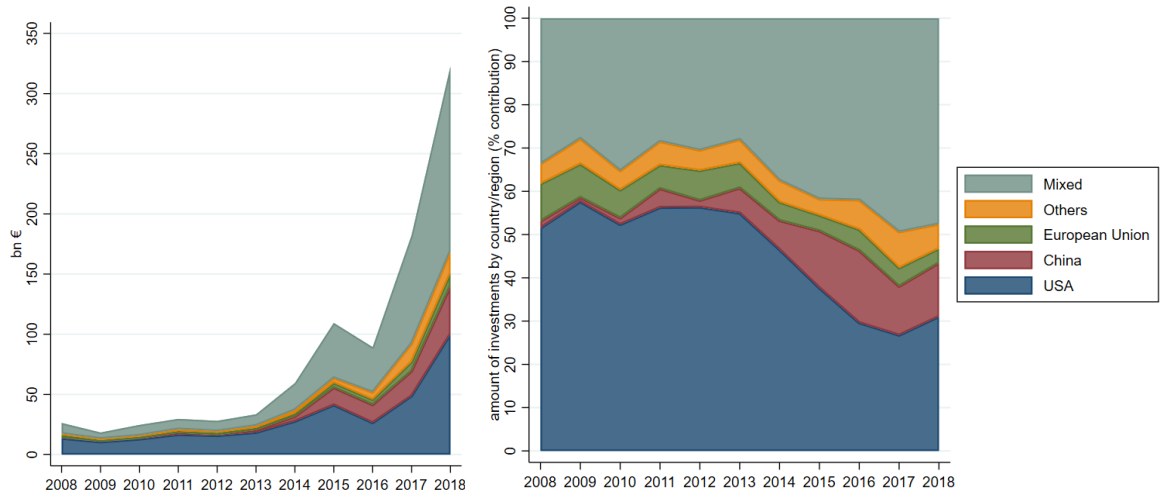
First, **VC investments significantly increased** between 2008 and 2018, **from EUR 30 billion to EUR 380 billion.**

Moving to the country-level analysis, two main pieces of evidence emerge. First, only a few countries host firms attracting VC investments. Indeed, the top three (groups of) countries (i.e. the United States, China and the EU) account for at least 80 % of total investments raised in the whole period, while adding Canada and India to the picture accounts for more than 90 % of all the VC investments.

Second, the **volume of VC investments increased in all major target countries.** For instance, in the United States volumes increased from about EUR 20 billion to more than EUR 150 billion, in China from EUR 2 billion to about EUR 150 billion and in the EU-28 from EUR 4 billion to EUR 28 billion. Nevertheless, although growth is widespread among all major target countries, most of this increase coincided with the significant penetration of venture capitalists' investments into the Chinese market. **Whereas in 2008 Chinese firms received less than 10 % of global VC investments, this share reached around 40 % in 2018,** a similar amount to that raised by US firms. This change accounted for an impressive 60-fold growth, compared with the much more contained – although significant – US and EU ones (both around a factor of seven). Altogether, **firms targeted by VC investors are concentrated in a few countries,** and this concentration is becoming even more evident, with the **United States** and, in particular, **China** emerging as the main targets and the **EU still lagging behind** them.

If the number of target countries receiving most VC investments is limited, the concentration of investments is further confirmed when we look at the investor countries.

Figure 3.2. – Worldwide distribution of VC activity by investor country (volumes and percentages), 2008–2018



Source: JRC elaborations on VentureSource data.

Figure 3.2 shows the change in volumes invested by investor countries worldwide during the period under analysis ([14]). Specifically, the left panel describes the volumes invested in absolute terms (i.e. expressed in billion euro), while the right panel compares the contributions of the various countries to the total in terms of percentages. In addition to the categories associated with the investor countries, we have also created a category tagged as 'Mixed'. It is attributed to all VC investments jointly completed from investors based in two or more different countries ([15]) (i.e. pool of investments). In the rest of the cases, investments by either an individual or a pool of VC investors based in the same country are attributed to a single country.

As expected, on the investing side too **the main players are the United States and the EU in the first sample years (2008–2012), and the United States and China in the later years (2013–2018).** Moreover, all investor countries increase their exposure over time, although at different paces. China grows faster than the United States, which, in turn, grows at a higher rate than the EU.

Importantly, deals with multiple investors based in different countries are also on an upward trend, accounting for almost 50 % of total volumes of investment in the most recent years, up

([14]) The sum of invested volumes is slightly lower than that of target countries. In some cases our dataset does not contain information about the investor country, while providing information about the target country. However, missing data appear to be random across different countries and years. In addition, the two historical series essentially show the same trend in the sample period.

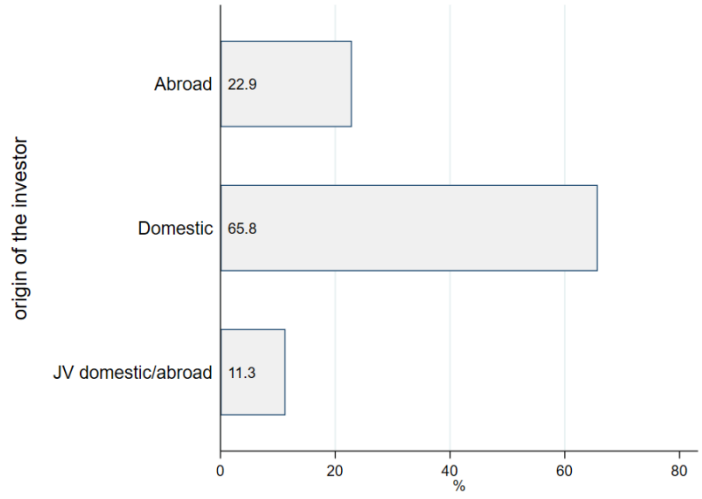
([15]) For instance, if a US-based investor and a Chinese investor make a joint VC investment in a UK-based company, their investment will fall within the 'mixed' category. The same rule applies to investors from any one EU Member States and not from the EU as whole.

from about 30 % in the first sample years. Although it is not possible to unequivocally assign these investments to a single country, nevertheless we can investigate the frequency with which the main players appear among the investors, with the aim of understanding how far their area of influence in the global VC business is extended.

Looking at the number of deals, the **United States, China and any one of the EU Member States appear as one of the investor countries in approximately 70 %, 14 % and 22 % of the mixed deals,** respectively. Interestingly, while **US venture capitalists seem to collaborate similarly with EU ([16]) and Chinese ones** (20 % and 16 %, respectively, of the total mixed deals with a US partner are jointly completed with them), **EU venture capitalists cooperate more frequently with US (67 %) than Chinese (4 %) ones.** Lastly, all three of these investor (groups of) countries have collaborated on only a limited number of investments (1 % of the mixed investments).

After having observed the behaviour of target and investor countries separately, the analysis focuses on the relationship between them. In particular, it is useful to understand how much of the total VC investment made by a country is intended for target companies on the domestic market and, conversely, how much is intended for the foreign market. While public policies to promote the dissemination of VC investments are generally designed to encourage the development of alternatives to bank financing for domestic firms, investors could in principle allocate part of the public resources abroad, in the absence of constraints on the allocation of funds. Figure 3.3 shows the distribution of VC investments by origin of investment.

Figure 3.3. – Distribution of VC investments by origin of investment (domestic, abroad, and mixed), 2008–2018



Source: JRC elaborations on VentureSource data.

([16]) Notably, mostly with the United Kingdom (62 %), Germany (24 %) and France (12 %).

VC investments are mainly allocated at the domestic level (approximately 66 % of the total), i.e. the investor(s) and target firm are based in the same country. At the same time, just over a fifth of all transactions take place entirely across borders, i.e. the investors are all foreign with respect to the target firm. Interestingly, **more than 10 % of investments are made through joint ventures (JVs) between domestic and foreign investors.** In other words, VC investment is completed in pools by investors in several countries, including the target country of the transaction.

However, this result seems to be quite heterogeneous among the different investor countries. If we compare the shares of US-based and Chinese investors, we find that **US-based firms receive funds almost exclusively from domestic VCs** (about 80 % in terms of number of deals) or from domestic/foreign JVs (approximately 10 %), while **56 % of Chinese firms receive investments from Chinese VCs and 14 % from domestic/foreign JVs,** with a higher proportion of foreign investors. Nevertheless, **the share of foreign investments in China declined rapidly in the most recent years,** from around 60 % (in 2008) to about 28 % (in 2018).

Regarding the single EU Member States, we note that **the level of VC investments from abroad is higher than in the United States** (i.e. 24 % vs 9 %). However, these findings do not discriminate the fact that many of the EU Member States' VC deals take place within the EU, which is a sign of the integration of the EU market. We discuss this in detail in the next section, focused on the EU.

3.2. Venture capital in the European Union

Using the VentureSource database, this paragraph focuses on VC investment in the EU Member States.

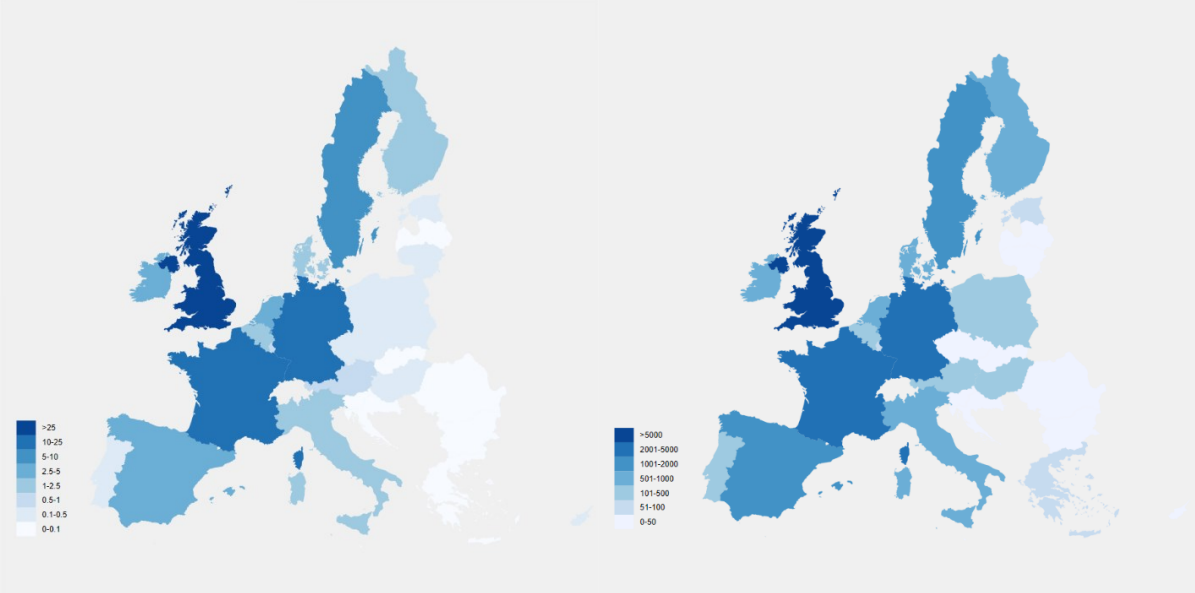
3.2.1. Venture capital investors and target firms

Figure 3.4 shows the cumulative investment volumes and numbers of deals raised by firms that are based in one of the EU Member States. The darker the colour assigned to the country, the more the investments raised, in terms of amount (left panel) or number of deals ([17]) (right panel).

Cumulatively, firms in the EU countries received different absolute levels of VC investments. **Most of the investments are focused on a limited number of countries, mainly the United Kingdom, France and Germany.** The results are substantially confirmed when looking at the numbers of the deals.

([17]) The DB includes a set of deals for which the invested amount is not available. Consequently, they are considered in the calculation of only the number of deals.

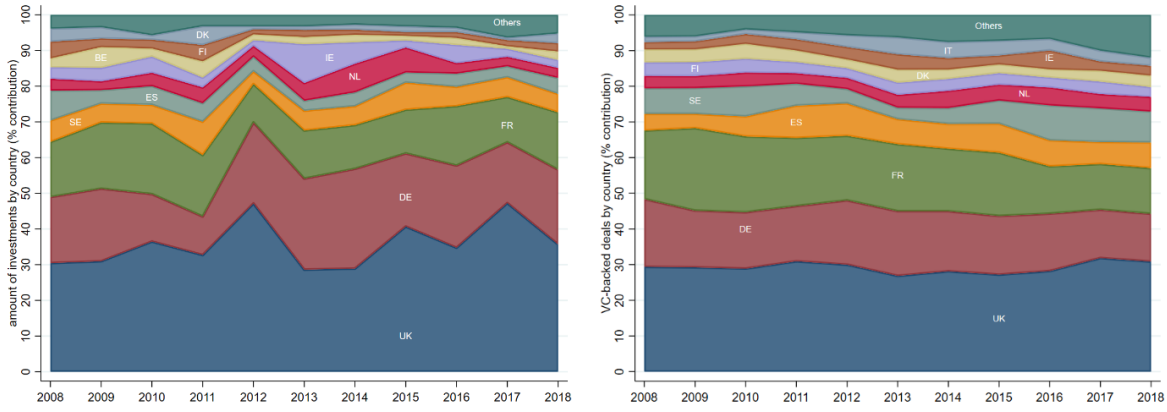
Figure 3.4. – Target country for VC investments: cumulative investment volumes and number of deals raised by firms based in EU Member States, 2008–2018 (billion euro (left) and number of deals (right))



Source: JRC elaborations on VentureSource data.

Figure 3.5 confirms that the polarisation of VC investments observed at the worldwide level also occurs within the EU.

Figure 3.5. – Target country for VC investments: changes in investment volumes and numbers of deals raised by firms based in EU countries, 2008–2018 (%)



Source: JRC elaborations on VentureSource data.

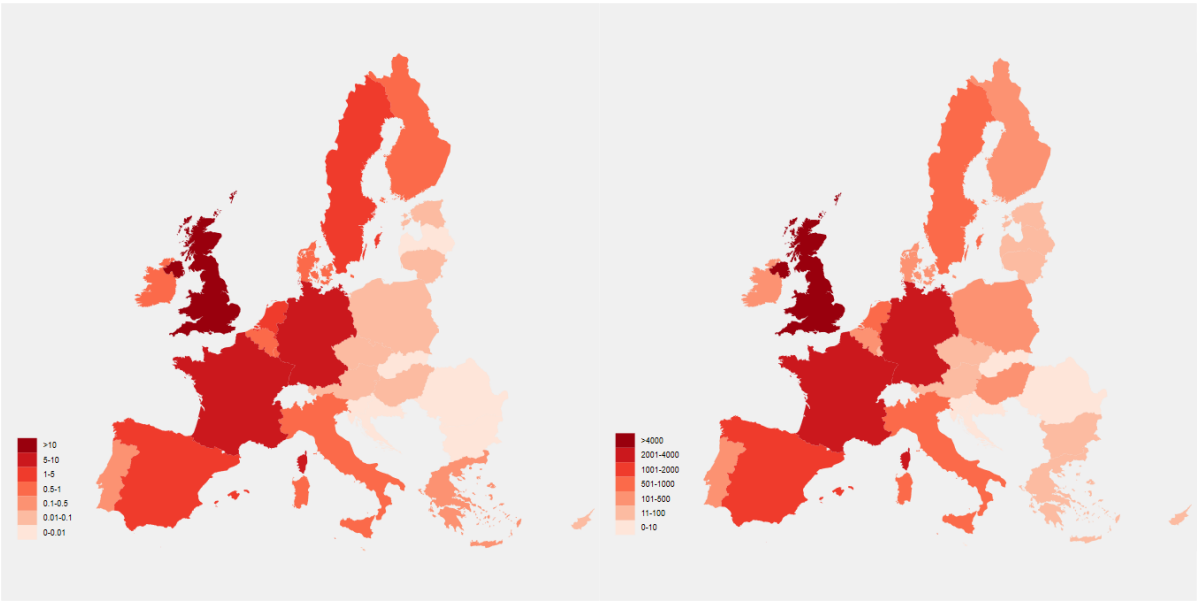
This phenomenon appears similar based on the amounts (left panel) and the numbers of deals (right panel). On average **the contribution of the top five countries** (i.e. the United Kingdom, Germany, France, Spain and Sweden) **accounts for approximately 80 % of the EU investments,** and that of the top 10 accounts for more than 90 % in the whole sample period.

At the same time, interestingly, the number of countries receiving VC investments started to increase in the most recent years of the sample (in the category 'Others'). Based on the matched DB, at the beginning of the sample period (2008) only 20 of the EU Member States were targets of VC investments, whereas all 28 were at the end of 2018.

Looking at the underlying transaction data, it emerges that in some circumstances single large operations may affect countries' overall results. For instance, this is the case of the 2012 UK peak, which basically depends on two large CVC deals, accounting for a total of EUR 1.5 billion ([18]). These peaks in volume are clearly not accompanied by the same proportional increases in the number of deals; hence, a simultaneous investigation of both graphs might shed light on whether an increase is in some way structural (volumes grow together with the number of deals) or more volatile.

We now investigate how EU-based venture capitalists invest worldwide. Figure 3.6 shows the amounts invested and number of investment deals performed by venture capitalists based in the EU.

Figure 3.6. – Investor country for VC investments: cumulative investment volumes and number of deals performed by venture capitalists based in the EU, 2008–2018 (billion euro (left) and number of deals (right))



Source: JRC elaborations on VentureSource data.

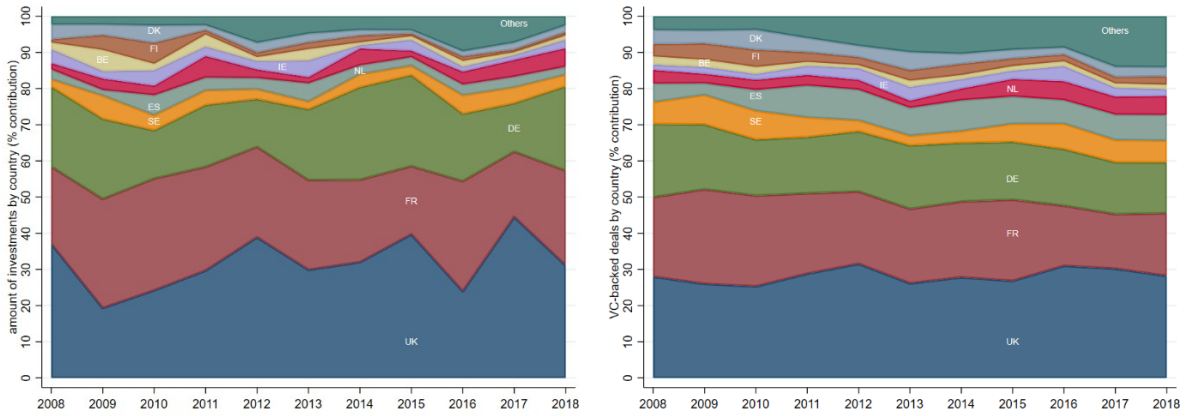
Looking at the geographical locations of investors (Figure 3.6), it emerges that the bulk of VC investment originates from the United Kingdom, France and Germany, in terms of both amounts (left panel) and number of deals (right panel). Interestingly, this is the mirror image

([18]) These are Qatar Holding LLC acquiring a stake in Heathrow (SP) Ltd. and Bright Food Group Co. investing in the UK cereal company Weetabix Ltd.

of the evidence in Figure 3.4 showing that most of the investments were focused on the same limited number of countries.

This evidence may suggest two findings. First, **a large proportion of VC investments may be completed within domestic borders,** which is in line with what emerged in Figure 3.3. This dynamic might also mean that the **geographical proximity between venture capitalists and VC-backed firms matters.** In particular, the same institutional and socioeconomic background, as well as the same language and culture, might reduce uncertainty, facilitating the investment. Second, **financial markets** that are mature enough to host a plethora of venture capitalists **are also keener to receive VC investments.**

Figure 3.7. – Investor country for VC investments: changes in investment volumes and numbers of deals raised by firms based in EU Member States, 2008–2018



Source: JRC elaborations on VentureSource data.

Figure 3.7 shows that the polarisation among EU countries observed in terms of VC investments raised is even stronger when looking at investor countries. In terms of absolute volumes, the contribution of the top three Member States (i.e. the United Kingdom, France and Germany) accounts for up to 80 % of the EU investments, and all the other 25 countries account for the residual 20 %. Moreover, the distribution of volumes across countries does not substantially change over the sample period, with only limited temporary adjustments (i.e. in 2009–2010 and 2016).

Although the results are slightly different when focusing on the number of the deals, with a relatively higher contribution from the other economies (accounting for approximately 40 % of the total in 2018), the overall structure of the contributors does not substantially change and the contribution of the top three Member States accounts for up to 60 % of the EU deals. Nevertheless, the category grouping the other countries ('Others') shows a slight increase in the most recent years of the sample, especially in number of deals, moving from less than 5 % in 2008 to more than 10 % in 2018.

As already described at the worldwide level, we now analyse the origin of investments received by EU firms, looking at the relationship between the investor and target countries. This analysis allows us to investigate the share of investments made by EU venture capitalists in the domestic, EU, and foreign markets. Hence, we apply a similar approach to the one adopted at the worldwide level, with the difference that we distinguish foreign flows into those from other EU Member States and those from non-EU countries. As a result, all VC investments were categorised as shown in Table 3.1.

Table 3.1. – Origin of the VC investments by category

Deals		Single	Multiple
Investor country = target country		Domestic	Domestic (if all venture capitalists are from the target firm's country)
Investor country ≠ target country	**EU origin**	Abroad: from EU	Abroad: JV within EU
	Non-EU origin	Abroad: from non-EU	Abroad: from non-EU
	Both	Not applicable	Abroad: JV EU/non-EU

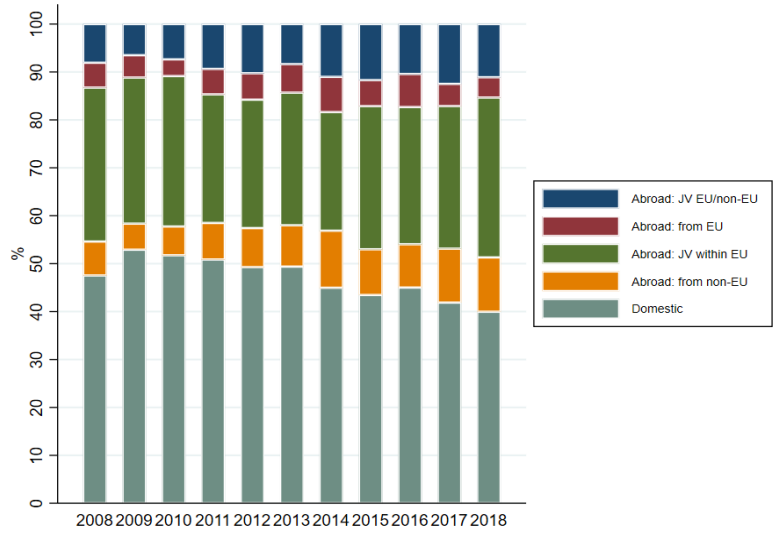
Source: JRC elaborations.

Looking at the case of single investors (column 2), the attribution is straightforward: the investment is tagged as 'domestic' if the investor country and the target country coincide; otherwise, it is considered to be from 'abroad'. In this latter case, we also distinguish between flows coming 'from EU' and 'from non-EU' countries.

Moving to the multiple investors case (column 3), if the investment is by venture capitalists based in the same country, we have tagged the investment as domestic. If the investment is by venture capitalists located in different countries, then three possibilities may occur. The investment can take place (i) from countries all located within the EU borders; (ii) from countries all located outside the EU; (iii) from some countries located in the EU and some others outside the EU. Figure 3.8 shows the results of this categorisation as a percentage of total VC investments.

As is apparent, on average approximately 45 % of investments come from venture capitalists who are based in the same country as the target firms. However, adding up single and multiple deals (i.e. 'Abroad: from EU' and 'Abroad: JV within EU') it emerges that **about 40 % of investments are from EU Member States other than the domestic ones.** This result suggests **a good level of integration of VC markets already achieved within the EU,** in particular compared with the inflow of investments from non-EU countries (between 5 % and 10 % in the sample). Interestingly, a growing share of the investment originates from JVs between EU and non-EU countries, moving from 8 % in 2008 to 11 % in 2018.

Figure 3.8. – Origin of the VC investments by category, 2008–2018 (% of total investments)

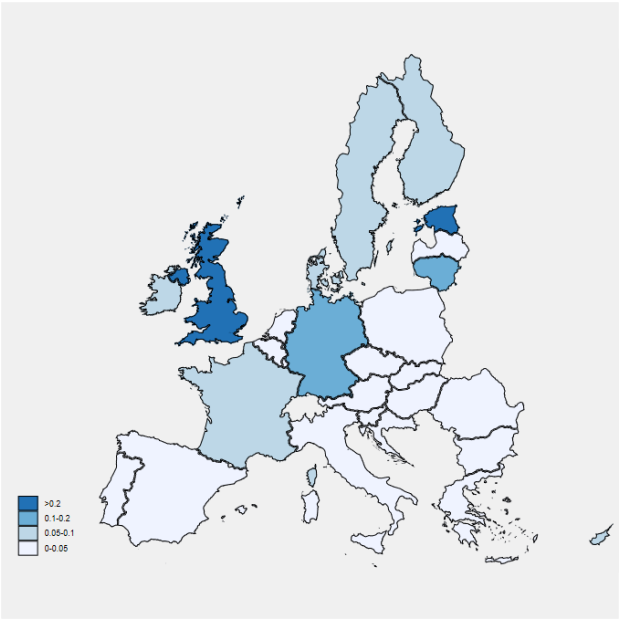


Source: JRC elaborations on VentureSource data.

3.2.2. Venture capital investments versus other sources of firms' financing

In order to better interpret the relevance of the VC instrument, it is useful to parameterise the volumes of VC financing with respect to a measure that constitutes the main source of firms' financing, i.e. bank loans. Accordingly, we created the ratio between the cumulative VC investments and outstanding loans to non-financial corporations (NFCs) by country in the sample period, as shown in Figure 3.9.

Figure 3.9. – Cumulative investment volumes as a percentage of cumulative NFC loans, 2008–2018



Source: JRC elaborations on VentureSource and Eurostat data.

