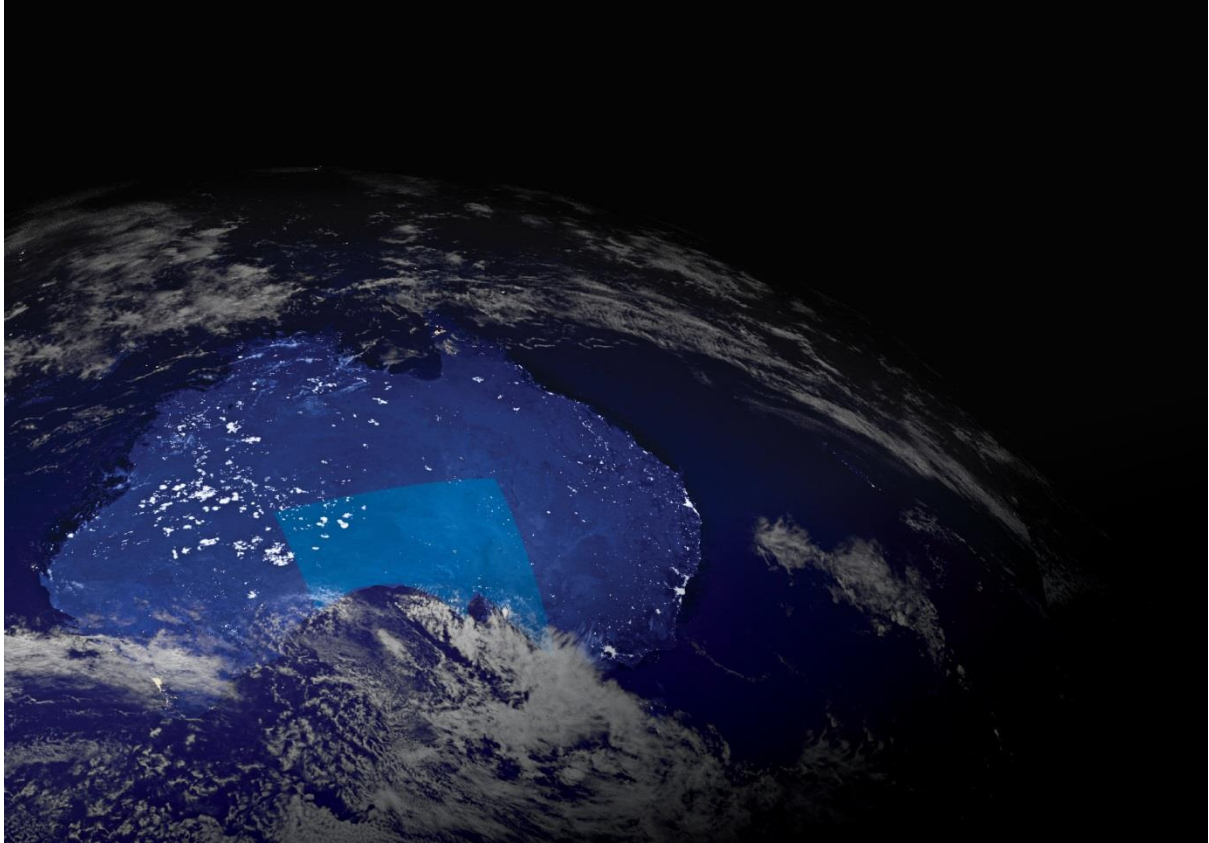


VENTURE CAPITAL IN THE NEWSPACE ECONOMY

Global trends and facts



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“Two things fill the mind with ever new and increasing admiration and awe, the oftener and the more steadily we reflect on them: the starry heavens above me and the moral law within me.”

Immanuel Kant, *Critique of Practical Reason*, 1788

Translation by Lewis White Beck

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Executive summary

This report provides insight into venture capital investments in the space industry for commercial activities in the so called *NewSpace* economy.

Venture capital investments are considered crucial for the growth opportunities of new companies. They provide invaluable support during the early stages of establishment where it is difficult to receive funding from other private institutions (such as banks) or even the government. Government grants alone are not usually sufficient for sustaining a business (they have to be matched by entrepreneurs' or other private investors' funding) and however they are delivered only for a short period of time. The principal obstacle to investment for start-ups is generally the elevated risk, which only venture capitalists (VCs) are able to bear.