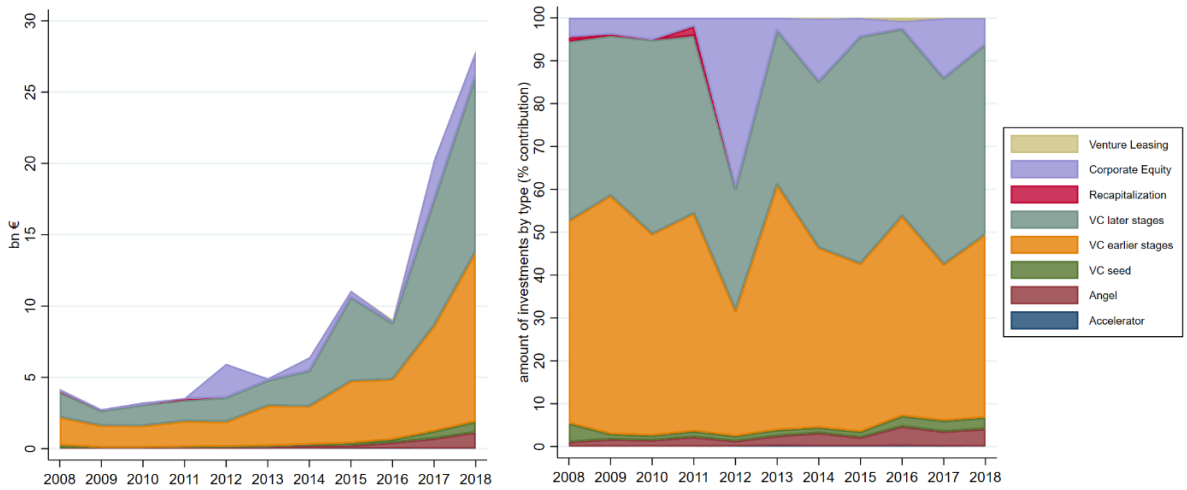
This ratio is a measure of the ability of firms to opt for other financial instruments than bank loans (Gucciardi, 2019). It is therefore a proxy for the relative importance of VC investments in the financial structure of companies. A darker colour corresponds to countries where VC financing is more widespread as an alternative to NFC loans.

Not surprisingly, a correlation emerges between the absolute level of VC investments and their ratio to loans. In other words, countries with higher levels of VC investments also show a larger VC presence in loans. Nevertheless, on the one hand some smaller economies experience a significant amount of VC (e.g. Estonia, Cyprus and Lithuania), while on the other hand larger economies lose some relative positions within this setting (e.g. Spain and Italy). Therefore, in these latter cases, despite a larger absolute diffusion, the VC market may not have reached the level of maturity to be considered a credible alternative to bank loans.

3.2.3. Venture capital investments by category of deals

The following figures describe the most recent changes in VC diffusion within the EU, and also provide a breakdown by VC instrument type.

Figure 3.10. – VC investments (volumes) raised in the EU by investment type, 2008–2018 (billion euro (left) and % of total investments (right))



Source: JRC elaborations on VentureSource data.

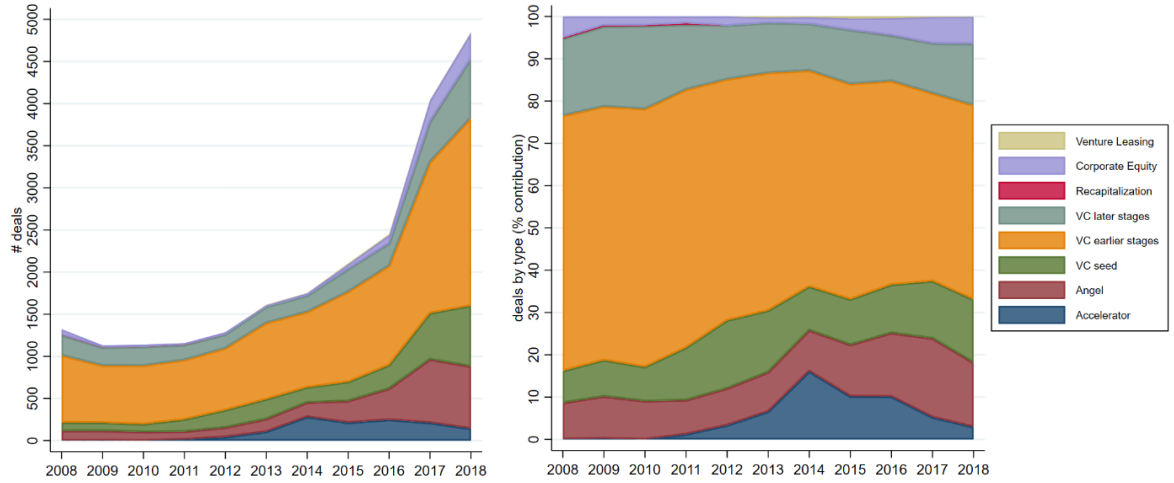
Altogether, Figure 3.10 shows a substantial growth in volumes starting from 2009, and a particularly significant increase in 2017 compared with 2016. The abrupt acceleration in 2017, following a decrease in 2016, was mainly driven by later-stage investments.

Moreover, it emerges that the instruments covering the VC early and later stages are predominant in terms of volumes. On average, the two add up to about 90 % of the total amounts. The composition of VC investments raised by the different investment types is substantially stable over the period, although we observe a relative growth in instruments

such as CVC ([19]) (with a peak in 2012, due to a limited number of deals) and business angels (since 2015). Interestingly, the percentage contributions of the early and later stages of VC investments seem substantially equal and constant over time (they both account for around 40 % in the whole period with the exception of 2012).

The distribution of the number of deals across all different VC instruments is shown in Figure 3.11.

Figure 3.11. – VC investments raised in the EU, by investment type, 2008–2018 (number of deals (left) and % of deals (right))



Source: JRC elaborations on VentureSource data.

VC early and later stages are still predominant over the other forms of investment, even though the sum of the two accounts for about 80 % of the total (vs 90 % of the volumes). Moreover, the number of VC early stages is always significantly larger than that of VC later stages. At the same time, when looking at the number of deals, the percentage contribution of CVC investments is lower, while it is higher for accelerators, business angels and VC seed (with growth emerging in the last years of the sample).

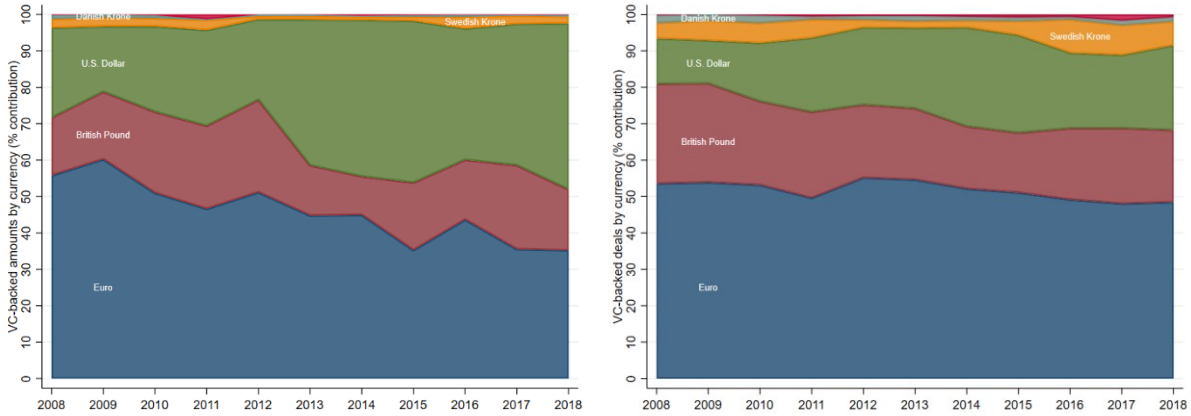
The joint interpretation of this evidence suggests that **firms that access later stages of VC investments are significantly fewer than those receiving only early stages of VC.** At the same time, **the former type of firms receives significantly larger investment volumes.** On the one hand, this may be related to firms' increasing financial needs at later stages. On the other hand, venture capitalists may prefer to invest more at later stages, since companies then have a higher likelihood of success (Dahiya and Ray, 2012).

([19]) Corporate Venture Capital (CVC), also called as Corporate Equity in the VentureSource database.

3.2.4. Venture capital investments by transaction currency

This paragraph documents the currencies in which the investments in the EU are performed, to see whether or not investments are completed using EU currencies.

Figure 3.12. – Currency of VC investments as a percentage of total investments in the EU, 2008–2018

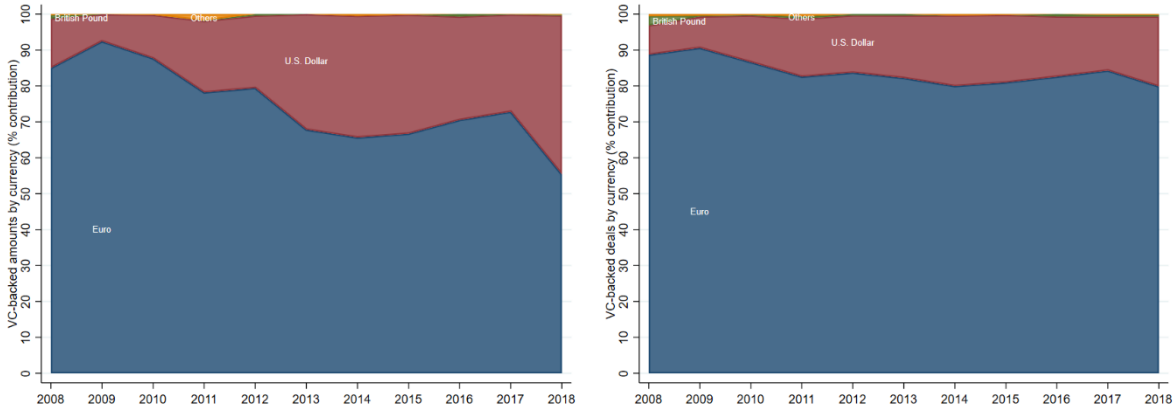


Source: JRC elaborations on VentureSource data.

Figure 3.12 shows that **the euro is the most adopted currency in VC transactions in the EU,** although in more recent years the US dollar has been gaining importance in relative terms. Specifically, the euro is the absolute reference currency (i.e. > 50 % of amounts and deals) in the period 2008–2010, while in recent years it maintains this status only by number of deals. Comparing the number of deals and the amounts, it emerges that the transactions made in US dollars are on average larger in volume, especially in the more recent years.

Nevertheless, if the same phenomenon is observed in only the euro area (as in Figure 3.13) it emerges that the number of investments made in euro is always more than 80 % of the total, while the remainder is substantially composed of transactions completed in US dollars. Looking at the VC-backed amounts, we note that on average 70 % are in euro, although a reduction in favour of the US dollar is also observed in this case in the last 2 years.

Figure 3.13. – Currency of VC investments as a percentage of total investments in the euro area ([20]), 2008–2018



Source: JRC elaborations on VentureSource data.

3.3. Some further evidence on target firms and venture capital transactions based on the matched database

This section leverages on the matched DB to shed some light on the characteristics of VC investments, and on the features of VC-backed firms in the year of the deal.

3.3.1. Venture capital investments and industrial sector analysis

First, we analyse the main sectors of the VC-backed target companies, by using the categorisation of sectors available in Orbis, associated with VentureSource's target firms. Specifically, we adopt Eurostat's NACE Rev. 2 classification (European Commission, 2008). Based on it, we show the development over time of the investments by sector, in volumes and numbers of deals.

Sectors may be aggregated at different granularity levels. We first adopt the 'Broad Structure' (European Commission, 2008, p.57) of the NACE Rev. 2 classification, which distinguishes a total of 21 categories ([21]). Hereafter, we refer to them as both broad sectors and macrosectors. Figure 3.14 shows the development over time of the share of investments by volume (left) and by number of deals (right) by sector over the total, according to this classification.

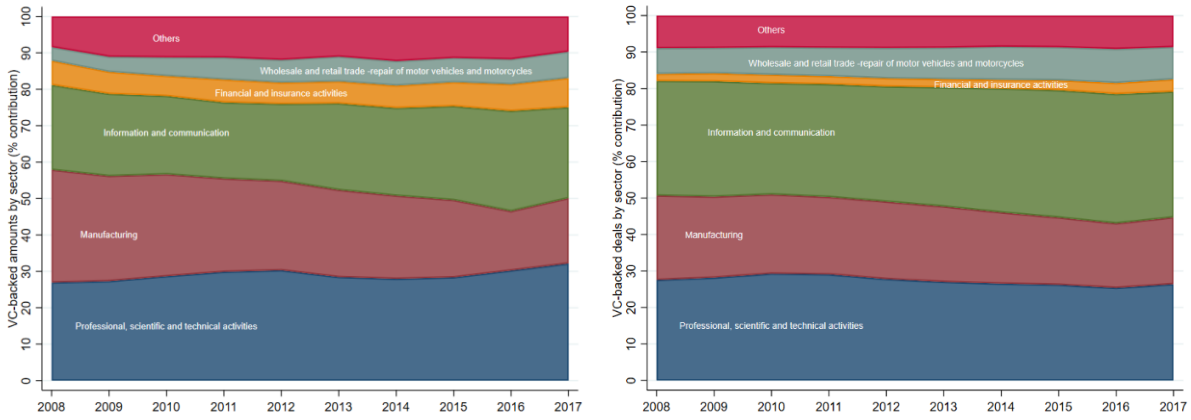
Figure 3.14 highlights the **polarisation of VC investments in a few macrosectors**. The top 5 macrosectors account for about 90 % of the total, while the other 14 categories cover the

([20]) Including Slovakia from 2009, Estonia from 2011, Latvia from 2015 and Lithuania from 2015.

([21]) Agriculture, forestry and fishing; mining and quarrying; manufacturing; electricity, gas, steam and air conditioning supply; water supply – sewerage, waste management and remediation activities; construction; wholesale and retail trade – repair of motor vehicles and motorcycles; transportation and storage; accommodation and food service activities; information and communication; financial and insurance activities; real estate activities; professional, scientific and technical activities; administrative and support service activities; public administration and defence – compulsory social security; education; human health and social work activities; arts, entertainment and recreation; other service activities; activities of households as employers; activities of extraterritorial organisations and bodies.

remaining 10 % of investments. The importance of these macrosectors is confirmed when investigating both the amount invested and the number of deals.

Figure 3.14. – VC investments by industrial macrosectors (NACE Rev. 2 – broad structure), 2008–2017 (%)



Source: JRC elaborations on the matched DB.

These sectors are professional, scientific and technical activities; manufacturing; information and communication; financial and insurance activities; wholesale and retail trade – repair of motor vehicles and motorcycles. The first area includes activities with a legal or accounting nature, as well as engineering, advertising, and research and development activities. The second area represents the broadest sector, since it contains a large part of all industrial production. The third sector includes high-tech activities and a focus on telecoms, information technology (ICT) and software programming. The fourth sector covers all financial intermediation activities (including banking and insurance). Lastly, the fifth sector mainly includes wholesale and retail trade activities.

By comparing amounts and numbers of deals, we note that on average deals in financial services have larger volumes, while those in ICT services are somewhat smaller. Looking at trends, we find a slight reduction in the manufacturing sector in favour of professional services, and information and communication, in particular from 2012 onwards.

A more granular representation of trends is reached when looking at the NACE four-digit level. The results of this analysis are presented in Table 3.2. It includes microsectors that raise at least 1 % of total VC investments. Each of the microsectors is also associated with its broad sector.

Interestingly, **many of the microsectors belong to two areas.** The first is **bio-oriented and pharmaceutical research.** Altogether, these microsectors account for about 28 % of total investments (tagged in Table 3.2 with the medicine bottle icon). The second prevailing area is the **engineering** one, with a particular focus on computer science and software development and publishing.

Table 3.2. – VC investments by industrial microsector (NACE Rev. 2 – four digits), 2008–2017 (cumulative %)

Broad sector	Microsector (four digits)	% of broad sector	% of total investments
Professional, scientific and technical activities	Other research and experimental development on natural sciences and engineering	38	11
	Research and experimental development on biotechnology	24	7
	Engineering activities and related technical consultancy	10	3
Manufacturing	Manufacture of pharmaceutical preparations	30	7
	Manufacture of electronic components	22	5
	Manufacture of instruments and appliances for measuring, testing and navigation	9	2
Information and communication	Computer-programming activities	29	7
	Other software publishing	17	4
	Other information technology and computer service activities	13	3
Financial and insurance activities	Other financial service activities, except insurance and pension funding	43	3
	Activities of holding companies	29	2
	Other credit granting	14	1
Wholesale and retail trade	Retail sale through mail order houses or internet	41	2
	Wholesaling of pharmaceutical goods	13	1
Others	Other human health activities	22	2
	Renting and operating of own or leased real estate	16	2
	Other business support service activities	12	1

Note: Top three 4-digit sectors (if they contribute at least 1 % to total investments) are selected within each broad sector.

Source: JRC elaborations on the matched DB.

The aggregation of these top microsectors accounts for about 26 % of total investment (tagged in Table 3.2 with the computer icon). Hence, these two areas, which include 12 of the top microsectors, account for more than 50 % of the total.

A third – still less relevant – area in the field of finance (tagged in Table 3.2 with the smartphone icon) seems to emerge. We know that financial technology is an expanding sector (Gabor and Brooks, 2017), even though it is falling behind in Europe in comparison with the rest of the world (Haddad and Hornuf, 2019). Nevertheless, it is probably underestimated in our sample, as many of the development activities are associated with changes in ICT paradigms, and therefore potentially included among microsectors related to software publishing.

Altogether, when refining the industry analysis looking at microsectors, it emerges that investments are strongly concentrated in high-tech, engineering and bio-oriented research activities, rather than more traditional sectors (e.g. manufacturing and sales).

These results provide some insights into how venture capitalists tend to allocate their resources based on the target firms' sector ([22]). The results could provide useful suggestions for policymakers who aim to encourage a rise in VC investments even in more traditional sectors. For instance, public funding dedicated to supporting venture capitalists' investments may be structured in sector-specific funds. This strategy would encourage a more homogeneous distribution of investments across sectors.

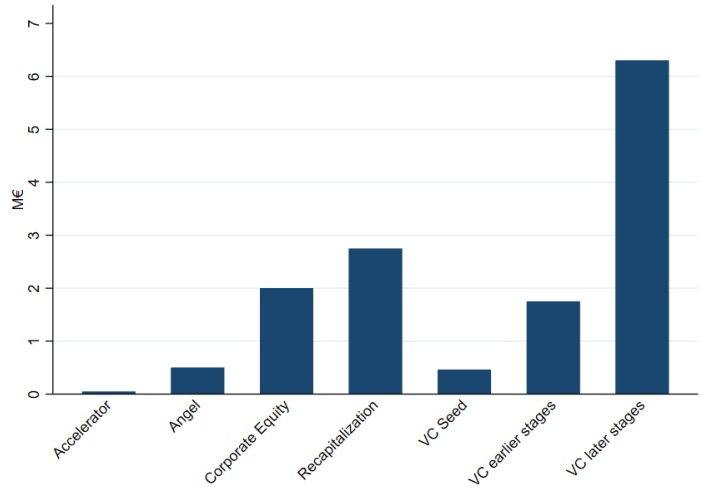
3.3.2. Analysis of transactions

In this section, we analyse from a financial point of view VC investments raised by EU companies. Figure 3.15 shows the median value of investments in million euro by round of investment.

First, **the amount varies significantly by rounds and types.** Specifically, the amounts invested in the early life stages of the firm are lower than those in the later phases. Accelerator, the first instrument typically provided to newly founded firms, shows a median amount of approximately EUR 50 000. In such cases, the transfer of cash is often associated with a fixed-term programme that aims to provide softer support in terms of connections, mentorship or training (Cohen and Hochberg, 2014), and enhance the skills of entrepreneurs in producing a proof of concept or a demo useful for later investment rounds (Cohen, 2013).

([22]) Nevertheless, this interpretation is based on descriptive (and not econometric) evidence. With this approach we cannot distinguish whether or not the likelihood of a VC transaction (i) is heterogeneous across sectors and (ii) is driven by either the demand (companies aiming to obtain financing) or the supply (venture capitalists looking for investment opportunities) side.

Figure 3.15. – Median VC investment amounts by round and type of investment, 2008–2017



Source: JRC elaborations on the matched DB.

The business angels and VC seed respond to similar needs in the first phases of firms' lives, after their foundation, but often before they begin to generate revenues or recruit employees. These instruments show similar median amounts, approximately equal to EUR 500 000. The first stages of VC investments produce median investments close to EUR 2 000 000, while firms that manage to enter the later stages can get more than EUR 6 000 000 per transaction. Recapitalisations of VC investments are completed by investors to divert allowances from concurrent pre-existing investors who are no longer interested in the business. For this reason, they normally come at later stages of the lives of firms. Consistently, the median investment ranges between the VC earlier stages' and later stages' values (just below EUR 3 000 000). Lastly, the median CVC investment is around EUR 2 000 000, close to VC early stages.

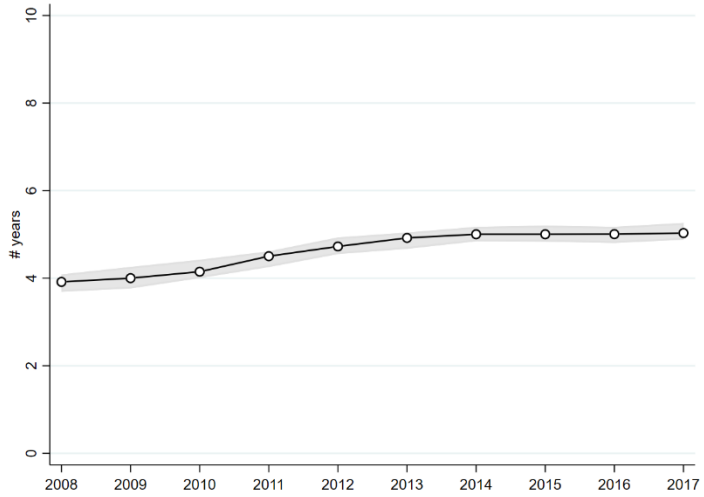
Altogether, these findings illustrate that **VC is quite a flexible instrument, which could be adapted based on target firms' financial needs.** The amounts may vary significantly according to the stage of firms' lives, from EUR 50 000 at the beginning of the activities (i.e. through an accelerator) to more than EUR 5 000 000 at later stages.

These findings may be of interest to policymakers. If the policy objective is to increase the number of SMEs receiving at least one VC opportunity, then it is vital to strengthen the diffusion of accelerator, business angel and VC seed instruments. Conversely, if the goal is to support more developed firms to further boost their growth, then later stages of VC investments should be incentivised. In other words, the same amount of resources would be allocated through venture capitalists to a larger or more limited group of target firms, in the first and second cases, respectively ([23]).

([23]) Nevertheless, this evidence being based on a descriptive analysis, it is not possible to draw robust conclusions on the existence of a causal relationship between the type or round of investment and the amounts granted.

While the amount of investment gives a measure of the size of the deal, its duration provides information on the time needed to observe its (long-term) effects on target firms. Figure 3.16 shows the median duration of VC investments, highlighting its development over time.

Figure 3.16. – Median duration of VC investments and confidence interval, 2008–2017



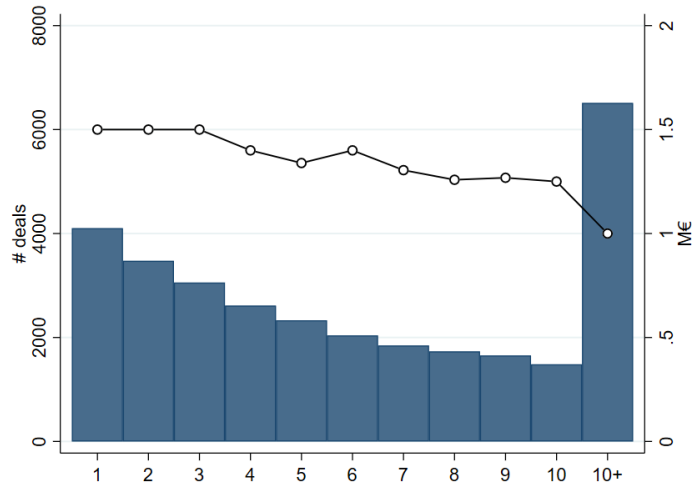
Source: JRC elaborations on the matched DB.

We then create the duration of the investment as the difference between the observed year (in our 2008–2017 sample) and the year of investment. In addition, following a similar approach to that of Cumming and Johan (2010), we consider a VC investment to be concluded when the firm has completed an exit strategy. We proxy the completion of an exit strategy with the occurrence of one of the following exit deals for our sample VC-backed firms: buyout, IPO and M&A. Therefore, if a firm first receives an accelerator and later a VC seed investment, the accelerator remains active even in the presence of VC seed, until the firm carries out one of the exit strategies. Based on this approach, the median duration of the investment varies between 4 and 5 years, with a slight upward trend in the sample analysed. This result suggests that **structural effects of VC investments on target firms** (such as their ability to go public or to be attractive in the market), although close in time, **may be delayed.** They do not emerge in a few months or 1 year.

This evidence seems to indicate that policies oriented towards firms' development through VC investments should be more effectively assessed in the medium term. Specifically, if you want to measure the effectiveness of a VC investment in terms of its ability to support young businesses until they become solid enough to go public or to be merged or acquired, then on average you should expect visible effects not before 4–5 years from the VC investment.

To complete our discussion, we investigate the relationships of the duration of investments with the amount invested and with the number of deals.

Figure 3.17. – Relationship between duration of VC investments and amount invested, 2008–2017 (number of deals (left *y*-axis) and median cumulative amount (right *y*-axis) vs duration of investment)



Source: JRC elaborations on the matched DB.

Figure 3.17 shows that the most frequent duration of VC investments is equal to 1 year ([24]). Moreover, the longer the maturity of investment, the lower the number of deals. Interestingly, based on this representation, the median invested amount does not seem to show a strong correlation with the duration of the investments, ranging from EUR 1.5 million to EUR 1.3 million up to the 10th year of investment. Nevertheless, the slight decrease emerging in particular after the sixth year may be due to some heterogeneity in the nature of different exit strategies. Faster exits are typically linked to IPOs, whereas subsequent exits come as a result of private transactions – for instance M&A or buyout (Cumming and Johan, 2010) – and the former are associated with higher levels of investments than the latter (Guo et al., 2015).

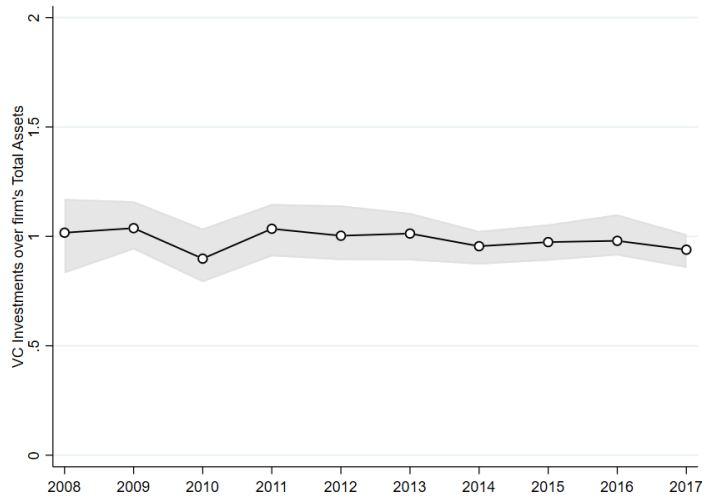
3.3.3. Significance of the investment to the target firm

We move now to investigate the relevance of VC investments on the targeted firms. The investment of venture capitalists is generally geared towards the acquisition of equity shares of young firms showing growth potential – although with still contained valuations – in order to maximise profits after the exit strategy (Guo et al., 2015). The choice of venture capitalists should then be reflected in the amount invested, rather than the main variables typically adopted for the firms' evaluation.

One first possibility is to observe the relationship between the investment and total assets of target firms. The trend is shown in Figure 3.18.

([24]) With the exception of the '10+' category, which covers all deals lasting more than 10 years.

Figure 3.18. – Ratio between VC investments and firms' total assets, 2008–2017 (median and confidence interval)

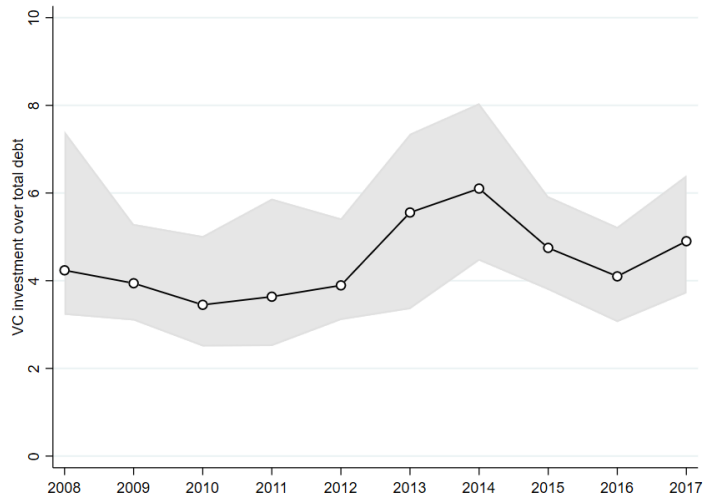


Source: JRC elaborations on the matched DB.

Interestingly, in our sample the median of this ratio is always around the value of 1. Hence, on average **venture capitalists seem to fully cover the value of total assets of target firms with their investments.**

In Figure 3.19, we investigate the relationship between VC investments and the debt structure of targeted firms. Specifically, we create a ratio whose numerator is the amount of investment in the investment year, and whose denominator is equal to the sum of the short- and long-term debts. Therefore, this ratio could be thought a useful tool to understand how corporate debt is in some way financed by the VC investment.

Figure 3.19. – Ratio between VC investments and firms' total debt, 2008–2017 (median and confidence interval)



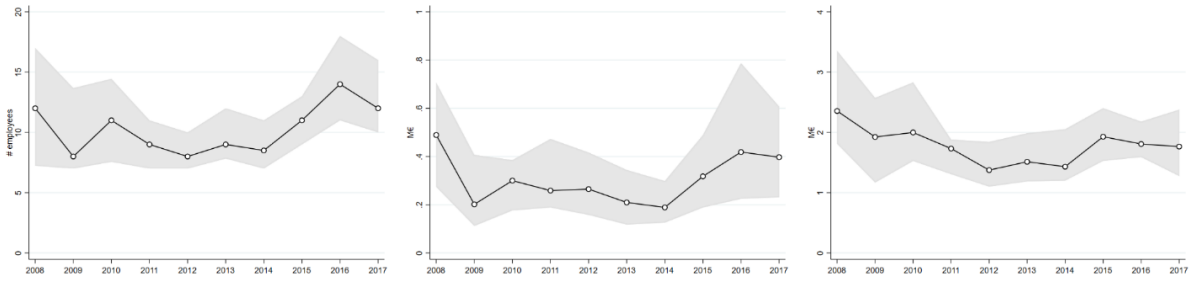
Source: JRC elaborations on the matched DB.

Figure 3.19 shows that the median of this ratio fluctuates between 3 and 6, suggesting that the **liquidity injected by venture capitalists in the targeted firms could fully cover the value of their debts.** It is also interesting to note that that ratio looks similar to the median duration of the investment (i.e. 4–5 years, as shown in Figure 3.16). In other words, we may assume that the sums invested can cover the debts of the target enterprise for 4–6 years, and then the entrepreneurial project is exhausted, or the firm undergoes any of the exit transactions (e.g. IPO, M&A).

3.3.4. A first identikit of the targeted European Union firms

We now draw some relevant characteristics of the VC-targeted firms. Specifically, we analyse the number of employees, total assets and sales (Figure 3.20) in the year of the VC investment.

Figure 3.20. – Number of employees, total sales and total assets of firms when receiving a VC investment, 2008–2017 (median and confidence interval of number of employees (left), total sales (centre) and total asset (right))



Source: JRC elaborations on the matched DB.

This figure shows that the median **profile of firms receiving VCs falls into the SME category,** based on the size criteria included in the European Commission's (2015) definition ([25]). Specifically, these firms employ between 8 and 15 employees, have yearly sales of between EUR 200 000 and EUR 500 000 and have total assets of between EUR 1.5 million and EUR 2.5 million.

Moreover, looking at the combination of the three results, the median firm falls within the definition of microenterprise ([26]) for 5 years ([27]) and small enterprise ([28]) for the other years of the sample. Specifically, the number of employees and total assets range around the threshold

([25]) While size constitutes a prerequisite, other conditions – including the independence of the firm – also have to apply for a firm to be considered an SME, according to the European Commission definition. The relationship between the definition of SMEs and VC is further investigated in Section 6.

([26]) Fewer than 10 employees and less than EUR 2 million of sales and/or total assets.

([27]) 2009, 2011, 2012, 2013 and 2014.

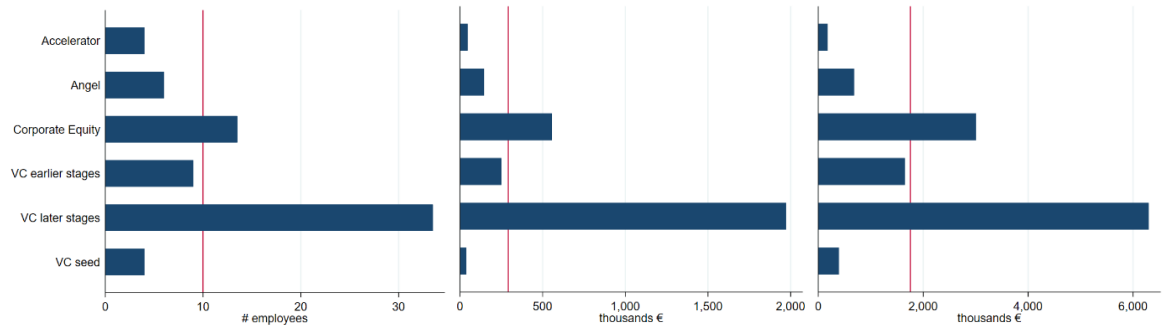
([28]) Fewer than 50 employees and less than EUR 10 million of sales and/or total assets.

dividing the two subcategories, while sales are always well below the threshold that identifies microenterprises.

This first set of results confirms that VC is a financial instrument that is typically received by SMEs and is specifically received by its smallest subcategories. From a policy perspective, this may suggest that, if a policy incentivising VC is implemented, on average it is likely to affect SMEs rather than larger companies.

Nevertheless, as already anticipated, different rounds of VC investments are typically oriented towards different types of firms. Hence, we expect to find some heterogeneity in the variables describing firms' dimensions when we investigate investments coming at the early versus later stages. Figure 3.21 shows the results of this heterogeneity analysis.

Figure 3.21. – Employees, total sales and total assets by round of investment, 2008–2017 (medians of number of employees (left), total sales (centre) and total assets (right))



Source: JRC elaborations on the matched DB.

The three panels of Figure 3.21 describe the median values of the number of employees, total sales amounts and total assets of target firms, respectively, discriminating by type or round of VC investment. The red vertical line within each panel indicates the median value calculated of total VC investments, in order to make the comparison among categories of investment easier.

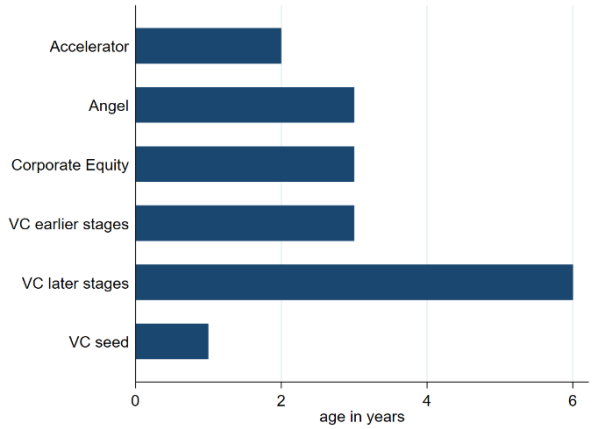
First, there seems to emerge a **correlation between the dimensions of the firm and its financial maturity.** On each dimension, VC later-stage investments are larger than the median, while accelerator, VC seed and VC earlier stages are smaller than the median. The progression from accelerator to VC later stages, passing through business angel, VC seed and early stages, is substantially confirmed when looking at all dimensions.

Second, we can draw some further conclusions on the dimensions of target firms. On average, firms receiving accelerator, business angel or VC seed investments are more likely to be microenterprises based on the European Commission definition. Their number of employees is significantly lower than 10, and their total sales and assets are less than EUR 2 million. On

the other hand, firms receiving VC later stages are typically small enterprises, although their total sales are just around EUR 2 million. The population of firms raising VC early stages is more likely to divided between micro and small enterprises, since the median values are around the threshold values for employees (10) and total assets (EUR 2 million).

Figure 3.22 shows the median age of firms by category of investment, created as the difference between its year of incorporation and the year in which it receives the investment.

Figure 3.22. – Median age of firms when receiving different rounds of investment, 2008–2017



Source: JRC elaborations on the matched DB.

We observe that the median age of the target firm is around 3 years for all VC-backed types. Nevertheless, some variability in results emerges when looking at the type of investment. Our findings confirm that accelerator and VC seed seem to be destined for newly established or very young firms (between 1 and 2 years old), while firms receiving CVC investments are on average 3 years old, similarly to what happens to VC early-stage investments. Lastly, VC later-stage investments are on average destined for 6-year-old firms.

These findings may be of interest for two policy reasons ([29]). The first is that, even discriminating by type or round of investment, the firm that is the target of VC investments matches an SME on average. The second is that it would be possible to target policies in an even more refined way, leveraging on the dimension and the age of target companies. For instance, if the objective is to encourage firms' access to later stages of VC investments, policymakers could restrict access to public funds dedicated to these rounds of investment to microenterprises, which, otherwise, might have less chance of receiving them.

([29]) Nevertheless, this evidence being based on a descriptive analysis, we cannot draw conclusions on the existence of a causal relationship between the type or round of investment and the size of the target company.

3.4. Key takeaways

The key takeaways of this section are reported in Box 3.2.

Box 3.2. – Key takeaways of Section 3

Key takeaways	▪ **VC** investments significantly **increased** from **EUR 30 billion** in 2008 to **EUR 380 billion** in 2018. ▪ At the worldwide level, **VC transactions** are **concentrated** in a **few countries,** with the **United States** and **China** recently further emerging as **main targets and investors** and the **EU** still **lagging behind** them. **Most** of the **transactions** (66 %) are completed between **investors** and **target companies** based within the **same country.** ▪ At the EU level, most of the VC investments are focused on a limited number of countries, mainly the **United Kingdom, France** and **Germany.** Moreover, a **good level** of **integration** of **VC markets** within the EU emerges, since nearly 40 % of EU investments are in Member States other than that of the investor. ▪ The **euro** is the **most adopted currency** in **VC-backed transactions** both within the **EU** and in the **euro area.** ▪ **The amounts of VC invested** vary significantly through the stages of a firm's development: **from EUR 50 000 at the beginning of its activities to more than EUR 5 million at later stages.** ▪ Since the **average duration** of the **VC investment** is in the range of **4–5 years,** effects of VC on target companies should be assessed in the **medium term.** ▪ Venture capitalists focus their investments on companies operating in high-tech sectors, specifically **bio-oriented and pharmaceutical research** and **engineering, computer science, and software development and publishing**. ▪ The average **EU company raising a VC investment** is an **SME. First** rounds of investments are typically raised by **microenterprises**, whereas **later** stages are generally obtained by **small enterprises.**

4. The investment strategies of venture capitalists

The financing of potential high-growth enterprises and start-ups through VC has recently been the object of increasing attention in the empirical finance literature. Several works have analysed venture capitalists' strategies, specifically investigating how venture capitalists' decision-making processes on investments work.

For the purpose of this study, most of the relevant empirical evidence on 'outside equity' finance (Myers, 2000) is summarised, focusing on the investment criteria ([30]) adopted by venture capitalists. Altogether, three main strands of research emerge ([31]): (i) investigation of the ultimate goal of the investments, (ii) the analysis of multiple stages and (iii) studying the impact of external macro-factors on the investment strategy.

Some recent studies in the first of those streams of research point out that the ability to exert a certain level of control over applicants once the investment is granted is a relevant factor influencing venture capitalists' decisions (Wang et al., 2017). Nevertheless, venture capitalists seem to be more interested in selecting firms with outstanding potential in terms of possible exit outcomes and company valuation (Gompers et al., 2020), and may increase their control over the target firm only if they feel the investment is becoming riskier (Kaplan and Strömberg, 2004), up to the ownership of the majority of shares within a typical principal–agent framework. At the same time, Drover et al. (2017) show how venture capitalists are willing to relinquish a certain degree of control over investees when the prestige of the entrepreneurial and management team increases.

In other words, the identification of the ultimate goal of the investment depends closely on the business relationship between the investor and the investee, usually the standard principal–agent relationship (Hart, 2001). Agency limitations or possible inefficiencies that might arise between the principal (venture capitalist) and the agent (firm invested in) may influence the way the investment affects the target company. In these cases, the principal may ask for stronger control over the agent, instead of providing only lighter external support (Kaplan and Strömberg, 2004). As a consequence, to mitigate some of these risks, venture capitalists either take some measures (e.g. recruiting the management team and exercising stock option plans) to increase their informal control of the investee or, in some other circumstances, could aim to own the majority of the shares to exert full legal control over the target firm. Some works also suggest that these stylised behaviours may change depending on the different stages or rounds of investments (e.g. Petty and Gruber (2011)).

([30]) By 'decision-making criteria', the literature refers to product/service characteristics, target market characteristics, financial potential and entrepreneurial/management team characteristics.

([31]) See, for instance, Drover et al. (2017) for an exhaustive literature review.

To mitigate agency problems and exposure to volatile deals and markets, venture capitalists adopt several contractual mechanisms. One of the most employed approaches is the multistage investment ([32]), which is also behind the second stream of research. Multistage VC investments allow venture capitalists to evaluate, at different stages, the performance of the target firm. This approach may help to decide whether to continue funding the project, renegotiate the contract terms or abandon the investment if the company fails to meet the prearranged performance targets, leading to more efficient investment decisions and outcomes (Gompers, 1995; Tian, 2011; Li and Chi, 2013). The literature finds an inverted U-shaped relationship between effective decision-making and experience in VC financing. In other words, increasing experience in projects' evaluation leads venture capitalists to more effective decisions up to a certain threshold. After that, overconfidence might prevail, potentially resulting in biased decisions and weak performances (Shepherd et al., 2003). Similarly, venture capitalists seem to adopt different individual criteria for evaluating projects based on their consolidated experience (Franke et al., 2008). While experienced venture capitalists give more positive evaluations to projects with more cohesive management teams, less experienced VC investors focus more on team members' qualifications in their evaluations of investment. Other studies show that the investment decisions of venture capitalists are also influenced by their values (Matusik et al., 2008): sharing similar backgrounds and past work experiences with the entrepreneur/management could encourage further VC investments (Franke et al., 2006; Chen et al., 2009). Finally, some studies analysed the certification effect of the venture capitalists' reputations on the offer of VC financing and on the performances of their portfolios' companies. Financial proposals made by VCs with a high reputation to start-ups on their first round of funding are three times more likely to be accepted than proposals made by VCs with a more limited track record (Hsu, 2004). Companies backed by VC from experienced venture capitalists with high reputations are more likely to go public (i.e. IPO), obtain higher share prices from an exit strategy (Sørensen, 2007; Pollock et al., 2010) and have a greater propensity to create alliances between venture capitalists and VC-backed companies in their portfolios (Gu and Lu, 2014).

The third strand of literature focuses on macro-factors that may affect decision-making on VC investments. Recent research points out how VC investments are also driven by external factors that may facilitate or limit potential investment decisions in specific markets or countries. One important macro-factor is the VC business cycle. VC investments tend to follow cyclical patterns with systematic variations in terms of projects financed and resources invested. Some works recognise the growth in gross domestic product and the reduction of labour market rigidities as decisive drivers of VC investments (Jeng and Wells, 2000).

([32]) Other contractual mechanisms adopted by venture capitalists to mitigate agency problems generally relate to settlements and covenants (Bengtsson, 2011), stock options and convertible securities (Cornelli and Yosha, 2003; Hellmann, 2006; Arcot, 2014), representation on the board and the monitoring of management (Yoshikawa, 2004; Wijbenga et al., 2007), replacing the founders of the investee start-up with an outside chief executive (Hellmann and Puri, 2002) and syndication (Manigart et al., 2006).

Conversely, other studies point out some possible limitations to the diffusion of VC investments due to external factors, mainly related to financial markets' characteristics (Inderst and Müller, 2004), network barriers that incumbent venture capitalists have erected to restrict outside venture capitalists from entering the market (Stuart and Sorenson, 2007; Hochberg et al., 2010), and scarcity or absence of government programmes, public incentives and public VC funding (Jeng and Wells, 2000; Cumming and MacIntosh, 2006; Cumming, 2007; Guerini and Quas, 2016).

The institutional and legal environments are also considered influential factors in VC decision-making. Differences between countries in legal and accounting standards have a significant impact on investment decisions (Jeng and Wells, 2000). Adequate laws facilitate faster screening and origination of deals (Cumming et al., 2010). Developed institutional and legal environments also make syndication easier and are associated with larger amounts and longer durations of investments (Dai et al., 2012), while they lower the probability of potentially harmful co-investment (Gu and Lu, 2014; Cumming et al., 2010). Greater protection of property rights increases entry rates and reduces the exit of venture capitalists from the market (Desai et al., 2003). On the contrary, some other elements such as geographical, cultural and institutional distance seem to be correlated with lower probability of VC investments (Bruton et al., 2010; Cumming and Dai, 2010; Dai et al., 2012; Li et al., 2014). Like other financial intermediaries, venture capitalists have better access to information when they can experience face-to-face interactions with (potential) investees. That might translate into a sort of local bias in favour of domestic investments.

The following analysis mainly focuses on the first two strands of the literature as more immediately affecting policy measures in Europe ([33]). The first policy-relevant aspect relates to the ultimate goal of the VC investment; our analysis will try to answer to the question of whether or not venture capitalists invest in companies by exchanging financing for equity stakes to obtain their ownership and help to increase their value. This last point clearly shows policy implications at the EU level. According to the European Commission's current definition of SMEs (European Commission, 2003), target companies lose their SME status if the venture capitalist obtains more than 50 % of the shares with its investment.

The second aspect builds on the second stream of the literature, with reference to the investment decisions adopted by VC investors to mitigate financial risks. In particular, the analysis will focus on multistage financing as one of the most important investment strategies adopted by venture capitalists to mitigate agency problems and to identify solid investment

([33]) We may assume that the EU Member States have relatively similar institutional and economic macro-factors that may affect the VC market. Nevertheless, since some differences might still exist within the EU, in the analysis related to the targeted firms' behaviour (Section 5) we adopt an econometric framework that takes into account country-specific factors that may limit potential investment decisions.

opportunities. This analysis could shed new light on how the diffusion of VC could be encouraged by policymakers, either focusing on initial rounds or extending policy support in favour of later stages.

Lastly, our analysis is complemented by investigating if and how VC investors respond to other comparable forms of investment. In particular, it covers a subset of firms receiving both VC and either CVC or public grants, to look for possible existing interaction between corporate venture capitalists or public authorities and institutional VC investors.

Box 4.1 highlights the key investigations conducted in this section.

Box 4.1. – Highlights of Section 4

Highlights	▪ This section investigates the **strategy of venture capitalists' investments,** by focusing on the **ownership** of the target company and on **multiple stage** financing. ▪ It compares the trends in **CVC** and other VC investments. ▪ It analyses the patterns of **public and private funding** of firms by comparing VC investments with public grants, including the **H2020 SME Instrument** and other public grants. ▪ It provides an overview of characteristics of firms targeted by (i) both venture capitalists and CVC and (ii) private VC and public entities.

4.1. Ownership in venture capital investments

This section analyses venture capitalists' investment choices as found in the first strand of the literature. In particular, **it investigates whether or not the venture capitalist might want to obtain the ownership of the firm through the acquisition of the majority of equity shares.** Ownership means that **the venture capitalist owns more than 50 % of equity shares** of the target company. In our framework, this analysis can be performed for the subset of firms (those included in our matched DB) for which the names of the VC investor(s) and of the GUO are available ([34]).

([34]) A complementary analysis might be focused on how venture capitalists exert control, rather than ownership, over target companies. This could in principle be analysed by exploiting information on either voting rights or different specific contracts, agreements and commercial arrangements between the VC and the target company. However, to our knowledge, this kind of information is neither publicly available nor in commercial databases. To overcome this issue, in the absence of voting rights and ancillary contracts, one possible proxy might be the presence of investors with at least 25 % of equity shares, i.e. GUO25. We leave this analysis to future investigations, since we would first need to complement our dataset with information on GUO25, which is currently not included for all the VC-backed firms.

Accordingly, **this analysis aims to show what proportion of VC investors own the majority of the shares of their target companies.** In other words, **it looks at the GUO of the target firm to check if it is the same as the venture capitalist who made the investment ([35]).**

From a policy perspective, it is also useful to understand whether or not venture capitalists are in general interested in the acquisition of the target company, given the implications for SME status. The target company would no longer be identified as an SME, thus potentially losing access to dedicated policies or funding (e.g. H2020).

In principle, **three possible scenarios** may emerge from this analysis. First, **a target company may be independent,** since it is not owned by a third party. Conversely, **a target company may be controlled by a third party,** which could be **either the venture capitalist or a different investor.**

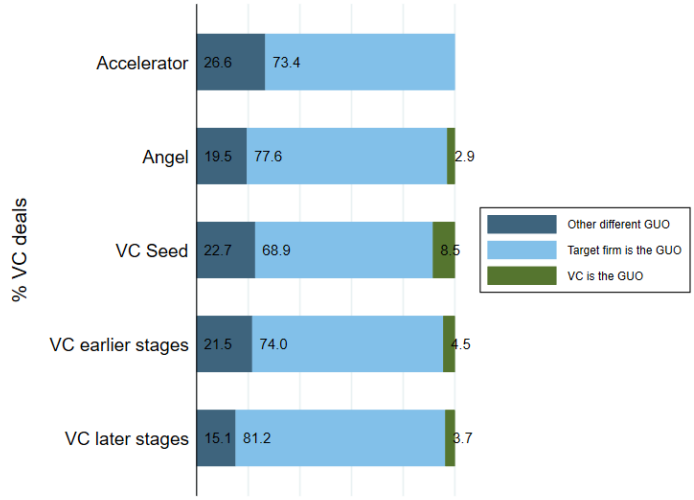
This analysis is performed on the subset of firms for which a GUO exists and is available in our matched DB. Specifically, the GUO50 indicator, identifying the subject with a minimum of 50 % ownership stake based on the Orbis definition, is adopted. Moreover, the matching between the investor and the investee is performed by comparing their names as strings, since an official link between VentureSource and Orbis is not distributed. To do that, standard textual analysis procedures are adopted to (i) harmonise and clean strings before the comparison (see, for instance, Allahyari et al., 2017), including deletion of punctuation and capitalisation of words, and (ii) compare sequences of strings (e.g. through Levenshtein distance). Lastly, all cases for which the investor is unique but anonymous (e.g. 'Individual Investor(s)' or 'Management') were excluded from this analysis, since we were not able to determine whether or not the investor and the investee coincided. Nevertheless, this approach might underestimate the number of independent firms, since the management team and individual investors may in some cases be the founders (and owners) of the firms.

After raising a VC investment, most firms are still independent (i.e. the target firm coincides with the GUO), **in between approximately 70 % and 80 % of cases. In fewer cases (up to 30 %), target companies are owned by a different subject.** In particular, **the VC becomes the GUO only under limited circumstances** (always fewer than 10 % of occurrences), **while some different investors may take the ownership in approximately 15–25 % of cases.**

The results of the analyses are presented in Figure 4.1.

([35]) In case of syndicated VC investments, the shares acquired by each VC investor involved in the transaction are considered separately for the identification of the GUO50 of the target company, unless a formal link between VC investors is in place (e.g. they form a group through direct or indirect control).

Figure 4.1. – Distribution of VC-backed firms across categories of ownership, by round of investment



Source: JRC elaborations on the matched DB.

These results seem to be in line with the related empirical literature, suggesting that venture capitalists are generally less interested in owning the absolute majority of equity stakes of target firms, especially in the very first rounds of investments (e.g. accelerator), than investing in firms with high growth potential (Gompers et al., 2020). In some circumstances, generally associated with a growing perceived risk in subsequent rounds, they may decide to acquire the majority of shares mainly to preserve their investment (Kaplan and Strömberg, 2004).

In addition, a sort of inverted U-shaped relationship emerges between the maturity of the round and the proportion of venture capitalists aiming to own the target company. After being negligible in the first rounds (e.g. accelerator), ownership shares reach a peak in the VC seed and earlier stages, and then fall in subsequent rounds. However, it is not possible to check whether the ownership has ben obtained through the acquisition of existing shares or with new shares (dilution).

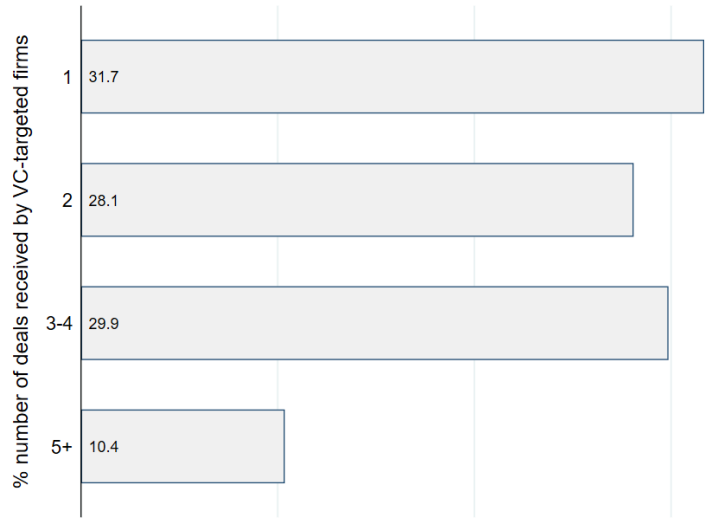
The results of this analysis indicate that **VC investors do not seem to include ownership as a major goal** in their mission. Consequently, **the proportion of SMEs that would lose their status seems to be contained and concentrated in relatively large and more mature firms that have access to later rounds.**

4.2. Multiple stages of venture capital investments

The second stream of investigation is dedicated to the analysis of multiple VC investments. It emerges that **a significant proportion of firms receive more than one VC deal to develop their business activities.**

Figure 4.2 shows the percentage distribution of the enterprises that received one or more deals over the period analysed.

Figure 4.2. – Distribution of firms receiving one or more VC-backed deals, 2008–2017 (cumulative %)



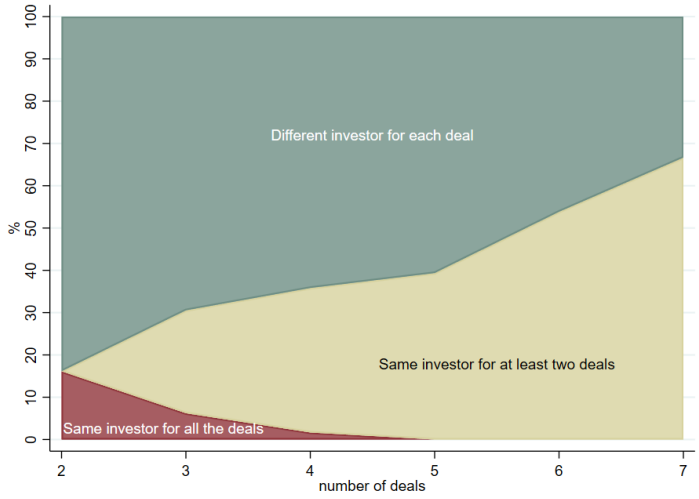
Source: JRC elaborations on the matched DB.

It clearly emerges that firms receiving one to four deals represent 90 % of the sample, and the relative proportions of firms that receive a single deal (31.7 %), two deals (28.1 %) and three or four deals (29.9 %) are very similar. It is important to notice that **firms receiving five or more deals represent only 10 % of the sample.** This representation provides an insight into the fact that **most firms (approximately 70 %) that have received a VC investment have looked for additional outside financing to develop their business.** At the same time, speculatively, **venture capitalists may be interested in investing in companies that have already received previous rounds of VC transactions.** This could be explained by the reduced agency costs and risks associated with investments in more consolidated and financially sound firms.

In order to confirm this assumption, it should be verified that companies receiving more than one deal are not exclusively financed by a single investor. Otherwise, it will not be possible to draw the conclusion that the first investment has constituted a positive signal to other VC investors.

Figure 4.3 shows the distribution between deals made by the same investor and deals made by different investors based on the number of deals received by the target company. Therefore, the first category shown in Figure 4.2 (i.e. companies in our sample that receive only one deal) is excluded from this analysis.

Figure 4.3. – Distribution of deals by investor and number of deals, 2008–2017 (cumulative %)



Source: JRC elaborations on the matched DB.

Three main categories emerge. The first one includes firms that receive funds from the same investor ('same investor for all the deals'). Hence, the risk related to investments falls on a single venture capitalist. Altogether, these represent a minority of cases and their proportion decreases as the number of deals increases. In particular, the proportion decreases from around 15 % of the enterprises receiving two deals to zero cases for companies receiving at least five deals.

The second category includes firms involved in multiple deals, each of them with a different investor ('different investor for each deal'). Therefore, in this case several investors follow each other in injecting VC investments into the same firm. In this case, the overall risk related to the firm's operations is shared among all the investors. This is the most frequent case for all firms receiving fewer than five deals. However, its proportion decreases with the increase in the number of deals: it goes from more than 80 % in the case of companies receiving two VC-backed deals to less than 40 % for firms receiving seven deals.

The third category comprises firms that are targets of mixed investment strategies ('same investor for at least two deals'), whereby funds are received from both repeat and one-time investors. The overall share of this category increases with the number of deals, and becomes dominant for firms receiving at least six investments. Hence, the risk related to investments is unevenly distributed among different VC investors ([36]).

Altogether, it emerges that venture capitalists seem more keen to invest in companies that have already raised other deals. Moreover, as shown in Figure 4.3, **only a minority of firms raise VC deals from a single investor.** Hence, consistently with the literature on multistage

([36]) Nevertheless, we should acknowledge that this could be not the case in terms of volumes (e.g., in the case of two venture capitalists investing in the same firm, if the first VC invests EUR 500 000 twice and the second VC invests EUR 1 million once, they will bear the same amount of risk).

investment strategy, venture capitalists are generally keen to share the risk of investment. Nevertheless, the most attractive companies (with at least five deals) seem to benefit from the presence of some recurring venture capitalists, which appear among the investors in at least two investments. These investors behave as a pivot for VC investments, allowing an increase in the overall capital raised by the firm while still sharing the investment risk with other subjects.

Lastly, **once VC investors identify potentially profitable emerging opportunities, they tend to repeat their investments in the same company.** According to our analysis, **approximately 70 % of firms receiving one VC investment are targets of a second deal.** These findings are in line with existing literature on multiple stage financing, suggesting that less profitable ventures are less likely to raise further VC investments (Dahiya and Ray, 2012). Moreover, this may suggest that policy actions aimed at extending the basis of VC beneficiaries – for instance bringing them into contact with venture capitalists – may stimulate the appetite for good investment opportunities. Public policies could also minimise the restrictions on repeated investments in order to foster a closer relationship between investor and investee.

4.3. Focus on corporate venture capital

Section 3 considered CVC as one of the components of our VC definition. This section further investigates this instrument, by focusing on the **strategies of CVC investors ([37])**.

In particular, it leverages on the **subset of firms that received both CVC and other forms of VC investments, to examine any existing interaction.** On the one hand, it looks **at whether or not corporate venture capitalists are more likely to invest in firms that have already received some other forms of VC.** On the other hand, it analyses whether or not **institutional venture capitalists (IVCs) are keen to invest in firms that have already received some forms of CVC investments.**

The analysis of the differences among strategies behind these two types of investments may have policy implications. If some significant differences emerge, it will then be useful for policymakers to distinguish between actions oriented towards the two types of investments; otherwise, this distinction will not be necessary.

All the analyses are carried out on our matched DB, obtained by merging VentureSource and Orbis. We identify CVC by looking at VentureSource investments tagged with the 'corporate equity ([38])' label.

([37]) For the sake of completeness, a complementary analysis to the CVC strategy is available in Section A.2 of the annex, with focuses on (i) CVC distribution among EU Member States and industrial sectors (Section A.2.1); (ii) the characteristics of firms targeted by CVC investments (Section A.2.2).

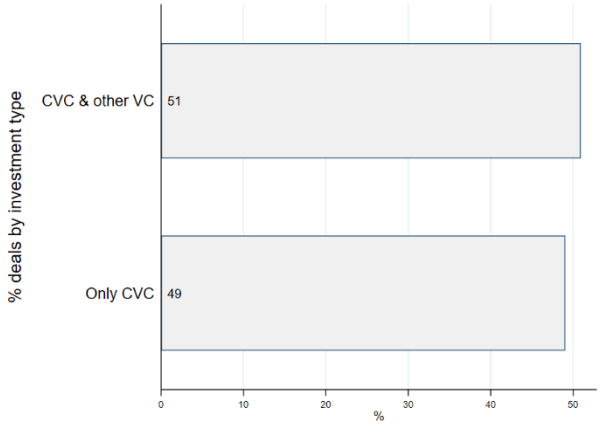
([38]) We will use the terms 'corporate equity' and 'CVC' interchangeably during the discussion.

4.3.1. Strategies of corporate venture capital investors

This paragraph **examines the strategies pursued by corporate companies when investing as corporate venture capitalists**. Specifically, it analyses the subset of firms that have received both CVC and other forms of VC investments (including business angel and IVC investments; hereafter, other VC). **The objective is to understand if CVC investors are influenced in their investment choices by the fact that target companies have already raised other VC investments.**

First, Figure 4.4 shows the distribution of firms that received CVC between (i) those exclusively raising CVC investment and (ii) those also receiving other VC investments.

Figure 4.4. – Percentage of target firms receiving only CVC or receiving CVC and private VC financing, 2008–2017 (cumulative %)

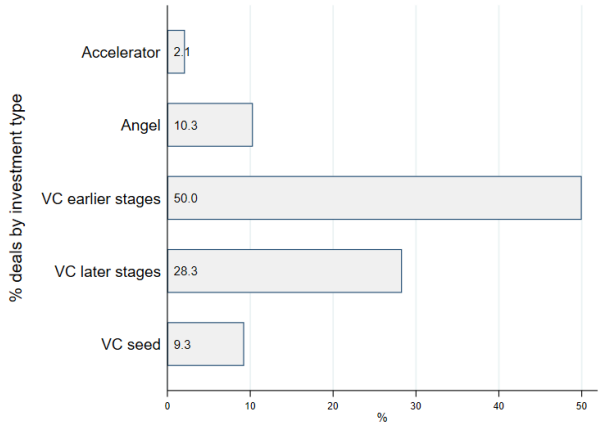


Source: JRC elaborations on the matched DB.

In our sample, **about half of the companies received both CVC and other VC investments.** Therefore, **CVC** can be considered a **non-exclusive instrument,** which potentially integrates with other forms of VC.

Second, Figure 4.5 shows that **CVC is mostly associated with early- and later-stage investments,** which account for about 80 % of total VC deals. This distribution is similar to that reported in Figure 3.11, which is not restricted to firms that have raised CVC investments. In other words, the fact that **firms received CVC does not seem to influence the type/rounds of other VC deals they could raise in addition.**

Figure 4.5. – Number of VC deals (by type) granted to firms that have also received CVC, 2008–2017 (cumulative %)



Source: JRC elaborations on the matched DB.

Third, Figure 4.6 **compares the characteristics of CVC and other VC investments, based on their chronology.** More specifically, we present the median values of CVC and other VC investments when they are chronologically the first investment in the company's history (left panel), and compare them with the median values of CVC and other VC investments when they are received later by the company (right panel).

Figure 4.6. – Comparison of median investment volumes (by type), based on the chronology of investments, cumulative 2008–2017: first investment raised (left), second or later investment (right)

Source: JRC elaborations on the matched DB.

This analysis **investigates whether or not the CVC investment varies in terms of volume based on whether or not the same firm has already received another VC investment.** This seems to be the case: the median amount of a CVC investment is approximately equal to EUR 1 million when it is the first VC investment, whereas it exceeds EUR 1.5 million when it is

the second or later investment. Therefore, CVC investors increase the median amounts of their investments if the firms have been already targeted by other previous VC investments. **This result provides further evidence on CVC as a quite flexible investment instrument, relatively responsive to the investment history of the target company.**

In particular, this interpretation is in line with other findings (Siota et al., 2020), which suggest that CVC may enter at different stages of the company's development. However, other VC investments are more sensitive to the chronological order of deals, as confirmed by a very marked difference (more than EUR 3 million) between first and second (or later) investments.

4.4. Public grants and venture capital investments ([39])

This section compares public and private funding of innovative companies in Europe. It analyses different types of public grants and VC investments in terms of their overall contribution to funding of firms and the characteristics of firms they target. For the analysis of public grants, we complement the two datasets on VC introduced in Section 2 with two additions. First, we included deals tagged as 'Grant-Government' in VentureSource. Second, we further integrated the datasets with information on firms that have received any SME Instrument grants by the European Commission within the H2020 scheme between 2014 and 2017.

Hence, the analysis is conducted on two datasets. The first one, being derived from VentureSource only, does not include historical information on the financials of targeted/granted firms. At the same time, it provides the full picture of both private VC and public grants in Europe in the sample period. The second one, being derived from the matched DB, allows us to perform more detailed analyses on firms (e.g. sectors and financials) but limited to the subsample of matched firms.

The full dataset ([40]) counts 3 659 public grants, of which 77 % are from H2020 and the remaining 23 % from other public granters. The matched DB ([41]) shows 579 of such grants, associated with approximately 200 granters ([42]). Specifically, we found 124 SME Instrument grants, of which 7 were already included in the VentureSource original dataset. Hence, the matched DB includes a total of 696 grants, of which approximately 18 % are referable to the SME Instrument and the rest to other public grants ([43]).

Altogether, granters of other public grants may be broadly classified into two categories, based on the matched DB: (i) supranational authorities, bodies or agencies, including the

([39]) This section was jointly developed by A. Bellucci, G. Gucciardi and D. Nepelski.
([40]) The full dataset feeds Figures 4.7 to 4.10.
([41]) The matched DB feeds Figures 4.11 to 4.16, in addition to all figures in Annex 3.
([42]) Some of the grants are provided jointly by (up to five) different entities.
([43]) For the sake of clarity, from now on we will tag as 'SME Instrument' the grants obtained from the H2020 dataset, as 'other public grants' the grants included in VentureSource or in the matched DB and as 'public grants' the sum of the two. Altogether, our matched sample covers approximately 19 % of public grants (from VentureSource and H2020).

European Commission and the European Investment Bank, accounting for approximately 30 % of the total; (ii) public authorities, including ministries, states and municipalities, together with national or local public agencies and public-owned companies, representing approximately 60 % of the grants. The remaining 10 % mainly includes joint ventures between private and public entities, or between supranational and national public authorities.

The following analysis **focuses on the SME Instrument and other public grants separately, because of their different** – and not necessarily homogeneous – **sources and natures.** Nevertheless, some analyses are also conducted on all public grants. The SME Instrument and other public grants are then compared with VC investments. The objective is to investigate the absolute level of public grants of any origin, i.e. the European Commission and other public agencies, and their relative level compared with VC investments in Europe. In addition, in order to analyse investment strategies of public and private entities, the characteristics of firms that they target are considered.

4.4.1. The evolution and geography of public grants and venture capital in the European Union

This paragraph looks at the evolution and geography of public grants and VC investments in the EU. Within public sources of funding, particular emphasis is given to the role of the SME Instrument in the European landscape of funding for innovative SMEs.

Figure 4.7 presents cumulative volumes and numbers of transactions, including the SME Instrument ([44]) and other public grants, and VC investments, in the period between 2008 and 2017. Concerning the total volume of funding, in 2008 European companies received EUR 4.3 billion. Within a decade, this amount quadrupled and reached EUR 20.5 billion in 2017. In 2008, VC investments accounted for 97 % of the total cumulative volumes of funding. The remaining 3 % was provided by public entities. In 2017, the contribution of VC investments was much the same as in 2008. At the same time, other public grants decreased to 1.5 % in favour of the SME Instrument, which contributed the remaining 1.5 %. The SME Instrument accounted for 0.03 % of the total funding when introduced, and rapidly reached nearly 1.5 % of the cumulative volume of funding to innovative firms in Europe. In 2017, among the SME Instrument phases, phase 2 accounted for 92 % of about EUR 304 million.

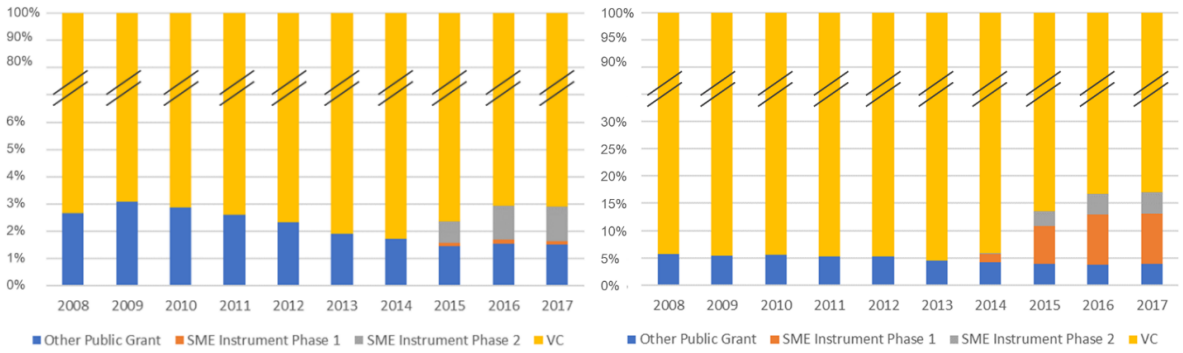
Regarding the total number of deals, i.e. including public grants and VC investments, in 2008, public entities and venture capitalists provided funding about 1 400 times to innovative companies in Europe. Like the volume of investments, this number more than tripled within a decade and reached about 4 900 in 2017. At the beginning of the period analysed, public

([44]) The SME Instrument was launched under the H2020 framework programme in 2014. Hence, the time span of the grants analysed ranges from 2014 to 2017.

grants accounted for 6 % and VC investments 94 % of the overall number of deals. In 2017, the share of public grants in the number of deals decreased to 22 %.

In 2017, **the number of SME Instrument grants accounted for 77 % of all public grants and 14 % of the total number of deals,** i.e. including public grants and VC investments. Because the grants were smaller, SME Instrument phase 1 accounted for over 70 % of the cumulative SME Instrument grants in 2017.

Figure 4.7. – Cumulative volumes by type (SME Instrument, other public grants and VC), 2008–2017: volumes (left) and number of deals (right) (%)

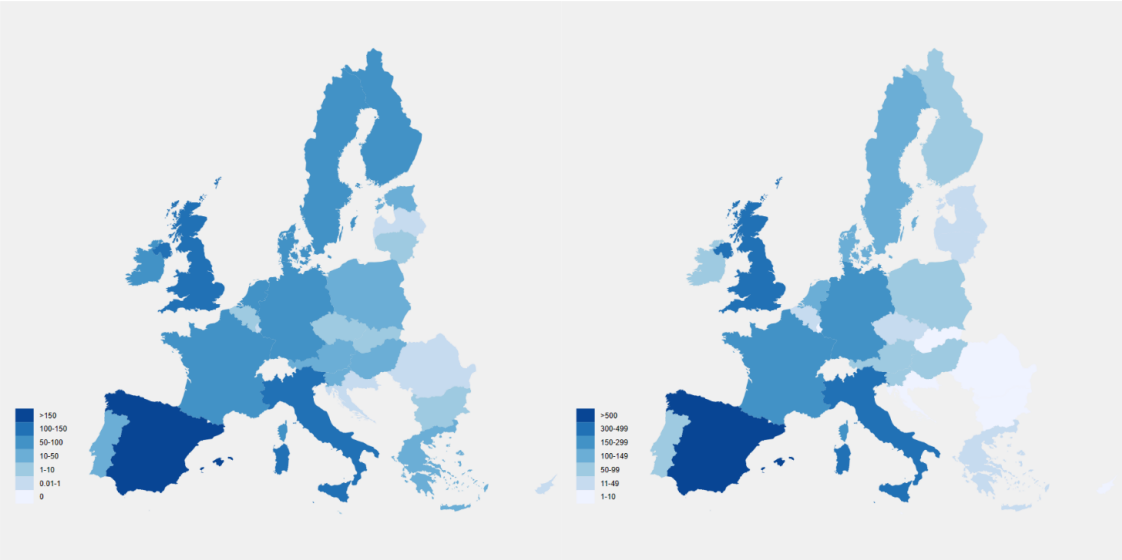


Source: JRC elaborations on VentureSource full dataset and H2020 official dataset.

The above analysis shows that **the share of public grants in the cumulative volume of funding was substantially stable between 2008 and 2017, with a shift from other public grants to the SME Instrument**. **The SME Instrument,** within a very short period from its inception, **became an important source of funding** in Europe. In 2017, SME Instrument grants accounted for 1.5 % of the cumulative volume of funding and 13 % of the total number of investments in innovative firms by private and public entities.

Turning to the geography of SME Instrument grants, Figure 4.8 presents cumulative volumes and number of grants across the EU Member States in 2014–2017. **Spain, Italy and the United Kingdom represent the top three countries raising cumulative SME Instrument funding, in terms of both amounts (43 %) and numbers of deals (50 %).** They are followed by Germany, France, the Netherlands, Sweden, Denmark and Finland. Altogether, SMEs located in these nine countries raised 80 % of the cumulative SME Instrument funding, in terms of volumes and numbers of deals, between 2014 and 2017.

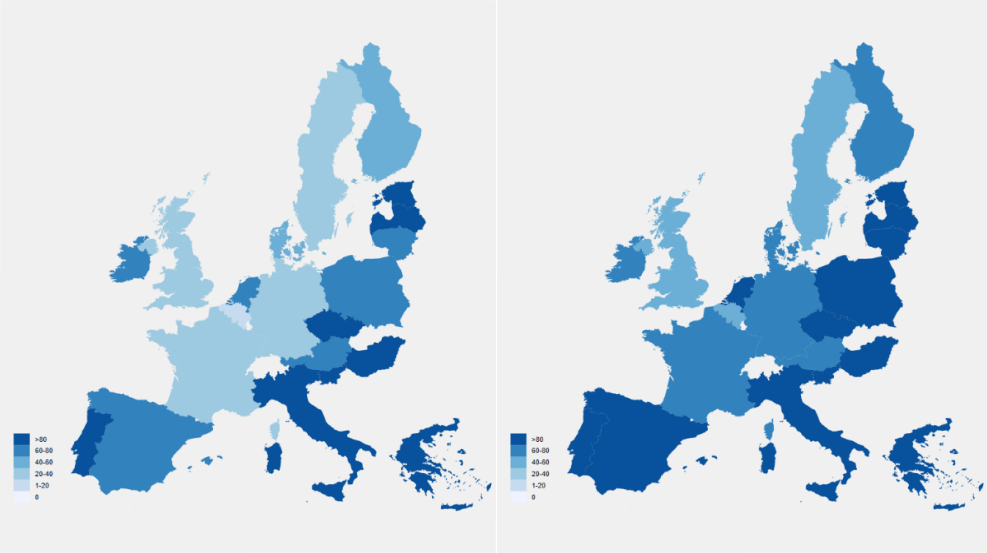
Figure 4.8. – Cumulative SME Instrument grants by country: volumes (million EUR, left) and numbers of grants (right), 2014–2017



Source: JRC elaborations on VentureSource full dataset and H2020 official dataset.

Figure 4.9 presents the cumulative SME Instrument grants as a percentage of total public grants, by volumes and number of deals by country.

Figure 4.9. – Cumulative SME Instrument grants as a percentage of total public grants by country: volumes (left) and numbers of deals (right), 2014–2017



Note: 7 countries with up to 10 public grants in the period 2014–2017 were excluded from the analysis and the figures to avoid biases in the interpretation of ratios of very small values.

Source: JRC elaborations on VentureSource full dataset and H2020 official dataset.

The SME Instrument plays a key role as a public source of funding for SMEs. In several countries (Czechia, Estonia, Greece, Italy, Latvia, Hungary and Slovenia), it accounted for more than 95 % of all cumulative public grant funding from 2008 to 2017. In contrast, in five

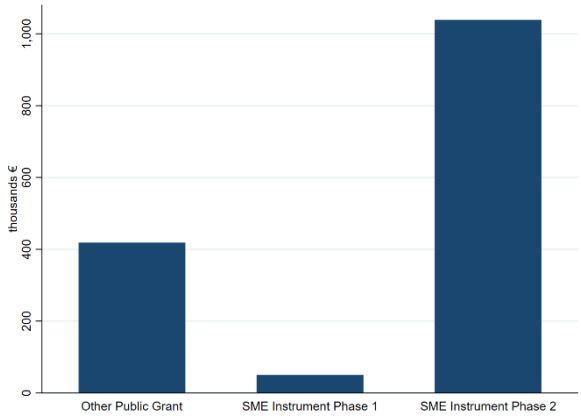
European countries (Belgium, Germany, France, Sweden and the United Kingdom) the SME Instrument volumes account for at most 50 % of public grants.

4.4.2. Analysis of public grants and venture capital funding

This section compares public grants with VC investments. In particular, **it looks at the amount of public grants by category.** Then it investigates the mix of funding from different sources by analysing how many firms receive only public grants and how many receive public grants and private VC financing. Finally, it attempts to see if there is any relationship between the source, the sequence of funding (private vs public) and the volume of grants/investments.

Figure 4.10 presents the median cumulative amount of funding by grant category between 2008 and 2017. The median grant provided by programmes other than the H2020 SME Instrument was EUR 0.4 million. **This value for the SME Instrument depends on the SME Instrument phase.** SME Instrument phase 1 offered innovative SMEs a lump sum of EUR 50 000 for exploring and assessing the technical feasibility and commercial potential of a breakthrough innovation. In contrast, SME Instrument phase 2 provided funding for innovation projects underpinned by a strategic business plan and feasibility assessment. The median amount of SME Instrument phase 2 grants was just over EUR 1 million. Hence, this new funding instrument for innovative SMEs, introduced in the H2020 framework programme, provides funding that was not available at the national and regional levels in Europe.

Figure 4.10. – Public grant amounts by category: median of cumulative amount by category of grant, 2008–2017



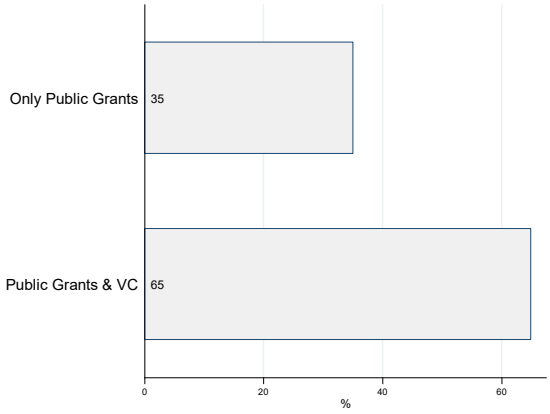
Note: SME Instrument phase 1 and 2 figures are given for the available period (2014–2017).

Source: JRC elaborations on VentureSource full dataset and H2020 official dataset.

Turning to the combination of public and private funding of firms, Figure 4.11 presents the percentages of firms receiving only public grants and those receiving public grants and private

VC financing. Among the firms analysed, **35 % received only public grants. The remaining 65 % of firms were able to receive both grants from public entities and VC investments. This shows that European companies that seek external funding make use frequently of both public and private sources of financing.**

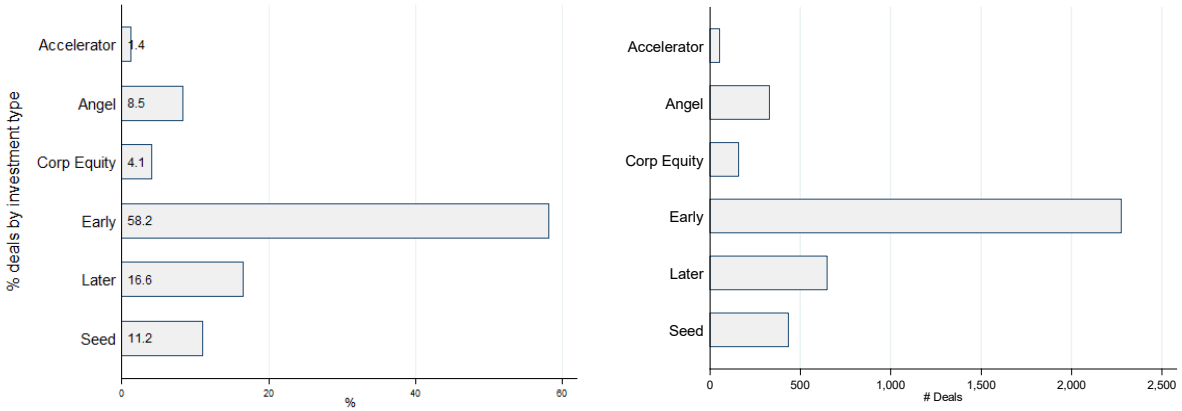
Figure 4.11. – Percentages of firms receiving only public grants and receiving public grants and private VC financing, cumulative 2008–2017



Source: JRC elaborations on matched DB and H2020 official dataset.

Figure 4.12 presents the types of VC funding raised by firms that also received public grants. **Firms that received public grants between 2008 and 2017 received mainly early stages of VC funding, accounting for 58 %** of nearly 4 000 VC funding rounds.

Figure 4.12. – Percentage (left) and number (right) of VC deals (by category) raised by firms that also received public grants, cumulative 2008–2017

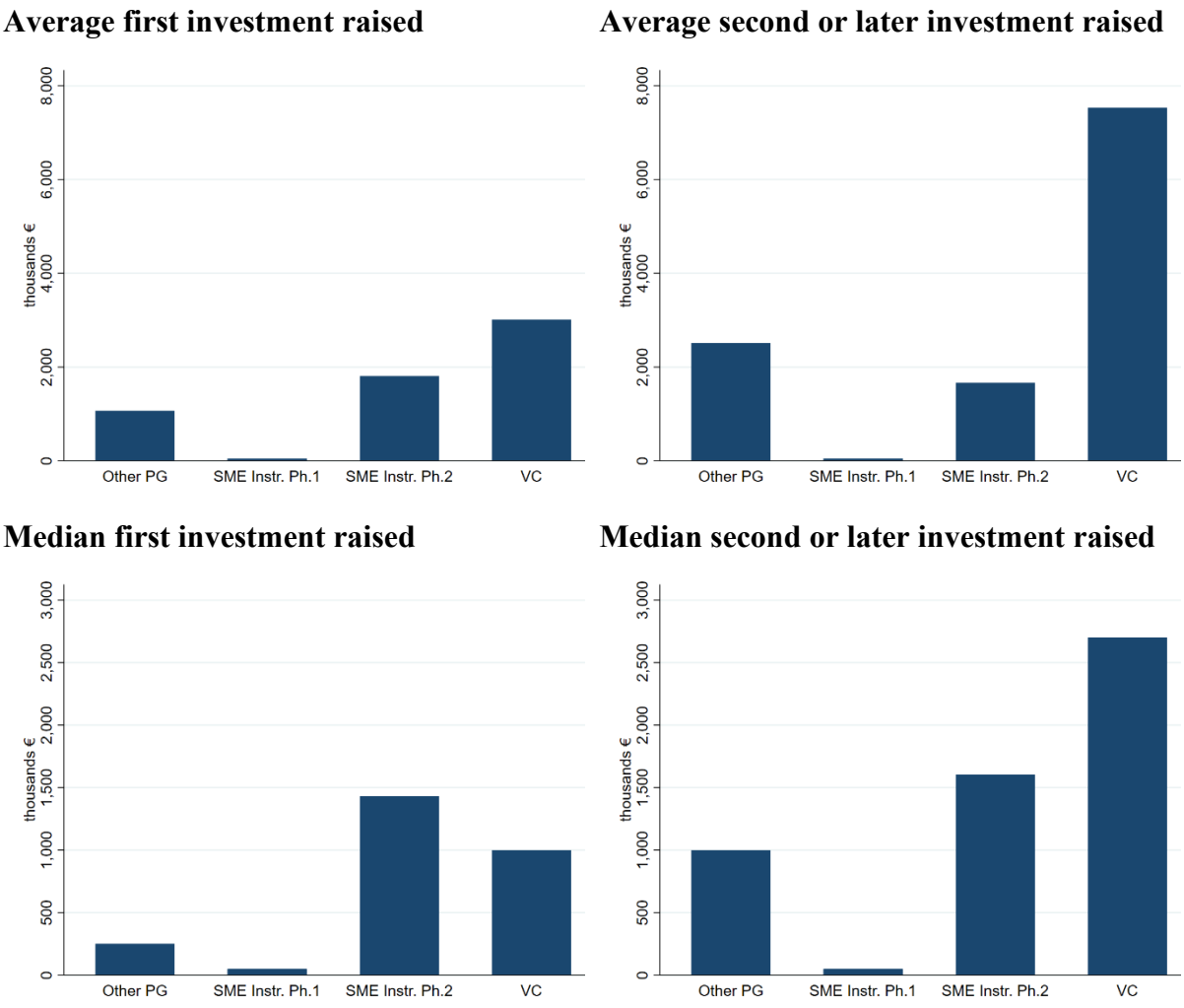


Source: JRC elaborations on matched DB and H2020 official dataset.

VC later stages represent the second largest type of funding by VC (17 %) for firms that also received public grant funding. Angel and seed funding represent altogether 8 % and 11 % of all VC deals, respectively. Funding from accelerators and corporates was 1 % and 4 %, respectively, of all the private investments involving firms that received public grants.

Hereafter, **the relationship between the volume of the first funding transactions and those of subsequent ones is investigated.** Accordingly, Figure 4.13 compares the average and median volumes of SME Instrument, other public grants and VC funding, when they appear to be the first separate investment received by a firm (left) and the second (or later) investments raised (right).

Figure 4.13. – Comparison of volumes (by category), cumulative 2008–2017



Source: JRC elaborations on matched DB and H2020 official dataset.

The average (median) volumes of funding for each investment type when it is the first investment/grant received by a firm are other public grants EUR 1.1 million (EUR 250 000);

SME Instrument phase 2 EUR 1.8 million (EUR 1.4 million); VC EUR 3 million (EUR 1 million) ([45]). The average (median) volumes of funding for each investment type when it is a subsequent investment/grant received by a firm are other public grants EUR 2.5 million (EUR 1 million); SME Instrument phase 2 EUR 1.7 million (EUR 1.6 million); VC EUR 7.5 million (EUR 2.7 million). Thus, according to Figure 4.13, except for the SME Instrument grants, the volume of funding increases from the first round to the follow-up funding rounds. This seems to be the case for both other public grants and private investments.

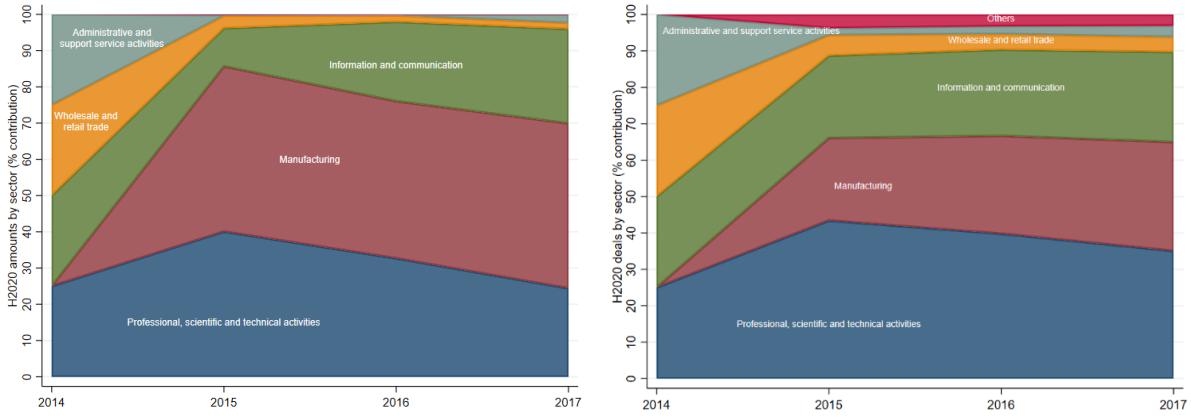
4.4.3. Features of firms receiving both public grants and venture capital investments

This section analyses the investment strategies of public and private entities with respect to characteristics of firms that they target. It starts with comparing the sector of activity of firms that receive SME Instrument and other public grants, looking at the NACE broad sectors ([46]). Then it looks at the demographics of these firms and their financial performance.

Figure 4.14 presents the development of H2020 SME Instrument grants by industrial sector. One year after its inception, i.e. in 2015, companies in the manufacturing sector received the largest part of the funding (46 %). With 40 % and 11 % of total funding, professional, scientific and technical activities and the information and communication technology (ICT) sector held the second and third places, respectively. By 2017, the ICT sector had increased its share in total funding to 26 % at the expense of the professional, scientific and technical activities sector, which accounted for 24 % of total funding in 2017. The distribution of the number of SME Instrument grants by firms' sector of activity presents a different picture. In the initial period, companies in the professional, scientific and technical activities sector received 43 % of the grants. Grants to firms in the ICT and manufacturing sector accounted for 23 % each. In 2017, the share of grants to firms in the manufacturing sector increased to 30 % and that of those to firms in the ICT sector to 25 % of the total number of grants.

([45]) SME Instrument phase 1 is not relevant in this comparison, because firms receive a lump sum of EUR 50 000.
([46]) A more granular analysis at the four-digit level is available in Annex 3.

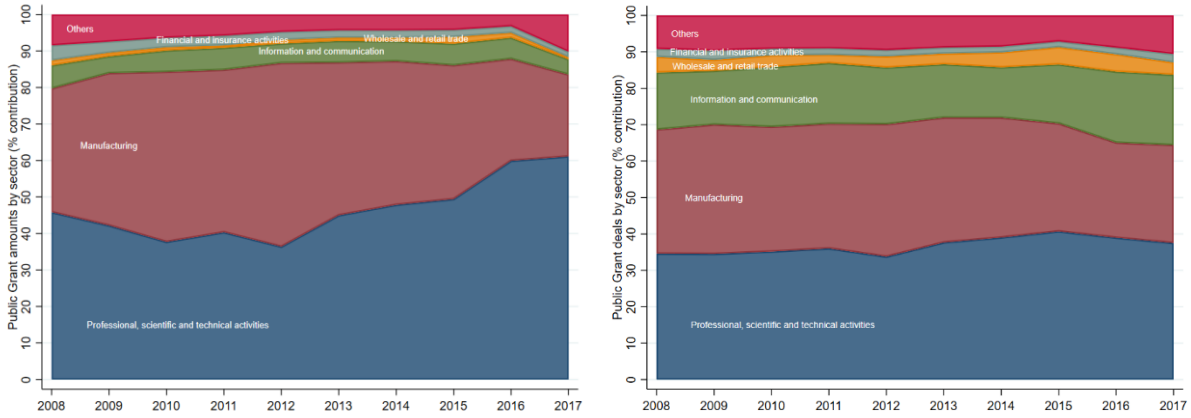
Figure 4.14. – Evolution of SME Instrument (phase 1 and 2) grants by industrial sectors (NACE Rev. 2 – macrosector), 2014–2017 (% volumes (left) and % deals (right))



Source: JRC elaborations on matched DB and H2020 official dataset.

Similarly, Figure 4.15 presents the development of other public grants by industrial sector. In 2008, companies in the professional, scientific and technical activities sector received the largest part of funding (46 %) from other public grants, followed by companies in the manufacturing (34 %) and ICT (6 %) sectors. Over time, the first sector consolidated its importance, and it accounted for over 60 % of the total funding in 2017. The manufacturing and ICT sectors maintained their second and third places in the ranking, but their shares in the total funding decreased to 22 % and 4 %, respectively.

Figure 4.15. – Other public grants by industrial sector (NACE Rev. 2 – macrosector), 2008–2017 (% volumes (left) and % deals (right))



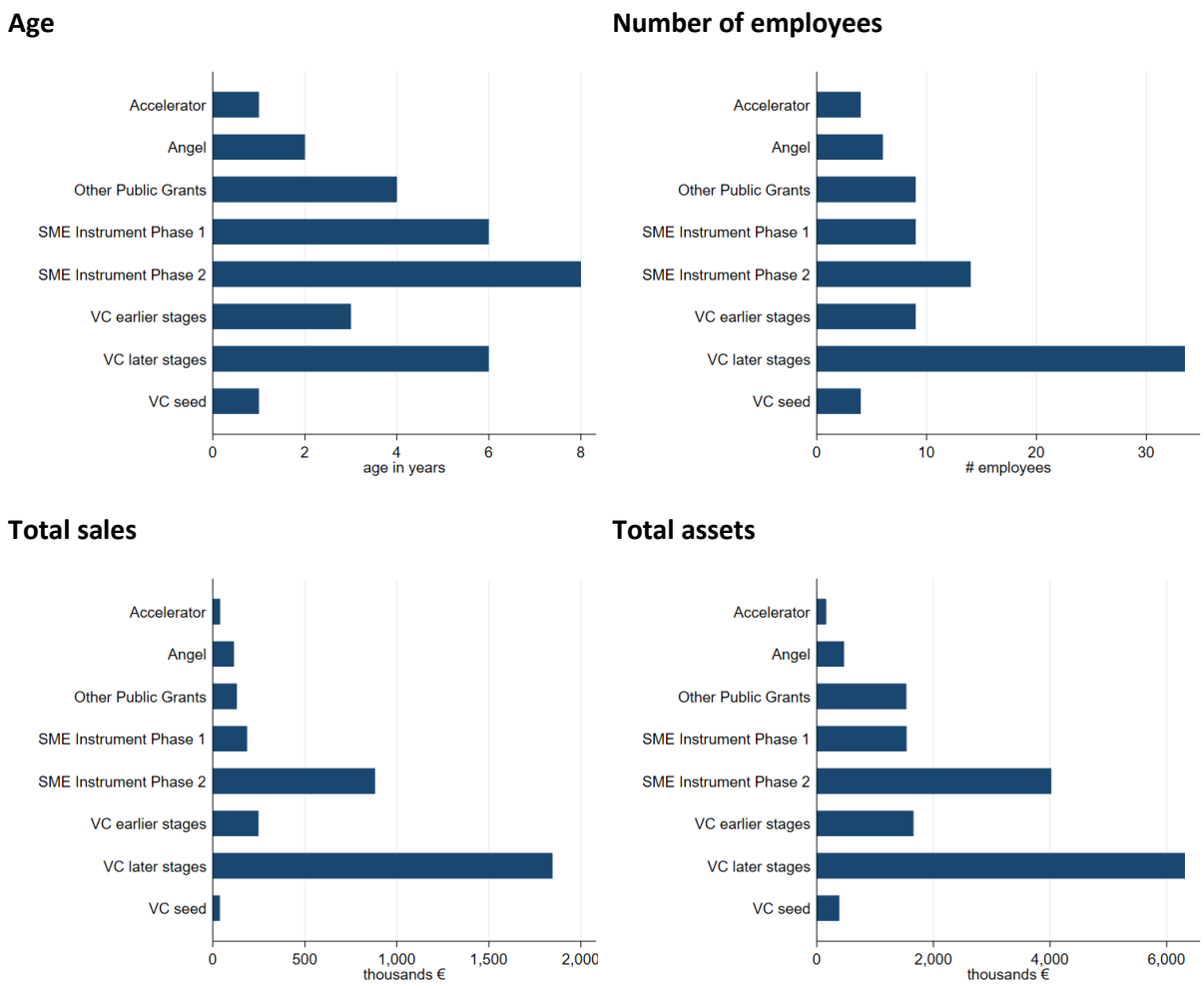
Source: JRC elaborations on matched DB and H2020 official dataset.

The distribution of the number of other public grants by firms' sector of activity follows a different pattern from SME Instrument grants. In 2008, companies in the professional, scientific and technical activities sector received 35 % of the public grant funding. Grants to firms in the ICT and manufacturing sectors accounted for 16 and 34 %, respectively. In 2017,

the share of public grant funding to firms in the manufacturing decreased to 27 % and that to firms in the ICT sector increased to 19 % of the total volume of funding.

Figure 4.16 presents an overview of characteristics of firms receiving public grants or private investments by investment category and source, i.e. public and private. It includes median values for four variables: number of employees, age, total sales and assets.

Figure 4.16. – Characteristics of firms when receiving public grants or private investments, median, cumulative 2008–2017



Source: JRC elaborations on matched DB and H2020 official dataset.

According to Figure 4.16, firms receiving funding from accelerators are the youngest, and the smallest in terms of number of employees, total sales and assets. Their median age is 1 year and they employ a median of 4 persons. The median sales and the value of assets are approximately EUR 40 000 and EUR 160 000, respectively. VC later stages are granted to the most mature firms in the comparison by all measures, except age. A median firm receiving VC

later stage investments is 6 years old, with 33 employees and an annual turnover of EUR 1.8 million. Its total assets are worth EUR 6.3 million.

Regarding firms receiving funding from public entities other than H2020, there are some remarkable differences between types of instruments. Public entities providing funding to innovative companies target relatively mature and large firms. A median firm receiving a grant other than the SME Instrument is 4 years old, employing 9 workers. Regarding the financial performance of firms targeted by other public grants, they have a median annual turnover of EUR 0.13 million and EUR 1.5 million of total assets. Thus, in terms of age, assets and employees, firms receiving other public grants resemble firms receiving VC early-stage investments, while their median sales are lower.

Firms supported by the SME Instrument are on average 6 (phase 1) and 8 (phase 2) years old and have 9 employees. In terms of turnover, their median sales are EUR 0.19 million (phase 1) and EUR 0.88 million (phase 2). Their assets are worth EUR 1.5 million (phase 1) and EUR 4 million (phase 2). Comparing firms funded by SME Instrument phase 1 with firms targeted by private VCs, one can observe that, in terms of total assets, sales and employees, they resemble firms that receive early-stage funding. In terms of age, they are, however, more similar to firms receiving VC later-stage funding. This could indicate that firms supported by the SME Instrument phase 1 are small, with relatively high asset values, but with low levels of sales. On the other hand, firms receiving SME Instrument phase 2 seem to be intermediate between firms that also raise early and later stages, but are longer established.

Summing up, the above findings indicate that considerable differences exist between the volumes and patterns of funding of innovative firms provided by public and private entities. The analysis also reveals that different types of funding entities target different types of firms.

4.5. Key takeaways

Box 4.2 brings together the key takeaways of Section 4.

Box 4.2. – Key takeaways of Section 4

Key takeaways	▪ **Venture capitalists** become the **GUO** of the **target company only under limited circumstances** (always fewer than 10% of occurrences). ▪ Venture capitalists are usually **interested in investing in companies that have already raised previous rounds** of VC transactions. ▪ **Raising a CVC** does **not influence the type/rounds of other VC deals** the company could raise in addition. ▪ Since its introduction, the **H2020 SME Instrument** has become an **important source of public funding for SMEs,** contributing 50 % of the total amount of public grants in 2017. ▪ **65 % of firms** receiving **public grants also raised private VC** investments.

5. The impact of venture capital on target companies

This section investigates how VC investments might affect the performances of VC-backed firms. In particular, it examines whether or not firms that have raised VC investments grow more than their non-VC-backed counterparts.

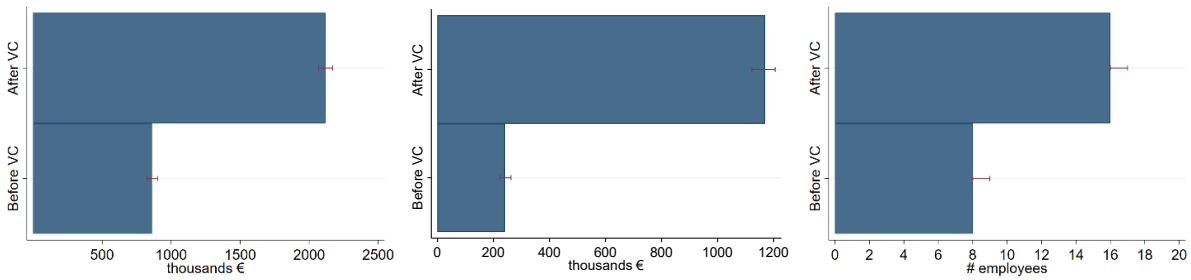
Most of the results emerging from the related empirical literature suggest that VC enables target companies to outperform non-VC-backed companies (Gompers and Lerner, 2001; Denis, 2004; Inderst and Müller, 2009; Bertoni et al., 2011; Martì et al., 2013). Firms' performances are generally measured with quantitative indicators such as employment, total assets, revenues and sales, consistently showing a positive impact of VC funds on growth (Pavlova and Signore, 2019). In particular, sales and employment seem to be the most recurrent indicators. Engel (2002), Davila et al. (2003), Engel and Keibach (2007) and Bertoni et al. (2011) find that VC-backed firms grow faster in terms of employees. According to Alemany and Martì (2005), Bertoni et al. (2011) and Puri and Zarutskie (2012), the sales of target companies in Spain, Italy and the United States, respectively, increase after they raise a VC investment. Lastly, Manigart and Van Hyfte (1999), Alemany and Martì (2005), and Chemmanur et al. (2011) find a positive impact of VC investments on the total assets of target companies in Belgium, Italy, Spain and the United States.

The analysis underlying this section hinges upon three relevant indicators, already used in the rest of this report, and extensively adopted in the literature, i.e. total assets, total sales and the number of employees. Furthermore, these three indicators jointly characterise the European Commission definition of SMEs. Based on findings presented in the previous sections, this section investigates whether or not any impact of VC on growth shows heterogeneous behaviours in terms of (i) different classes of age of the target company, (ii) round of investment, i.e. early vs later stages, and (iii) type of VC investment, i.e. institutional vs corporate. All the results will be also subject to a set of robustness tests. The analysis of the impact of VC investments on relevant indicators builds on the matched DB presented in Section 2 ([47]).

Before we move to the empirical analysis, the levels of total assets, total sales and number of employees of target companies before and after the VC investment are descriptively compared. The results are shown in Figure 5.1.

([47]) For each VC-backed company, the matched DB associates the contract terms of the VC deal (i.e. the amount, the deal date, the type of investment or the funding round, the currency, and the name and geographical location of the venture capitalist(s)) with the financial information about the VC-backed company available from Orbis's balance sheet (e.g. total assets, total debt, turnover, number of employees). Then we exploit the panel dimension of the matched DB: the identifier is the VC deal, with financial information for the corresponding VC-backed firm for each year of the sample period (2008–2017) and with information on the VC investment in the year of the deal.

Figure 5.1. – Impact of VC investments on relevant indicators of the target companies: left, total assets (thousand EUR); middle, total sales (thousand EUR); right, number of employees



Source: JRC elaborations on the matched DB.

Interestingly, when observing companies after they raise the VC investment, it emerges that on average they look larger according to all the three variables inspected. First, the median amount of total assets of firms that have already raised a VC is more than twice that of companies that have not yet been targeted by VC financing (i.e. EUR 2.1 million vs EUR 0.8 million). Second, the median amount of total sales in companies that have received VC is approximately five times that of others (i.e. EUR 1.1 million vs EUR 0.2 million). Third, firms targeted by VC employ on average twice as many staff as others (i.e. 16 vs 8 employees).

These findings constitute preliminary evidence that VC investments have a positive effect on target companies, despite being only descriptive and performed on aggregate numbers of firms before and after investments completed in different periods. In order to estimate more precisely the benefits of introducing VC investments to target companies, a difference-in-differences (DiD) approach ([48]), in which the treatment is the completion of a VC investment, is implemented. Leveraging on the fact that the treatment is staggered along the overall sample (i.e. VC investments are heterogeneously distributed over the sample period), the analysis compares the difference between the control group (companies that have not yet raised VC) and the treatment group (companies that have raised VC) before and after the introduction of the treatment for our relevant outcome variables, i.e. total assets, total sales and number of employees. The empirical strategy is presented in Section 5.1.

The highlights of this section are reported in Box 5.1.

([48]) According to DiD terminology, the treatment is the intervention (e.g. a policy or an event) under investigation, the treatment group is the group of units that has been the target of the intervention, and the control group is the group of units that has not been the target of the intervention. The fact that our control group is composed of companies that are ultimately targets of a VC investment (i.e. our treatment), even though observed in the period prior to the investment, should assure the comparability of the treatment and control groups.

Box 5.1. – Highlights of Section 5

Highlights	▪ This section investigates the **impact of VC investments** on three measures of growth of the target companies adopted in the empirical literature, i.e. **total assets, total sales and number of employees.** ▪ It explores the potential **heterogeneity of this impact,** based on relevant **features of the transaction** (i.e. round and type of the investment) **and of the target company** (i.e. its age). ▪ The empirical analyses survive a set of **robustness tests.**

5.1. Empirical strategy

This section presents the empirical strategy to investigate the potential benefits of VC investments on target companies. Specifically, the DiD approach, in which the treatment is the VC investment, is adopted. This model observes for each company of the panel the effect of raising a VC investment on three relevant business indicators, i.e. total assets, total sales and number of employees. In other words, the average effect of raising VC on the treatment group is compared with the average effect on the control group, to check for possible statistically significant differences, by using annual company-level panel data for the period 2008–2017. The original pool is composed of nearly 9 000 deals, distributed over more than 5 000 target companies based within the EU.

The baseline model is estimated as follows:

$$Y_{it} = \alpha + \beta dVC_{it} + \phi_i + \phi_t + \gamma trend_{it} + \epsilon_{it}, \qquad (1)$$

where Y_{it} is the natural log of total assets, total sales or number of employees of the target company, depending on the specification of the model. Moreover, dVC_{it} is the treatment variable, which takes the value of 1 since the year in which the company received the first VC deal, and 0 otherwise ([49]). All the estimations include target company (φ_i) and year (φ_t) fixed effects, to take into consideration unobserved heterogeneity across firms and shocks common to all companies in each year *t*, respectively. In addition, a second set of estimations includes company-specific linear time trends, $trend_{it}$, to check for any temporal pattern independent of the treatment status. Lastly, ϵ_{it}, is the error term, clustered at the target company level.

([49]) If a company has raised more than one VC investment in the period, the treatment starts in the year the company raised the first VC investment, to avoid inconsistencies in the definition of the control group.

Hence, β is the DiD estimate of the effect of raising the first VC investment on total assets, total sales or number of employees of the target company, depending on the specification.

5.2. Baseline results

The results of the first set of regressions are provided in Table 5.1. In particular, in column 1 the estimates of equation (1) are documented, including only target company and year fixed effects. The results show that raising the first VC investment is associated with a 1 % significant increase (1.153) in the (log of) total assets of target companies. A significant increase emerges also when performing the same estimation using as dependent variables total sales and the number of employees, with the two estimated coefficients being equal to 0.551 and 0.378, respectively (as shown in columns 3 and 5).

Table 5.1. – Baseline results

	Total assets (ln)		Total sales (ln)		Employees (ln)	
Dependent variable	(1)	(2)	(3)	(4)	(5)	(6)
VC	1.153***	0.712***	0.551***	0.136	0.378***	0.236***
	(0.048)	(0.049)	(0.081)	(0.092)	(0.036)	(0.039)
Observations	11 503	11 503	7 158	7 158	7 297	7 297
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Company fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Company*trend	No	Yes	No	Yes	No	Yes
Adj. *R*-squared	0.758	0.841	0.767	0.797	0.793	0.844

Note: VC is a dummy variable that takes the value 1 from the year of the first VC deal raised by the target company up to an exit strategy, and 0 otherwise. Standard errors, clustered at the target company level, are shown in parenthesis. ***, ** and * indicate significance at the 1 %, 5 % and 10 % levels, respectively.

At the same time, the change in the dependent variables through time (assets, sales or employment) could be due to occurrences not related to the VC investment. To account for this, a set of company-specific linear time trends, which affect the estimated DiD coefficient, is included. Specifically, while the sign of the coefficients remains positive in all the estimations, the impact of raising the first VC on the target company is statistically significant only on total assets and the number of employees, while it is not for total sales (*p*-value: 0.138). Moreover, the magnitude of the coefficients is reduced in all cases.

In line with the existing literature, the effect of having received a VC investment on the growth of total assets, sales and number of employees materialises almost immediately after the first round of VC finance is raised (Alemany and Martì, 2005; Davila et al., 2003; Bertoni et al., 2011;

Guo and Jiang, 2013). Results also indicate that firms receiving VC funding after having successfully passed the screening of venture capitalists may transmit a positive reputational signal that might attract new customers and high-quality employees, as well as increasing their sales (Davila et al., 2003). The increase in total assets, sales and number of employees may also indicate that the start-up implemented a successful business model that is spurring growth. It may also signal that the probability of success of the venture has increased, whereas, conversely, the risk of failure has reduced. Hence, the VC funding not only provides resources for the financing needs but may also contribute to accelerating the growth of the firm.

5.3. Robustness checks

5.3.1. Common trend assumption

The validity of the DiD method depends on the actual presence of pre-treatment common trends for target companies in the treatment (companies that have raised a VC investment) and control (companies that have not yet raised a VC investment) groups. To check for the validity of the pre-treatment common trends assumption, the Autor test (Autor, 2003) is performed by estimating equation (1) again with the inclusion of interaction terms of yearly dummies and our treatment variable for all the pre-treatment periods. In line with the empirical literature ([50]), the pre-treatment interactions are referred to as 'leads'. For the pre-treatment common trends assumption to hold, it is necessary that the coefficients of these interaction terms be not statistically significant. This would mean that the trends in dependent variables (i.e. total assets, total sales and number of employees) are the same for both the control and treatment groups before the treatment. The same estimation also includes the 'lags', i.e. the interaction terms between the year dummies after the treatment and the treatment variable. Specifically, the model includes yearly lags up to the second year of investments, and then a 'long-term' lag, which takes the value of 1 after the third year after the investments to control for more persistent effects. In more formal terms, the following equation is estimated:

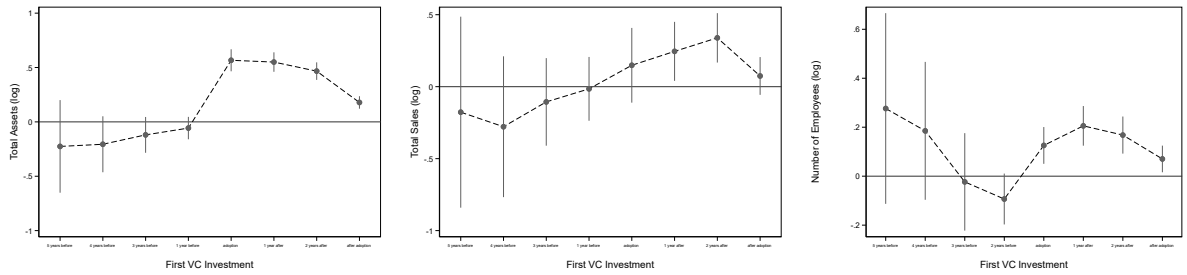
$$Y_{it} = \sum_{j=0}^{9} \beta_{-j} VC_{i,t-j} + \sum_{j=1}^{2} \beta_{+j} VC_{i,t+j} + \beta_{t=3-8} VC_{i,t=3-8} + \phi_i + \phi_t + \delta trend_{it} + \epsilon_{it}, \quad (2)$$

where the first term ($\sum_{j=0}^{9} \beta_{-j} VC_{i,t-j}$) includes all anticipatory effects except for the reference year, the second term ($\sum_{j=1}^{2} \beta_{+j} VC_{i,t+j}$) accounts for the first two lags after the investment and the third term ($\beta_{t=3-8} VC_{i,t=3-8}$) describes the long-term effect ([51]). The DiD common trends assumption holds if the estimated coefficients of the first terms are zero. Moreover, if the lags are positive and statistically significant, some conclusions on the persistency of the

([50]) See, for instance, Ferraresi et al. (2020).
([51]) The average effect considering the period since the third and up to the eighth year after the investment.

impact could be drawn. Figure 5.2 plots the results of the estimation of equation (2), showing no significant effect of the leads up to the year in which the target company raises the first VC investment.

Figure 5.2. – Test on common trend assumption: ln of total assets (left panel), ln of total sales (middle panel) and ln of number of employees (right panel)



Note: Plots of the coefficients (and their 95 % confidence intervals) for the estimation of equation (2). The reference years are $t - 2$ for total assets and total sales, and $t - 1$ for number of employees.

Moreover, the coefficients in the year of treatment are always positive, although statistically significant only in the cases of total assets and number of employees, consistently with the baseline results shown in Table 5.1. Interestingly, the lags up to the second year after the treatment are positive and significant at the 5 % level in all specifications, with the long-term effect always being lower in magnitude. These findings suggest that the positive effect appears from the year of treatment (except for sales), persists the following 2 years and then degrades and eventually almost disappears after two years from the treatment. Altogether, the results of the test should assure the validity of the common trend.

5.3.2. Placebo treatment

A further robustness test is conducted on the treatment to check its validity. Specifically, this analysis aims to detect any previous ('anticipatory') effects, adopting a 'placebo treatment'. The placebo treatment assumes that the target company raised its VC investment before it actually did. The anticipatory effect is set 2 years before the transaction ([52]). A positive and statistically significant coefficient emerging in this framework could cast some doubts on the validity of the empirical strategy. Reassuringly, as shown from the results in Table 5.2, the effect of estimating the anticipated placebo treatment 2 years before the true date of the VC investments is not statistically significant, corroborating the validity of our empirical strategy.

([52]) A 1-year anticipation has been excluded, as the completion of a VC transaction is not an immediate process but typically requires from 3 months (Fried and Hisrich, 1994; Gompers et al., 2020) to 1 year (Pearce and Barnes, 2006). During this period, the company may reap some market benefits from the public announcement of the VC deal. Conversely, if a longer anticipation (3 years or more) is adopted in the construction of the fake treatment, the main results are not significantly affected.

Table 5.2. – Placebo treatment

	Total assets (ln)	Total sales (ln)	Employees (ln)
Dependent variable	(1)	(2)	(3)
Placebo-VC	0.116	–0.034	0.009
	(0.071)	(0.116)	(0.050)
Observations	14 033	8 911	8 988
Year fixed effect	Yes	Yes	Yes
Company fixed effect	Yes	Yes	Yes
Company*trend	Yes	Yes	Yes
Adj. *R*-squared	0.860	0.824	0.867

Note: *Placebo-VC* is a dummy variable that takes the value 1 from 2 years before the first VC deal raised by the target company up to an exit strategy, and 0 otherwise. Standard errors, clustered at the target company level, are shown in parenthesis. ***, ** and * indicate significance at the 1 %, 5 % and 10 % levels, respectively.

5.4. Heterogeneous effects

This section analyses the effect of the first VC investment on the target company along different dimensions to account for any heterogeneous effect. The estimations are performed using the specification of the model that includes target company and year fixed effects, and linear time trends specific to the target company.

5.4.1. Age of the target company

The age of the target company when it obtained the VC investment could be one source of heterogeneity. The empirical evidence suggests that, on average, younger firms grow at a faster pace (Nichter and Goldmark, 2009), with higher growth rates documented for firms up to 5 years of life (Lawless, 2014; Anyadike-Danes and Hart, 2018). At the same time, young companies at earlier stages face greater difficulties in accessing external finance (Berger and Udell, 1998, 2002; Beck et al., 2005b; Beck and Demirgüç-Kunt, 2006; Hall, 2008; Fraser et al., 2015; Lee et al., 2015; Pellegrino, 2018). Hence, one could expect that the youngest and innovative firms with access to an external source of finance could benefit more than the others when receiving a VC investment.

To test whether VC investments have different impacts on target companies based on their age, the following model is estimated:

$$Y_{it} = \alpha + \beta dVC_{it} + \gamma dVC_{it} * AGE_{it} + \phi_i + \phi_t + \delta trend_{it} + \epsilon_{it}, \qquad (3)$$

where AGE_{it} is a dummy variable taking on the value of 1 for target companies older than 5 years in the year of the VC transaction ([53]). Consequently, in this framework γ is the DiD differential estimate of the effect of raising VC investments on the usual dependent variables for older target companies with respect to younger ones.

Results in Table 5.3 show that, as expected, younger firms benefit more from VC transactions in terms of total assets (+ 0.760), total sales (+ 0.216) and number of employees (+ 0.254). This is confirmed by the negative and significant signs of all the estimated interaction terms, which suggest that the coefficient for older firms is always significantly lower than the one estimated for younger companies. Nevertheless, while growing less, older firms still increase their total assets (+ 0.538) and number of employees (+ 0.173), with the differences between older and younger being negative and statistically significant (– 0.222 and – 0.304, respectively). Conversely, significant effects on total sales are not detected. These findings are coherent with the literature showing that younger firms grow more than older ones after receiving external financing (Becchetti and Trovato, 2002; Robb, 2002).

Table 5.3. – Heterogeneous effect: age of target company

	Total assets (ln)	Total sales (ln)	Employees (ln)
Dependent variable	(1)	(2)	(3)
VC	0.760***	0.216**	0.254***
	(0.049)	(0.095)	(0.041)
*VC*OLD*	–0.222***	–0.304***	–0.081***
	(0.035)	(0.076)	(0.029)
Linear combination: *VC + VC*OLD*	0.538***	–0.089	0.173***
Observations	11 507	7 158	7 305
Year fixed effect	Yes	Yes	Yes
Company fixed effect	Yes	Yes	Yes
Company*trend	Yes	Yes	Yes
Adj. *R*-squared	0.842	0.798	0.845

Note: VC is a dummy variable that takes the value 1 from the year of the first VC investment up to an exit strategy, and 0 otherwise. *OLD* is a dummy variable that takes the value 1 for firms older than 5 years, and 0 otherwise. Standard errors, clustered at the target company level, are shown in parenthesis. ***, ** and * indicate significance at the 1 %, 5 % and 10 % levels, respectively.

([53]) This threshold for the age is consistent with similar definitions of young firms provided in previous studies by Criscuolo et al. (2014) and Hallak and Harasztosi (2019) among others. Nevertheless, according to Gompers (1996), the definition is robust to slightly anticipated (4 years) cut-offs. In a separate estimation, available upon request, we have found that anticipating the threshold to 4 years does not qualitatively change the results of the analysis presented in Table 5.4.

5.4.2. Round of investment

This section investigates any difference between early and later stages of VC investments in impact on total assets, total sales and number of employees. The rationale lies in the fact that the growth rates may vary considerably between the different rounds of VC investment. While for early-stage financing of start-ups annual rates of growth over 100 % are considered usual, they would be considered exceptional for companies in later-stage financing (Alemany and Martì, 2005). Then, the hypothesis that early-stage VC financing may spur firms' growth at faster rates than later-stage financing is tested.

Accordingly, the analysis is restricted to strictly institutional VC, comparing early (first and second rounds) and later (third to ninth) stages. To test if later stages of VC investments show differential impacts on target companies, the following model is estimated:

$$Y_{it} = \alpha + \beta dVC_{it} + \gamma dVC_{it} * LATER_{it} + \phi_i + \phi_t + \delta trend_{it} + \epsilon_{it}, \quad (4)$$

where $LATER_{it}$ is a dummy variable taking on the value of 1 for target companies raising a later-stage investment. Consequently, in this framework γ is the DiD differential estimate of the effect of raising a later-stage investment with respect to an early-stage one on the usual dependent variables.

Table 5.4. – Heterogeneous effect: round of investments

	Total assets (ln)	Total sales (ln)	Employees (ln)
Dependent variable	(1)	(2)	(3)
VC	0.475***	0.065	0.125***
	(0.032)	(0.064)	(0.028)
*VC*LATER*	–0.282***	–0.133	–0.081***
	(0.035)	(0.083)	(0.026)
Linear combination: *VC + VC*LATER*	0.193***	–0.068	0.043*
Observations	20 146	12 716	13 357
Year fixed effect	Yes	Yes	Yes
Company fixed effect	Yes	Yes	Yes
Company*trend	Yes	Yes	Yes
Adj. *R*-squared	0.843	0.794	0.870

Note: VC is a dummy variable that takes the value 1 from the year of the VC early-stage investment up to an exit strategy, and zero otherwise. *LATER* is a dummy variable that takes the value 1 for later-stage investments, and 0 otherwise. Standard errors, clustered at the target company level, are shown in parenthesis. ***, ** and * indicate significance at the 1 %, 5 % and 10 % level, respectively.

As presented in Table 5.4, early stages of investments show stronger effects on total assets (+ 0.475) and the number of employees (+ 0.125) than later stages. At the same time, the impact of later-stage investments on the two variables is still positive in both cases, although both the magnitude and the significance of the estimated coefficient decline. These results are in line with the finding of Kerr et al. (2014) that VC-backed companies receiving early-stage financing improved their growth rates in several dimensions, such as assets, survival rate, employment and patenting, among others. Lastly, when restricting the sample to early and later stages, no impact of VC on total sales is detected.

5.4.3. Type of investment

To conclude, this section investigates possible heterogeneous impacts of VC investments on target companies due to the nature of the investor. Specifically, it tests whether or not investments from institutional VCs show different impacts on performances of target companies from CVC investments.

Some variability due to the different reasons behind the strategies of institutional and corporate venture capitalists is expected. On the one hand, the aim of a CVC investment is more skewed towards setting up strategic partnerships between the investor and the target (Gompers and Lerner, 2000), typically materialising in the joint development of products or services complementary to the offer portfolio of the investor, and based on technologies developed by the target company (Dushnitsky and Lenox, 2006) ([54]). IVCs, instead, are more interested in the growth of the target company per se, since the VC is aimed at increasing its market value in view of a future exit strategy (Gompers and Lerner, 2001; Cumming and Johan, 2008). Based on this interpretation, it might be expected that benefits from growth would be shared between investor and target company when the technologies developed by the target are complementary to those of the investor (Da Rin et al., 2013), unlike companies targeted by IVCs.

Within this framework, the following model is estimated:

$$Y_{it} = \alpha + \beta dVC_{it} + \gamma dVC_{it} * CVC_{it} + \phi_i + \phi_t + \delta trend_{it} + \epsilon_{it}, \qquad (5)$$

where CVC_{it} is a dummy variable taking the value 1 for CVC investments, and 0 otherwise. In this framework γ is the parameter measuring the effect on total assets, total sales and number of employees of raising a CVC investment rather than institutional VC.

([54]) According to an alternative interpretation, incumbent players could decide to invest in entrant firms as corporate venture capitalists to prevent them from raising funds from IVCs, thus discouraging new competitors in their market and sector (Norbäck and Persson, 2009). If this is the case, different survival rates for VC- and CVC-backed firms after the investment should be observed. This analysis is left for future work.

Table 5.5. – Heterogeneous effect: type of investments

	Total assets (ln)	Total sales (ln)	Employees (ln)
Dependent variable	(1)	(2)	(3)
VC	0.423***	0.054	0.103***
	(0.028)	(0.050)	(0.023)
*VC*CVC*	–0.046	0.055	–0.102
	(0.187)	(0.311)	(0.081)
Linear combination: *VC + VC*CVC*	0.378**	0.108	0.001
Observations	24 810	15 699	16 773
Year fixed effect	Yes	Yes	Yes
Company fixed effect	Yes	Yes	Yes
Company*trend	Yes	Yes	Yes
Adj. *R*-squared	0.843	0.799	0.867

Note: VC is a dummy variable that takes the value 1 from the year of the VC institutional (including business angel) investment up to an exit strategy, and 0 otherwise. *CVC* is a dummy variable that takes the value 1 for CVC investments, and 0 otherwise. Standard errors, clustered at the target company level, are shown in parenthesis. ***, ** and * indicate significance at the 1 %, 5 % and 10 % levels, respectively.

Table 5.5 shows that the baseline results are mainly guided by institutional VC, with total assets and number of employees positively affected by the transaction, while total sales are not significantly affected. Moreover, looking at the CVC's estimated coefficients, it emerges that only total assets are positively affected (even though not differently from what happens with institutional VC), while the number of employees and total sales do not significantly increase owing to a CVC investment.

This last finding is consistent with the narrative that sees IVC and CVC investors have different impacts on their target companies. While VC-backed companies benefit from the VC investments across all growth dimensions considered, companies raising CVC show a significant increase only in total assets. This confirms that the synergy in technology development between the investor and the target positively affects the economic value of the target company only (broadly proxied by its assets), while the potential benefits on the commercial side, if any, are absorbed by the investor ([55]). Lastly, the absence of a positive impact on human capital is in line with the hypothesis that CVC investors and target companies operate in a symbiotic relationship (Ivanov and Xie, 2010), and the CVC-backed company benefits from the knowledge and experience of the staff of the investor without increasing its number of employees (Colombo and Murtinu, 2017).

([55]) Another hypothesis is that the effect on sales might materialise more slowly in the case of CVC, since corporate venture capitalists are less inclined to speed up the process towards an exit strategy than IVCs (Colombo and Murtinu, 2017).

Key takeaways

The key takeaways of Section 5 are brought together in Box 5.2.

Box 5.2. – Key takeaways of Section 5

Key takeaways	▪ **Altogether, the first VC investment has a positive impact on the growth of target companies,** in terms of both total assets and number of employees, while mixed results emerge when looking at total sales depending on the empirical specification. ▪ **Results are heterogeneous** and depend upon the features of target companies (age) and transactions (round and type). – **Younger firms benefit more** from VC transactions, in terms of total assets, total sales and number of employees, than older ones. The effect on older companies is still positive but lower. – **CVC** investments affect the growth of only **total assets,** while institutional VC investments also show a positive impact on total sales and number of employees. – **Later rounds** of VC investments show a **lower impact** on the growth of target companies **than early stages.** ▪ The estimated **positive impacts of VC investment survive** a set of **robustness tests.**

6. The definition of small and medium-sized enterprises and venture capital investments

This section **presents and discusses the current definition of SMEs provided by the European Commission** (2003). In particular, **it is put in the context of similar definitions** either adopted in the economic literature or implemented by international organisations, public authorities and countries.

While discussing in combination some of the challenges to this definition raised by different scholars and practitioners, this analysis focuses on one specific implication of the European Commission's definition of SMEs, i.e. **how being the target of a VC investment may affect the status of an SME in the EU.**

Specifically, **it investigates to what extent the change of the threshold related to the VC exception may have an impact on VC investments,** using the small subset of companies that have obtained H2020 grants and had already been targeted by VC investments at the time of the grant application. The highlights of this section are reported in Box 6.1.

Box 6.1. – Highlights of Section 6

Highlights	▪ This section provides an **overview of the current European Commission definition of SMEs** and puts it in the context of similar definitions. ▪ The analysis proposes a **methodological approach** to quantify **how being the target of a VC investment may affect the status of an SME** in the EU. ▪ By focusing on one specific implication of the European Commission definition of SMEs, this section investigates to what extent **the change of the threshold related to the VC exception may have an impact on VC investments.**

6.1. What are small or medium-sized enterprises?

Small and medium-sized enterprises (SMEs) are considered among the most important **contributors to economic growth,** for instance through the creation of new jobs, the promotion of competition, and the spillover of knowledge and innovation (see, among others, Audretsch, 2002, 2007; Thurik and Wennekers, 2004; Beck et al., 2005a; Acs and Szerb, 2007; Aghion and Jaravel, 2015). In particular, SMEs are frequently referred to as the **'backbone' of**

the EU economy (Schmiemann, 2009; European Commission, 2019). For these reasons, SMEs have been repeatedly targeted by various **EU policies** aimed, for instance, at improving their **access to financing,** at reducing **regulatory burden** and improving **market access,** and at supporting the transition to **sustainability** and **digitalisation,** which are currently the three pillars underlying the 'SME strategy for a sustainable and digital Europe' (European Commission, 2020b).

Given this acknowledged importance, it is crucial to investigate **how differently SMEs may be defined.** Intuitively, the development and implementation of dedicated policies may be affected by the different segmentations or categorisations of firms.

The **European Commission** established the **current definition of SMEs in 2003** (Commission recommendation 2003/361/EC) ([56]). The most important aspect considered in the definition is the **size** of the firm, which is measured using three indicators: **staff headcount, turnover** and **balance sheet total ([57]).** Based on these measures, the definition provides two conditions for a firm to be considered an SME: (i) it has **fewer than 250 employees** and (ii) either its **turnover** is **no more than EUR 50 million** or its **balance sheet total** is **no more than EUR 43 million.**

When a further differentiation within the SME category is necessary, a firm is defined as **micro** if it has fewer than 10 employees and either the turnover or the balance sheet total is no more than EUR 2 million, and as **small** if the employees are fewer than 50 and either the turnover or the balance sheet is no more than EUR 10 million, while the residual group is composed of **medium-sized** enterprises ([58]). Box 6.2 recaps classifications of SMEs together.

Box 6.2. – Rules on size underlying the definition of SMEs

Company category	Staff headcount	Financials		
		Turnover	or	Balance sheet total
SME	< 250	≤ EUR 50 million		≤ EUR 43 million
Small	< 50	≤ EUR 10 million		≤ EUR 10 million
Micro	< 10	≤ EUR 2 million		≤ EUR 2 million

Source: JRC elaborations of European Commission (2003).

([56]) The definition officially came into force in January 2015. The first European Commission definition of SMEs was published in 1996 (Recommendation 96/280/EC). Major amendments to the original version include (i) the introduction of the definition of microenterprises; (ii) the discussion on implications of VC investments on the definition; (iii) a more comprehensive definition of independent firms.

([57]) Also indicated as total assets.

([58]) However, in the definition these categories are not described as exclusive. This implies that, in principle, microenterprises are also small enterprises, and both micro and small enterprises, together with medium-sized enterprises, are included in the wider category of SMEs.

In addition to the size of the individual firm, a **second relevant aspect** is that a **firm** may be in some way **linked to a larger group.** According to the European Commission definition, in this case the evaluation on the size should be conducted including (part of the) staff headcount and the turnover or balance sheet data of the overall group. More precisely, the recommendation describes companies as 'autonomous', 'partners' or 'linked'. Typically, an **autonomous company** is fully independent, meaning that it has no shares in other companies and no other companies have shares in it. However, a firm is also considered autonomous if it owns holdings accounting for less than 25 % of the capital (or voting rights) in one or more other companies, and if other parties have holdings of no more than 25 % of its own capital (or voting rights) ([59]). Conversely, two firms are considered **partners** when they establish an inter-firm relationship based on reciprocal holdings of ownership shares, but neither can exert legal control over the other. This happens when a company owns more than 25 % but no more than 50 % of the capital (or voting rights) of another one. Lastly, two enterprises are **linked** when they form a proper group, i.e. when one controls the majority of the shares (or the voting rights) of the other ([60]).

The quantification of the size is straightforward for an autonomous firm, being limited to the firm itself. Conversely, to calculate the headcount and financial data of partner companies, it is necessary to add to the figures of one firm the related figures of all the partners, weighted by the quota of owned shares. Lastly, for linked firms, the totality of the linked company's figures must be added to those of the company being evaluated for SME status. Therefore, a company that may be categorised as an SME if assessed as a separate entity could be evaluated differently if in partnership or linked with others.

The definition further specifies that a company only loses SME status if it passes the thresholds (on staff and monetary indicators) for two consecutive years (Article 4.2). The rationale for this is to provide stability for enterprises that have a successful commercial year but then fall back under the ceilings the next year. However, this 'grace period' does not apply if the passing of the thresholds is due to a change of ownership, which is seen as permanent instead of temporary ([61]).

Alongside the official EU definition, **a large variety of criteria have been adopted in academic economic literature regarding what an SME is** (Aybar-Arias et al., 2003; Gilmore et al., 2013) **even when EU-based companies are analysed.** Several scholars have used the staff headcount as the only indicator defining an SME (Hatten, 2011). Most analyses define SMEs as companies in the range of 0–250 employees (Greene and Travis, 2002; Ayyagari et al., 2003; Ruiz-Santos et al., 2003; Kushnir et al., 2010; Rossi et al., 2015). However, a certain degree of variability emerges even within this category of works. Specifically, some works set the cut-off at 100

([59]) Some exceptions to the 25 % share are envisaged by the definition, including a case in which the firm receives investments from business angels or venture capitalists. We discuss these exceptions in more detail in the following section.

([60]) Under a more extensive interpretation, the link between firms also emerges when one company either can autonomously appoint or remove the management or can exercise a dominant influence (based on signed contracts or agreements) on the other one.

([61]) VC investment is considered such a permanent change and thus the loss of the status is immediate.

employees (Voulgaris et al., 2000; Becchetti and Trovato, 2002; Papadogonas, 2007; Uhlaner et al., 2013), 200 employees (Robson and Bennet, 2000; Segura and Toledo, 2003) or 500 employees (Levy et al., 2002; Corso et al., 2003; Çokpekin and Knudsen, 2012), even in the context of EU-based companies. In more limited cases, the criterion adopted is exclusively the turnover (Lopez-Gracia and Aybar-Arias, 2000; Bellucci et al., 2013, 2014), or both turnover and balance sheet total (Pérez et al., 2002), while the number of staff headcount is not taken into consideration. Conversely, others scholars have identified SMEs following the European Commission definition, in its full version (Deloof et al., 2007; Eikebrokk and Olsen, 2007; Varum and Rocha, 2013; Bellucci et al., 2019a,b) or with some limited variations, also based on the characteristics of the investigated country (Ikonomou, 2011).

Similarly, **a unique definition of SMEs does not exist even among international organisations or public authorities** (Buculescu, 2013; Berisha and Pula, 2015). Two relevant examples are documented in Box 6.3.

Box 6.3. – SME definitions from the Organisation for Economic Co-operation and Development and the World Bank

International organisation	Micro	Small	Medium
OECD	1–9 employees	10–49 employees	50–249 employees
World Bank (International Finance Corporation)	a. < 10 employees b. < EUR 0.1 million annual turnover c. < EUR 0.1 million balance sheet total	a. < 50 employees b. < USD 3 million annual turnover c. < USD 3 million balance sheet total	a. < 300 employees b. < USD 15 million annual turnover c. < USD 15 million balance sheet total

Source: JRC elaborations from OECD (2019) and World Bank (2019).

First, the Organisation for Economic Co-operation and Development (OECD) proxies the size of the firm based solely on the staff headcount. Specifically, to be considered SMEs, firms should employ no more than 249 staff (OECD, 2019) ([62]), the same as in the European Commission's definition. Conversely, it does not define thresholds with reference to annual turnover or balance sheet total. Second, the World Bank adopts a multicriteria approach, based on the same indicators as used by the European Commission. Nevertheless, two differences emerge. On the one hand, the monetary criteria (i.e. on turnover and balance sheet) should apply jointly and are not alternatives as in the European Commission's

([62]) We should acknowledge that in other publications (e.g. OECD, 2005) the thresholds adopted are quite different, with a firm defined as an SME when it has fewer than 500 employees. In that case, there are four, instead of three, underlying subcategories of SMEs: 1–9, 10–49, 50–99 and 100–499.

definition. On the other hand, the thresholds are slightly different for all the indicators. Specifically, the limit set for the staff headcount for being considered an SME is larger (i.e. 300 vs 250), while the monetary criteria are significantly lower (i.e. USD 15 million vs EUR 50 million for turnover and USD 15 million vs EUR 43 million for balance sheet total).

Another source of **heterogeneity in the SME definition comes from the country where the firm is based.** Countries may adopt different definitions of SMEs. For instance, according to the OECD (2010) the upper threshold of the staff headcount determining whether or not a firm is an SME is 99 for New Zealand, 150 for Mexico, 199 for Australia and Korea, 249 for Japan and Turkey, and 499 for Canada and the United States.

Altogether, it emerges that **a common, shared and unique definition of SMEs is not available,** although the debate around the homogenisation of this definition is still ongoing. At the same time, **the European Commission definition is an established reference,** at least for EU-based companies. This prominent position in the debate has attracted some comments in the economic literature, sometimes oriented to challenge the European Commission definition by detecting possible biases.

The main issues pertain to three areas. First, several scholars have discussed some **drawbacks of the indicators underlying the current SME definition,** in particular the weight given to the staff headcount. This choice could be motivated by the fact that information on the headcount is generally objective and easily applicable (Berisha and Pula, 2015), it can hardly be directly controlled by the employer (Filion, 1990), and it is not artificially inflated by price development (Ganguly, 1985), such as turnover or total assets. Conversely, a simple headcount may give less immediate indications in the current labour market, in which part-time and temporary work are becoming more common (Curran and Blackburn, 2001). More generally, the staff headcount may not reflect the real size of a small company (Osteryoung and Newman, 1993). Moreover, it is not obvious that a growing company should employ more workers to act as a competitive player (Buculescu, 2013). Further concerns were also raised with regard to the asset indicator. In particular, in some cases high assets could hide inefficiencies in the firms' capital allocation (Gibson and van der Vaart, 2008).

Second, **the adopted thresholds are somewhat arbitrary, and should be adjusted based on some relevant factors,** which could act as sources of heterogeneity. Among them, it emerges that cross-country accounting differences may affect turnover and, mostly, total assets. Fixed and intangible assets could be valued differently based on different accounting systems (Buculescu, 2013). Similarly, different tax systems could affect the monetary indicators of the SME definitions (Berisha and Pula, 2015). Another possible source of heterogeneity is related to the size of the population, which mostly affects the headcount staff indicator. For instance, according to Soomro and Aziz (2015), the number of employees should be parametrised to the total population of the country where the company is based, to guarantee cross-country comparability of the size of companies. Moreover, thresholds for the monetary indicators should be modified from time to time based on inflation and exchange rates (Stokes and

Wilson, 2010). Lastly, the size of a firm should be relativised based on the industrial sectors in which it operates (Loecher, 2000; Hatten, 2011). Firms show inherent differences across sectors concerning all the indicators underlying the European Commission's definition of SMEs. In particular, the number of employees (Stokes and Wilson, 2010), the turnover and the total balance sheet (Gibson and van der Vaart, 2008) are on average different between sectors.

Third, according to some other works, **additional indicators could be included in the definition of an SME as well or instead,** for instance profitability and net worth (Henschel and Heinze, 2018). In some other cases, current indicators are slightly modified to overcome some of the criticisms, for instance by indexing the monetary indicators to one common currency or to the country's gross national income per capita at purchasing power parity (Gibson and van der Vaart, 2008).

6.2. Implications of European Commission definition of small and medium-sized enterprises for venture capital and business angel investments

VC and business angel investments could play an important role in determining the status of a EU-based firm, according to the European Commission definition. Besides the conditional definition of the size of an individual SME, an SME may also lose its status if it raises a VC investment and (at least one of) the VC investor(s) receives more than 50 % of its equity shares (or voting rights).

The application of the 50 % threshold clearly constitutes an exception to the standard rules on the determination of an autonomous company included in the European Commission's definition. Article 3.2(a–d) of the definition includes venture capitalists and business angels within the restricted list of entities ([63]) whose investments up to 50 % of the shares of the target firms are not sufficient for them to be considered partners ([64]). In other words, these firms are still assessed as autonomous, and thus fully eligible to be considered SMEs if all the other criteria are respected. On the other hand, in the case of an investment by a single VC above 50 %, the company itself, the VC and all the other investees in which it has a majority are considered as a group and consequently, in most cases, these companies lose their SME status.

This exception seems to be essentially related to the benefits of VC investments to target companies, especially in the first stages of their activities, and is seen as a way to encourage the creation of enterprises and the equity financing of SMEs. As documented in recital 10 of the European Commission definition, VC – and particularly business angel – investors can

([63]) This list also includes public investment corporations; universities and non-profit-making research centres; institutional investors, including regional development funds; autonomous local authorities with an annual budget of less than EUR 10 million and fewer than 5 000 inhabitants.

([64]) In the case of business angels only, the financial involvement in the same company must also be below EUR 1.25 million.

valuably 'give relevant advice to new entrepreneurs' and 'provide smaller amounts [of equity capital] at an earlier stage of the enterprise's life'.

Hence, being considered an SME based on the European Commission's definition is not just a matter of classification, but is a prerequisite for access to several EU SME-dedicated support schemes. Among others ([65]), there is H2020, the largest EU programme providing public grants to small and medium-sized innovative firms. Young and innovative firms may benefit from raising both private and public investments, so the definition and application of this threshold could be crucial.

Despite the clear benefits of VC investment to the growth of target firms, documented in Section 5 of this report, some **concerns about these exceptions** could still emerge. A recent work by Crehan (2020) presents a comprehensive discussion of some possible drawbacks in the application of these rules.

The first one is specifically related to the **exception granted to VC investments** in the definition of SMEs. In particular, the European Commission definition does not fully take into consideration some specific peculiarities of the legal structuring of VC activities, which could in principle affect the application of the exception. In particular, venture capitalists organise their activities through agreements often based on a limited partnership, a legal framework in which two different parties operate, i.e. one general partner (GP) and at least one limited partner (LP). While LPs play the role of the investors, by risking their own capital limited to the amount invested, the GP takes care of managing and running the fund subscribed by the LPs, as well as supporting the growth of target companies. Consequently, from a purely operational point of view, the venture capitalist should be identified with the GP. At the same time, the GP mainly invests LPs' funds in target companies, while it generally uses its own financial resources in minimal amounts. Given these differences, it is necessary to clarify whether the concept of venture capitalist included in the SME definition coincides with the GP, the LPs or both. Understandably, this choice is not without consequences. The first – and more practical – reason is that the evaluation of the thresholds (and consequently of the possible links between target company and VC) may generate different results depending on how 'venture capitalist' is defined. Conversely, the second reason is more directly linked with the rationale underlying the rule, i.e. the reason why a VC-backed firm should be considered linked to its VC investor. On the one hand, given its guidance role for target companies, the GP usually sits on their boards, and can therefore more directly control them. At the same time, it usually holds only minority shares in the target company, and therefore cannot directly steer it through its shares. On the other hand, LPs rarely sit on the boards, but they may be more likely to own (individually or jointly) more than 50 % of the shares. Therefore, the VC

([65]) The European Commission also provides public support for SMEs through many other financing and guarantee scheme programmes such as the programme for the competitiveness of enterprises and small and medium-sized enterprises (COSME), the employment and social innovation programme (EaSI), the connecting Europe facility (CEF) and the cultural and creative sector guarantee facility (CCSGF).

should be identified with the GP if the rule underlying the definition aims to privilege control over ownership, whereas it should be identified with the LPs if the ownership is considered more relevant. Moreover, according to Crehan (2020), the target company has no access to the staff, revenues or assets of the VC fund. Consequently, including these figures in the computation of the overall numbers of the target company in its assessment would not correctly represent the real size of the company.

The second issue concerns **broader aspects related to the assessment of the independence of firms** and hence may be applied both to venture capitalists and to other standard investors. The first concern is related to the definition of thresholds per se. The choice of the 25 % and 50 % thresholds could be interpreted as arbitrary, since there is no scientific evidence that this limit should be applied. Second, based on this definition, the notions of ownership and control seem to be considered interchangeable. This is proven by the fact that the same 50 % threshold applies to both concepts in the definition. Nevertheless, in principle ownership and control are different – and in some cases divergent (Lin et al., 2011, 2013) – concepts. Ownership is strictly related to shares in the firm and to the connected legitimate claims on profits, while control is associated with the right to take strategic decisions (Marks, 1999), generally measured by the voting rights, expressed as having a seat on the Board of Directors. Given the different natures and aims of these two concepts, it is not obvious that they are perfect substitutes as in the European Commission's definition of SMEs ([66]). Therefore, it would be useful to clarify what both criteria are intended to measure and determine, including in the light of the increasing literature on the heterogeneous effects of ownership and control on firms' results ([67]).

6.3. Case study: what if the thresholds change?

This section proposes a **methodological approach** to quantify to what extent the **change of the threshold related to the VC exception** may have an **impact on VC investments.** In particular, it focuses on the small subset of companies that jointly satisfies the following three conditions: (i) they have received an SME Instrument grant from the European Commission H2020 scheme in our period of analysis; (ii) they have also raised a private VC investment in the same period; (iii) the VC investment was raised after the SME Instrument was granted ([68]).

It focuses on this subset of companies because, having already received a VC investment by the time they applied for the H2020 grant, they have survived the scrutiny of the H2020 commission and have been assessed, evaluated and certified as SMEs. In other words, since these firms have been certified as SMEs after this scrutiny, we have assurance that the VC

([66]) This is particularly the case for VC investors, in the light of the implications of the standard GP–LP legal framework of VC investments.

([67]) Evidence on the expected benefits of privileging one measure over the other is mixed. For instance, according to Zhou et al. (2017), owners are more effective than controllers at producing a positive impact on firms' performances. Conversely, other works find a positive correlation between independent directors and firm performance (Peng et al., 2015).

([68]) Given that we need to use information on both public grants and VC transactions, we rely on the matched DB adopted in Section 4. The same limitations on the representativeness of the overall figures discussed above also apply here.

investments they raised before the public grant did not cross the thresholds. Consequently, it might be stated that these grants would have been lost if a lower threshold had been applied. Figure 6.1 shows the changes in the number of grants and amounts, respectively, after having applied the three conditions related to the VC exception for the definition of the status of SME. Specifically, panel A represents the number of the grants, and panel B the related amounts granted ([69]).

Altogether, applying the first of our three conditions to our dataset (Figure 6.1, panels A and B), we match 124 SME Instruments transactions (tagged as 'H2020'), amounting to approximately EUR 74 million. Second, in approximately 68 % of these transactions, companies given an SME Instrument grant also received a private VC investment in our period of analysis ('H2020 and VC'). Hence, when the second condition is applied, the analysis is restricted to a sample of 84 companies that obtained an SME Instrument grant, accounting for approximately EUR 57.1 million. Lastly, when we introduce the third condition, the focus of our analysis is further restricted to 61 transactions (accounting for approximately EUR 38.7 million) in which the SME Instrument is granted after a VC investment.

This set of grants could have been endangered if the 50 % threshold for VC transactions had been lowered to the usual 25 % applied to all the other private investors.

In order to test what would happen if the threshold were lowered ex post, it is necessary to discriminate target companies for which there is at least one investor owning more than 25 % of the shares in the year of the SME Instrument grant ([70]). If there is not a GUO with at least 25 % of the shares (i.e. GUO25), it means that the company could be considered autonomous based on the European Commission's definition. In this exercise, this amount coincides with 24 grants (tagged as 'No GUO25') accounting for approximately EUR 14 million. Second, the exception to the rule applies only if the GUO25 is a venture capitalist. For this reason, a further 28 cases (accounting for EUR 22.4 million) in which other different investors are the GUO25 (i.e. 'GUO25 = third investor') were excluded from this sample. The final set of SME Instrument transactions that would not have been granted if the threshold had been 25 % (i.e. 'GUO25 = VC investor'), instead of the current 50 %, is thus identified. In this exercise, there are nine such cases, accounting for approximately EUR 2.3 million.

Altogether, based on this illustrative exercise, which has several limitations ([71]), **a lower threshold for third-party investor affects a limited number of firms.** These cases represent approximately the 15 % of SME Instrument granted after a private VC transaction (equal to

([69]) We should acknowledge that for 8 out of 124 H2020 grants the information on the amounts is missing in our dataset.

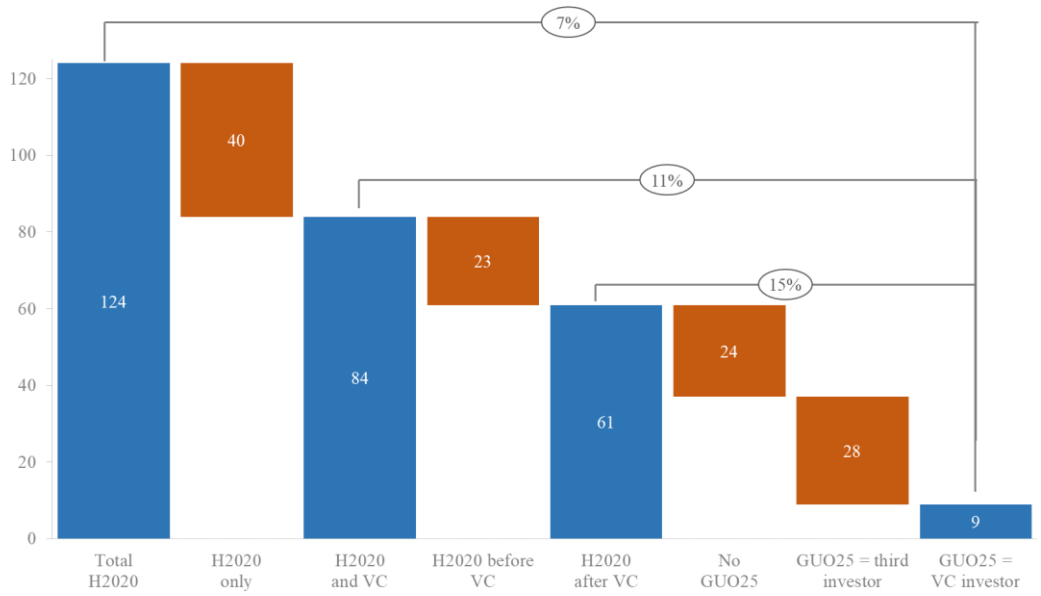
([70]) In cases of syndicated VC investments, the shares acquired by each VC investor involved in the transaction are considered separately to identify the GUO of the target company, unless a formal link between VC investors is in place (e.g. they form a group through direct or indirect control).

([71]) This analysis indicates a methodological approach but suffers from two main limitations, which should moderate any policy implication. First, since it is an ex post investigation, it is not possible to take into consideration any strategic response to the change in the rules by either VC investors or target companies. Second, while it is necessary to use the matched DB to conduct this analysis to jointly exploit information on VC deals/public grants and on the target company (e.g. the GUO25), the sample analysed is not entirely representative of the full set of SME Instruments. In other words, these results should be interpreted as illustrative and should be tested on a wider and more representative matched DB. This analysis is left for future work.

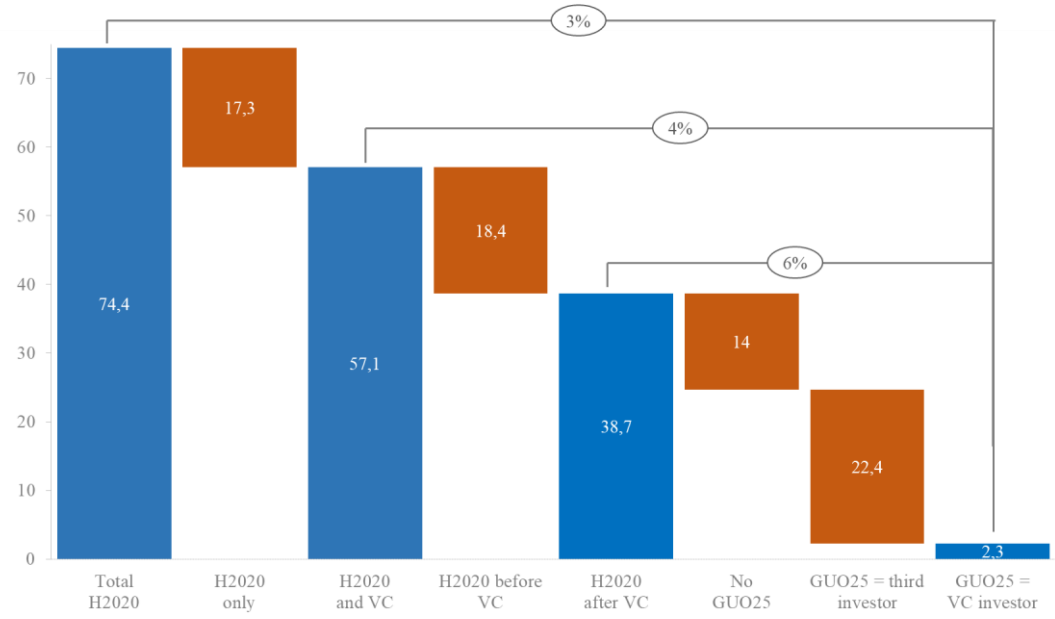
the 6 % in terms of volumes), and the 7 % of the overall granted SME Instruments (equal to the 3 % in terms of volumes).

Figure 6.1. – Methodological approach to quantify possible changes in VC thresholds: a case study (number (panel A) and total amounts (million EUR; panel B) of the grants)

Panel A



Panel B



Source: JRC elaborations on matched DB and H2020 official dataset.

6.4. Key takeaways

The key takeaways of Section 6 are brought together in Box 6.4.

Box 6.4. – Key takeaways of Section 6

Key takeaways	▪ A change in the definition of SMEs may affect the interpretation of their impact on the economy, and experts' evaluations of the implementation of dedicated policies. ▪ A single shared definition of SMEs is not available. At the same time, the European Commission definition seems to be a well-known and established reference for EU-based companies. ▪ Conditional on all the limitations of our analysis, this section proposes a **methodological approach** to quantify to what extent a **change in the threshold related to the VC exception** may have an **impact on VC investments.**

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List of boxes

List of figures

List of tables

Annexes

Annex 1. Further details on VentureSource and Orbis database matching

Table A.1.1 provides summary statistics of all existing companies in the Orbis txt/flat files in the last available data release, at the time of database construction in the third quarter of 2018, to give an overview of how much information is available for each matching variable. The coverage varies considerably between countries and matching variables. Considering cases for which at least one of the four variables is available, the percentage of coverage ranges from 4 % for Ireland to 93 % for Lithuania.

Table A.1.1. – Summary statistics of available firms for matching variables at country level

Country	Total observations	Website exists	Phone exists	Email exists	Fax exists	1 of 4 exists	Web (%)	Phone (%)	Email (%)	Fax (%)	1 of 4 (%)
AT	1 184 277	225 463	444 690	236 451	211 306	499 658	0.19	0.38	0.20	0.18	0.42
BE	3 657 656	232 234	1 269 383	69 137	368 160	1 300 696	0.06	0.35	0.02	0.10	0.36
BG	1 740 485	65 353	995 805	294 728	103 586	1 038 139	0.04	0.57	0.17	0.06	0.60
CY	461 651	13 970	39 115	11 681	7 279	44 790	0.03	0.08	0.03	0.02	0.10
CZ	2 870 712	419 710	713 064	473 014	123 797	808 805	0.15	0.25	0.16	0.04	0.28
DE	3 674 927	1 221 276	1 684 167	1 123 864	1 283 054	1 828 853	0.33	0.46	0.31	0.35	0.50
DK	1 438 174	191 177	850 295	751 080	163 122	1 053 047	0.13	0.59	0.52	0.11	0.73
EE	343 900	48 202	212 569	250 392	24 561	263 757	0.14	0.62	0.73	0.07	0.77
EL	1 284 570	54 891	62 011	41 216	51 129	82 905	0.04	0.05	0.03	0.04	0.06
ES	3 991 051	399 801	1 370 218	4 341	461 333	1 549 928	0.10	0.34	0.00	0.12	0.39
FI	1 497 535	293 787	835 388	341 090	153 231	896 427	0.20	0.56	0.23	0.10	0.60
FR	2 396 566	649 381	932 398	229 339	428 630	1 295 294	0.27	0.39	0.10	0.18	0.54
HR	345 790	32 400	37 265	22 689	24 541	59 478	0.09	0.11	0.07	0.07	0.17
HU	2 060 100	65 646	104 337	478 714	61 813	528 300	0.03	0.05	0.23	0.03	0.26
IE	648 385	23 501	2 869	383	103	24 423	0.04	0.00	0.00	0.00	0.04
IT	5 759 498	631 759	1 341 457	17 553	22 143	1 613 069	0.11	0.23	0.00	0.00	0.28
LT	185 043	50 413	166 464	126 529	59 960	171 244	0.27	0.90	0.68	0.32	0.93
LU	197 509	9 884	25 255	1 396	19 632	27 957	0.05	0.13	0.01	0.10	0.14
LV	389 719	36 870	138 614	62 960	69 591	158 127	0.09	0.36	0.16	0.18	0.41
MT	95 423	7 754	26 420	4 888	4 353	29 148	0.08	0.28	0.05	0.05	0.31
NL	5 189 053	1 835 682	2 731 001	5 693	859 521	3 600 090	0.35	0.53	0.00	0.17	0.69
PL	2 426 394	540 698	954 892	563 025	407 955	1 203 676	0.22	0.39	0.23	0.17	0.50
PT	902 895	88 214	380 419	212 136	154 252	423 399	0.10	0.42	0.23	0.17	0.47
RO	2 956 096	83 637	1 623 489	125 562	94 456	1 660 154	0.03	0.55	0.04	0.03	0.56
SE	2 282 359	247 702	1 187 284	2 095	110	1 223 172	0.11	0.52	0.00	0.00	0.54
SI	439 078	32 365	125 510	60 743	34 232	138 697	0.07	0.29	0.14	0.08	0.32
SK	873 350	130 587	224 042	114 276	31 526	262 553	0.15	0.26	0.13	0.04	0.30
UK	13 515 157	1 168 762	1 228 148	404 282	7 269	1 554 748	0.09	0.09	0.03	0.00	0.12

Source: JRC elaborations on Orbis data (see Bellucci et al., 2020c).

Table A.1.2 shows the success rate of the matching between VentureSource and Orbis.

Table A.1.2. – Linking success rates (VentureSource&Orbis) of VC-backed firms at country level

Country	VC-backed firms from VentureSource	Matched	Not matched	Accuracy (%)
AT	450	318	132	71
BE	776	622	154	80
BG	43	27	16	63
CY	25	5	20	20
CZ	130	93	37	72
DE	5 471	4 524	947	83
DK	1 093	854	239	78
EE	92	57	35	62
EL	74	43	31	58
ES	2 234	1 614	620	72
FI	1 419	1 188	231	84
FR	7 584	5 253	2 331	69
HR	29	16	13	55
HU	254	91	163	36
IE	846	204	642	24
IT	1 264	902	362	71
LT	65	47	18	72
LU	109	63	46	58
LV	55	37	18	67
MT	25	14	11	56
NL	1 796	1 514	282	84
PL	334	253	81	76
PT	227	146	81	64
RO	63	37	26	59
SE	2 621	1 798	823	69
SI	29	20	9	69
SK	39	25	14	64
UK	11 971	5 898	6 073	49
Total	**39 118**	**25 663**	**13 455**	**66**

Source: JRC elaborations on matched DB (see Bellucci et al., 2020c).

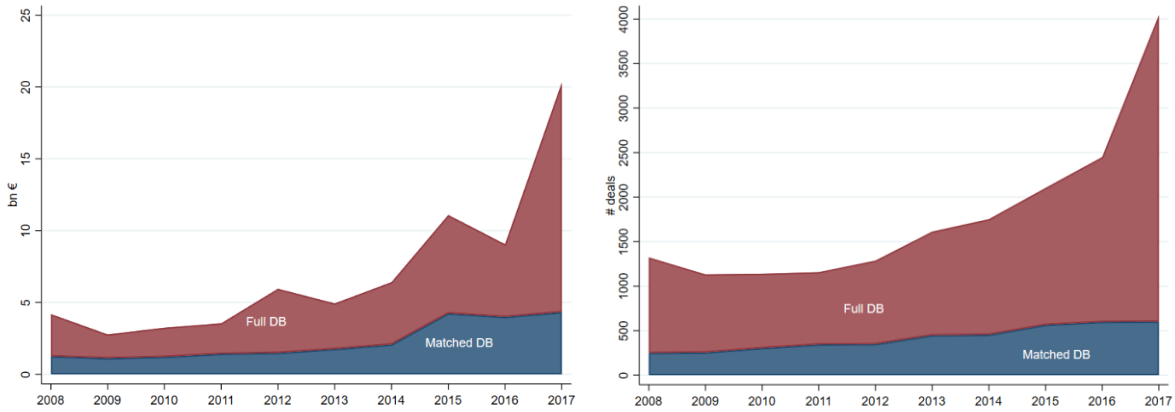
VentureSource provides 39 118 entries for the variable 'Company Name', which refers to the name of the VC-backed company. An issue in VentureSource is that some companies are listed twice because of a slight difference in spelling (e.g. Agro Innovacio Kft vs Agro-Innovacio Kft) or listed in the language of the company where the company is located and in English (e.g.

Steigenberger Akademie vs Steigenberger Academy GmbH). In this work 39 118 is taken as 100 % since no other external benchmark is available.

Before proceeding to download the relevant variables for the Orbis identifiers, we took additional steps. First, we removed duplicates by looking at company names to identify the unique Bureau van Dijk identifier by intersection. Then, we capitalised all company names in Orbis because of differences between the Orbis and VentureSource files (e.g. UAB IMPULS LTU vs Impuls LTU). Lastly, we manually searched for more than 2 500 observations with missing information on company website with the aim of finding their Orbis identifiers. To retrieve additional information, we proceeded as follows: (i) we copied the name of the firm with the missing website from the VentureSource file; (ii) we pasted the name of the firm with the missing website into the online Orbis website; (iii) based on VentureSource company information (address, city, country and company overview) together with web searching, we tried to understand which company (if any) listed by Orbis was our target firm; (iv) once we had detected the firm in the online Orbis website, we copied and pasted the Orbis identifier into the output file of the matched DB. In the matched DB, for 18 413 companies out of 39 118 Orbis did not provide any type of information except for the Orbis identifier and company name.

Figure A.1.1 provides a comparison between VentureSource and the matched DB in terms of amounts and numbers of deals of VC investments in the EU.

Figure A.1.1. – Comparison between matched DB and full dataset in terms of amounts and deals of VC investments in EU, 2008–2017



Source: JRC elaborations on the matched DB.

It emerges that the matched DB covers between 30 % and 50 % of the total VC-backed volume and between 20 % and 30 % of the number of deals included in the whole VentureSource database, depending on the year of analysis. At the same time, the trends in both VentureSource and matched DB time series seem quite similar, especially when looking at

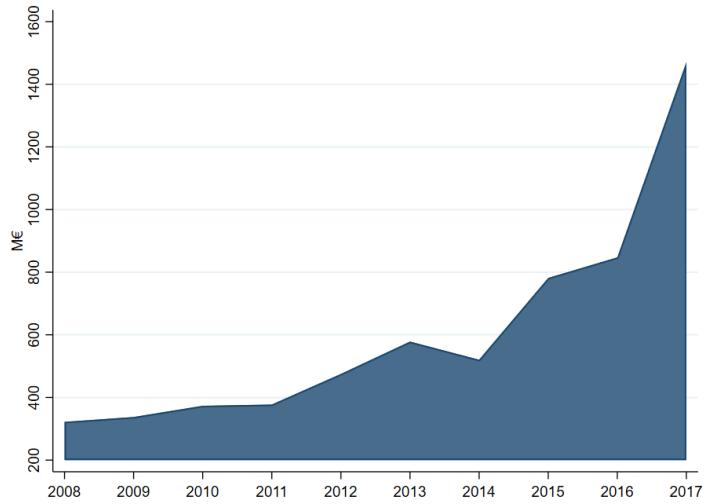
volumes, although yearly changes seem less pronounced in absolute terms in the case of the matched DB (especially the growth in 2017).

Annex 2. Overview of corporate venture capital

A.2.1. Changes in volumes and numbers of deals in the European Union

The development of CVC in the EU has followed a similar trend to other VC investments.

Figure A.2.1. – Corporate venture capital cumulative investments in the EU, 2008–2017 (million EUR)



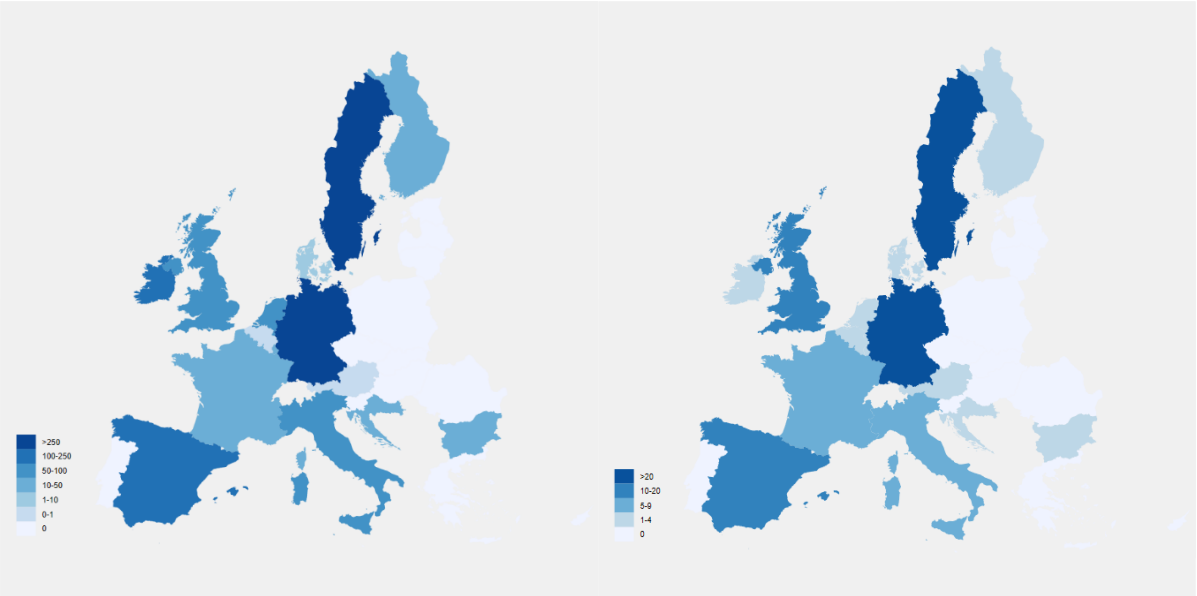
Source: JRC elaborations on the matched DB.

Figure A.2.1 shows that, within the EU, the amount of CVC outstanding moved from approximately EUR 300 million in 2008 to more than EUR 1.4 billion in 2017. This represented a growth of over EUR 1 billion in less than 10 years, equivalent to a fourfold increase, already net of withdrawals due to firms' exit strategies. Nevertheless, this development has followed different patterns across the EU.

Figure A.2.2 shows the overall level of CVC raised by EU Member States from investors worldwide, during the period 2008–2017. The left panel indicates the volume of investments in millions of euro, while the right panel indicates the number of completed deals.

Heterogeneous distributions of CVC across the EU emerge in both the volumes and the numbers of deals. Specifically, investments are concentrated in a limited number of countries. The amount invested in the top 5 countries (i.e. Germany, Sweden, Spain, Ireland and Italy) covers approximately 80 % of the total CVC investments in the period between 2008 and 2017.

Figure A.2.2. – Cumulative corporate venture capital volumes and deals raised by EU countries, 2008–2017 (million EUR (left) and number of deals (right))



Source: JRC elaborations on the matched DB.

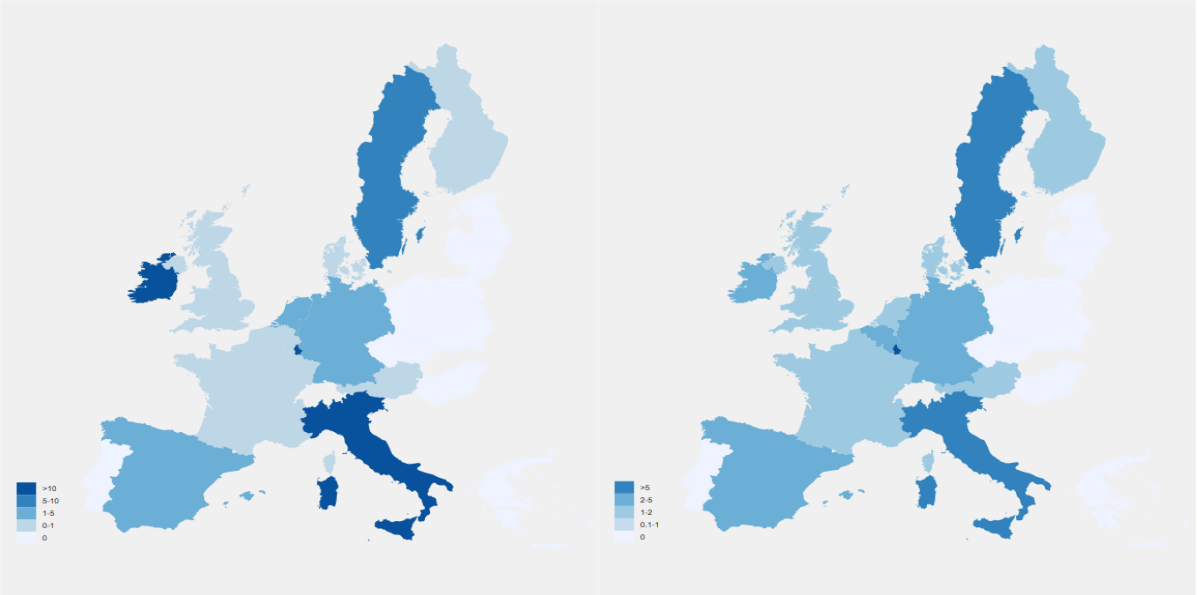
The results do not differ substantially when investigating the number of deals. However, Ireland shows a low number of deals with respect to the overall amounts raised, suggesting that the average amount of each deal was higher than the EU average. On the other hand, among countries with more developed CVC markets (i.e. with at least five deals in our time sample), France emerges as the one with the highest number of deals in proportion to the volumes raised.

Furthermore, looking at the contribution of CVC to the total of the VC investments made between 2008 and 2017, some Member States seem to be more likely to receive CVC than other forms of investment, once they are found to be VC targets.

More specifically, Figure A.2.3 indicates that in Luxembourg, Ireland, Italy and Sweden CVC investment formed higher proportions of total VC investments in terms of volumes and numbers of deals. It follows that, although these investments are a minority of VC investments, some countries might be proportionally more constrained by specific policies related to CVC.

Altogether, the CVC market emerges as still limited and, above all, concentrated in a few countries, generally the most advanced economies. Therefore, a possible policy objective could be to favour the entry of similar forms of investment in countries where the CVC is scarcely widespread or completely absent.

Figure A.2.3. – Corporate venture capital volumes (left) and numbers of deals (right) raised by EU countries as a percentage of total venture capital investments, 2008–2017



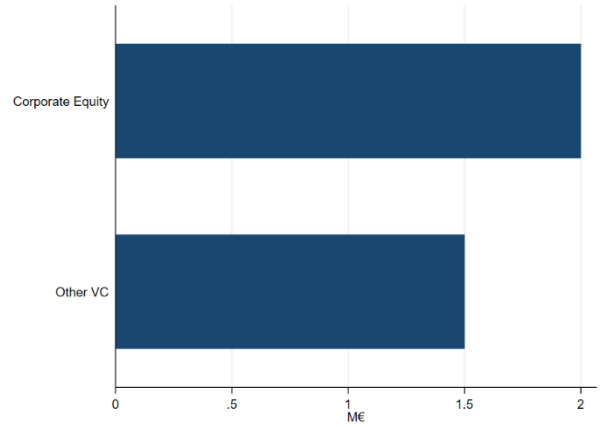
Note: Six countries with up to five deals raised in the period 2008–2017 were excluded from the analysis and the graphs, to avoid biases in the interpretation of ratios of very small values.

Source: JRC elaborations on the matched DB.

A.2.2. Differences between corporate venture capital and other forms of venture capital

This paragraph analyses CVC investments in more detail by comparing their median amount with that of all the other forms of VC. Figure A.2.4 shows the result of the analysis.

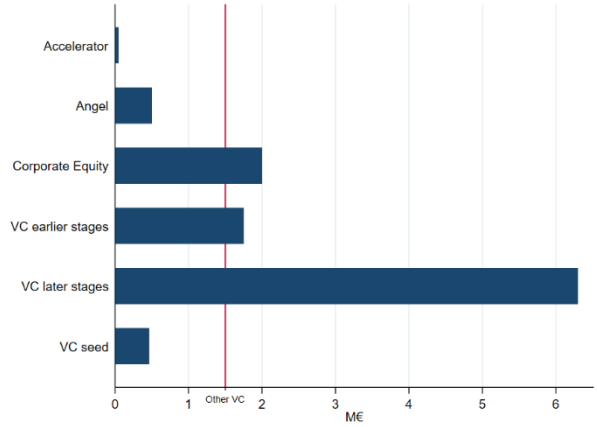
Figure A.2.4. – CVC vs other VC investments, median amounts raised, 2008–2017



Source: JRC elaborations on the matched DB.

First, CVC investments show a median value of EUR 2 million, about 33 % higher than the median value of the other VC investments (EUR 1.5 million). Nevertheless, VC shows different levels of amounts when looking at different rounds of investments.

Figure A.2.5. – CVC vs other VC investments (by type), median amounts raised, 2008–2017

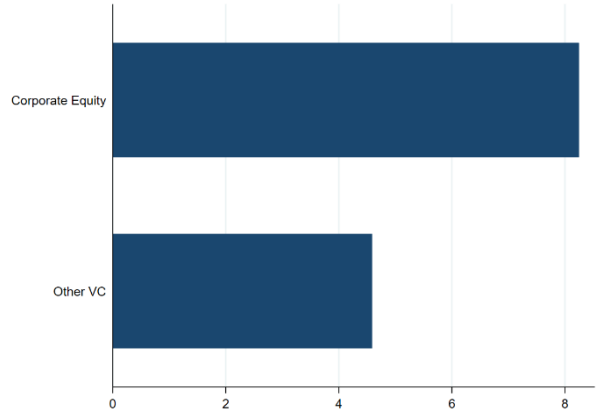


Source: JRC elaborations on the matched DB.

Figure A.2.5 shows that CVC has a higher value than most VC investment types, with the sole exception of VC later stages. CVC investments are more likely to be comparable to the first stages of VC (i.e. VC earlier stages) than to those categories more typically associated with the first phases of firms' lives, such as accelerator, business angel or VC seed. At the same time, the median amount of CVC investments is only about one third of VC later stages ones.

The duration of CVC investments compared with that of other VC investments is depicted in Figure A.2.6. As described above, the investment duration is measured as the difference between the observed year and the year of the investment, net of any divestment news indicating the closing, sale (e.g. M&A) or public listing of the company.

Figure A.2.6. – Duration of CVC investments vs other VC investments, median, 2008–2017 (years)



Source: JRC elaborations on the matched DB.

This graph also shows the median duration over the period 2008–2017 of investments received by firms before the period of analysis, in order to take account of the history of all the investments they have received.

Interestingly, an important difference between the duration of CVC investments and that of other VC investments appears to emerge. On average, CVC seems to have a longer life expectancy than other forms of VC. In our sample, CVC shows a median duration of more than 8 years, compared with less than 5 years for the other forms of VC.

This could be a sign that CVC investment is less volatile than other VC. Corporations adopting CVC investments may be more interested in acquiring or learning from the technological and innovative capabilities of the target firm than in investing to get a rapid sale or listing.

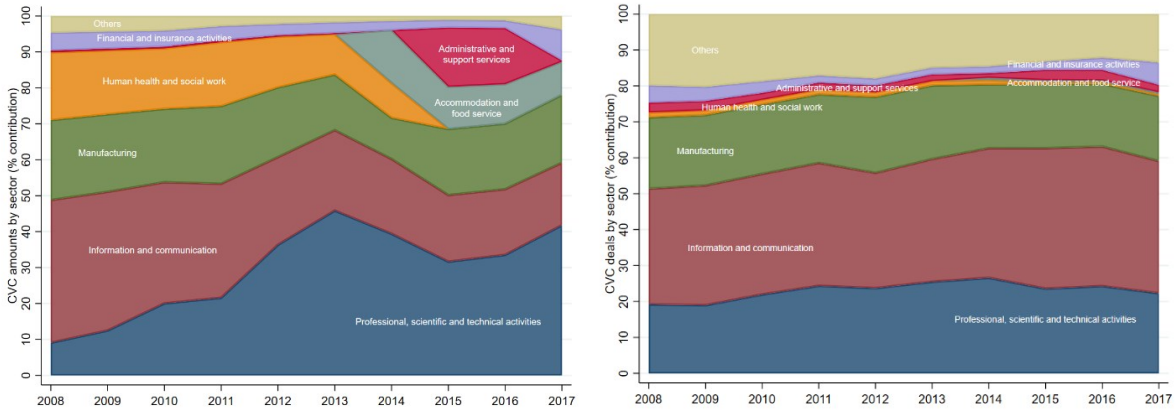
This finding could also be policy relevant, since a widespread use of this kind of instrument can foster a more balanced development of the business ecosystem. Two quite different forms of firms may coexist, with reciprocal beneficial effects. On the one hand, large companies, which are more solid, ensure production and employment on a large scale in different productive sectors; on the other hand, SMEs or even start-ups, which show a stronger capacity to innovate, are more responsive to technological and market-driven changes (Siota et al., 2020). The development of a collaboration through CVC may allow the first group to stay at the technological frontier, being updated on the latest market developments, and the second group to obtain further resources to develop their projects, as well as practical knowledge and assistance on the commercial and production fronts.

A.2.3. Features of corporate venture capital target firms

This section analyses some features of firms that are targets of CVC investments. The purpose of this investigation is to understand whether or not CVC investors seek different characteristics in target firms from what other venture capitalists do. Accordingly, CVC target firms' sectors, as well as relevant financial indicators (i.e. number of employees, total sales and total assets), are observed.

As illustrated in Section 3, Figure A.2.7 shows the distribution of CVC investments by broad sector.

Figure A.2.7. – CVC investments by industrial macrosectors (NACE Rev. 2, broad structure): volumes (left) and deals (right), 2008–2017



Source: JRC elaborations on the matched DB.

The same three broad sectors cover about 70 % of total (CVC) investments. Compared with general VC, the distribution between professional, scientific and technical activities, information and communication, and manufacturing is slightly more homogeneous, especially when looking at the number of deals (right panel). Conversely, unlike the VC general case, the remaining 30 % is not shared among several sectors, but in terms of volumes it is concentrated in three other main sectors: human health, accommodation and food service, and administrative and support services. The same cannot be said of the numbers of deals, which suggests that individual deals of significant amounts can more significantly influence the distribution between sectors. However, altogether, there does not seem to emerge a substantial difference from the general level shown in Figure 3.14.

Furthermore, the same phenomenon is investigated using the maximum level of sector granularity, i.e. microsectors. Table A.2.1 shows microsectors accounting for at least 1 % of total CVC investments in each broad sector, up to the top three.

The microsectors most represented are like those identified in Table 3.2. They are mainly attributable to the three areas already identified as bio-oriented and pharmaceutical research, engineering, and financial technology. Altogether, these areas – covered by eight microsectors marked with icons in Table A.2.1 – account for approximately two thirds of total CVC investments. Therefore, it seems that the concentration of investments in these microsectors is more pronounced than in general VC, which included in the three areas 15 microsectors accounting for approximately 60 % of total VC investments.

In the specific case of CVC investments, the concentration in high-tech sectors seems to be confirmed and further accentuated than in general VC. This finding is in line with other works emphasising that corporate venturing operates in areas/sectors in which technology transfer (e.g. in terms of patents and innovative ideas) is more strongly developed (Siota et al., 2020). This may have some relevant policy implications: favouring the diffusion of CVC investments

can facilitate faster technology transfer, allowing innovative projects at the proof of concept stage (developed by start-ups) to be developed into marketed products and services, and taking advantage of larger-scale production through the investor company.

Table A.2.1. – CVC investments by industrial microsectors (NACE Rev. 2, four digits), 2008–2017 (cumulative %)

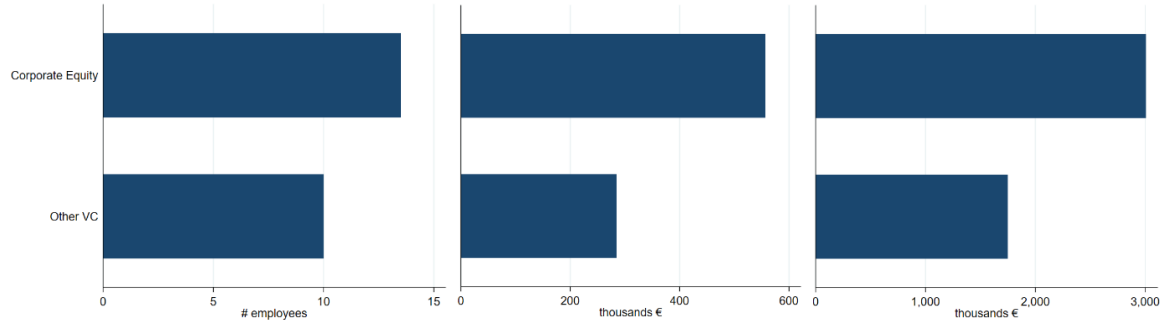
Broad sector	Microsector (four digits)	% of broad sector	% of total investments
Professional, scientific and technical activities	Research and experimental development on natural sciences and engineering	80	27
	Engineering activities and related technical consultancy	8	3
Manufacturing	Manufacture of builders' ware of plastic	55	10
	Manufacture of pharmaceutical preparations	29	5
Information and communication	Wired telecommunications activities	53	13
	Computer-programming activities	19	5
	Motion picture, video and television programme production activities	8	2
Financial and insurance activities	Activities of holding companies	56	2
	Other financial service activities, except insurance and pension funding	44	2
Human health and social work activities	Renting and operating of own or leased real estate	100	8
Accommodation and food service activities	Restaurants and mobile food service activities	100	7
Administrative and support service activities	Other business support service activities	93	5

Source: JRC elaborations on the matched DB.

In addition to the sector, the analysis provides insights into whether or not CVC investors are interested in firms with similar characteristics to firms that are targets of other VC investments. Section 3 has already shown that VC-backed firms are SMEs. Specifically, they

can be microenterprises or small enterprises, based on the European Commission definition. Figure A.2.8 compares the characteristics underlying the definition of SMEs (i.e. number of employees, total sales and total assets) across CVC and other VC target companies.

Figure A.2.8. – Employees, total sales and total assets of firms when receiving CVC vs other VC, 2008–2017: median of number of employees (left), total sales (thousand EUR, centre) and total assets (thousand EUR, right)



Source: JRC elaborations on the matched DB.

Interestingly, companies receiving CVC are on average larger than enterprises receiving other forms of VC. Specifically, the median number of employees, total sales and total assets in the year of investment are always higher in cases of CVC than other VC investments. This difference is more marked when looking at total sales (by a factor of 2), while it is more limited in terms of the number of employees and total assets (in both cases a factor of 1.5).

On average, companies raising CVC investments belong to the SME category. Specifically, their identikit matches a small enterprise, as they have more than 10 employees and more than EUR 2 million in total assets. In contrast, other VC investors are more likely to target smaller firms, i.e. microenterprises. This difference can be important in order to more precisely target policies that specifically incentivise CVC compared with other forms of VC.

Annex 3. Further details of microsectors of companies receiving public grants

Table A.3.1 is designed to detect the importance of the sectors at NACE Rev. 2 (four digits) level in which venture capitalists invest more, still associating them with the macrosectors presented in Figure 4.14 not to miss the broader view. Specifically, they are microsectors targeted by at least 1 % of total SME Instrument investments.

Table A.3.1. – SME Instrument (phases 1 and 2) grants by main microsectors (NACE Rev. 2, four digits), 2014–2017 (cumulative %)

Broad sector	Microsector (four digits)	% of broad sector	% of tot SME Instrument
Professional, scientific and technical activities	Other research and experimental development on natural sciences and engineering	49	15
	Engineering activities and related technical consultancy	33	10
	Research and experimental development on biotechnology	13	4
Manufacturing	Manufacture of pharmaceutical preparations	33	15
	Manufacture of engines and turbines, except aircraft, vehicle and cycle engines	13	6
	Manufacture of medical and dental instruments and supplies	10	5
Information and communication	Computer-programming activities	70	15
	Other software publishing	19	4
	Wireless telecommunication activities	6	1
Wholesale and retail trade	Retail sale through mail order houses or internet	41	2

Note: Top three NACE Rev. 2 microsectors (if they contribute at least 1 % to total H2020 investments) are selected within each NACE Rev. 2 macrosector.

Table A.3.2 is designed to detect the importance of the sectors at NACE Rev. 2 (four digits) level in which venture capitalists invest more, still associating them with the macrosectors presented in Figure 4.15 not to miss the broader view. Specifically, they are microsectors targeted by at least 1 % of total other public grants (hence excluding SME Instrument) investments.

Table A.3.2. – Public grants (excluding H2020) by main microsectors (NACE Rev. 2, four digits), 2008–2017 (cumulative %)

Broad sector	Microsector (four digits)	% of broad sector	% of total public grants
Professional, scientific and technical activities	Research and experimental development on biotechnology	34	17
	Other research and experimental development on natural sciences and engineering	30	15
	Engineering activities and related technical consultancy	25	12
Manufacturing	Manufacture of pharmaceutical preparations	27	10
	Manufacture of engines and turbines, except aircraft, vehicle and cycle engines	22	8
	Manufacture of electronic components	17	6
Information and communication	Computer-programming activities	37	2
	Computer programming, consultancy and related activities	25	1
Others	Travel agency activities	27	2
	Combined office administrative service activities	17	1
	Other financial service activities, except insurance and pension funding	15	1

Note: Top three NACE Rev. 2 microsector (if they contribute at least 1 % to total public grants) are selected within each NACE Rev. 2 macrosector.

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