Venture capitalists that invest in space companies are mostly concentrated in the United States of America (US) (74 percent).¹ In particular, California hosts 53 percent of US VCs. One of the major non-US hubs at a country level is the United Kingdom (UK), which hosts about one third of non-US VC firms. Among countries with an emerging space economy, China and India, which boast two of the most advanced space programs in the world, are also starting to open their doors to private investors.

Venture investments can be performed in different periods of a company's lifecycle, from its seed stage (when the project's research and development is ongoing) to the later stages (when the company starts to commercialize its product/service and is perhaps realizing positive cash flows).

VC activity has showed an interesting increase in commercial space investments in the last 15 years,² especially in the Low Earth Orbit (LEO) sector and thanks to the new trends that have completely changed the way of approaching space. In particular, due to new nanosatellite technology, costs are decreasing – making access to space more affordable – and new commercial application for satellites are emerging, such as big data analysis and Internet of Things (IoT). Moreover, VC space investment volumes are highly dependent on corporate later-stage financing. This is one of the reasons for the significant variability of space venture capital funding.

Apart from the US market, private space investments struggle to increase and in some countries they are even in a developing or underdeveloped phase. Public support is still important – two examples are the European Space Agency's Advanced Research in Telecommunications Systems (ARTES) programme and the South Australian Venture Capital Fund. However, countries are gradually improving and widening private sources of investment.

¹ The Tauri Group, 'Start-Up Space: Rising Investment in Commercial Space Ventures', *Bryce Space and Technology Reports*, 2016, p. 25, <https://brycetech.com/reports.html> (accessed March 2017).

² Dillow, C., 'VCs Invested More in Space Startups Last Year Than in the Previous 15 Years Combine', *Fortune*, [website], 22 February 2016, <http://fortune.com/2016/02/22/vcs-invested-more-in-space-startups-last-year/> (accessed March 2017).

Introduction

This report is a detailed analysis of Venture Capital (VC) investments in the commercial space sector. In the last fifteen years there has been a significant increase in investments, in particular during 2015, which recorded total venture financing of US\$1.8 billion. It is interesting to understand why investors are so attracted to space and if this trend will carry on in the future or if it has been just a sporadic event. A comparison among countries/regions would be also effective in detecting if this trend has spread out all over the world or if it is bounded within specific areas. In order to understand all these issues, the report is organized in five chapters.

Chapter 1 provides a theoretical overview of venture capital. A literature analysis explains how VC works, focusing first on the investment process (how it is structured) and then on the deal structure that involves investors (who provides the money) and the VC fund (who manages the money). A description of the different VC firms' ownership structure is also provided, briefly summarizing the results from the literature. In the end, the chapter deals with the investment criteria adopted both from investors and VCs. In particular, it first presents the criteria which investors rely on in order to choose which country to invest their money in and to which VC fund to entrust their funds, and then the criteria that VCs use for selecting the best entrepreneurs and projects.

Chapter 2 deals with the general trends of VC investments in space, with a focus on the historical barriers that have restrained private involvement in space projects and on new trends that now are positively affecting them. A brief analysis is carried out for 2015 and 2016 investments, trying to understand if the 2015 boom will replicate in the future or not. Some perspectives for future opportunities are also provided. In the last part of the chapter, VC firms and Angel investors engaged with space companies are presented, since they represent the most substantial groups of space investors.

Chapter 3 provides a twofold regional analysis: first, the general attractiveness of the VC market is assessed for each country/region, carrying out an analysis of market's strengths and weaknesses that could affect investors' decision; then, regional trends and facts for space investments are described. In particular, the chapter focuses on four countries/regions: US, Europe (with a focus on the UK and Russia), China and India. The countries were selected due to the fact that they are the world's leading space nations. The report finds that the US has the best performing VC market in general the world as well as in the space sector. In Europe, the UK the leading country, while Russia is found to perform rather poorly. China and India are the two most promising Asian countries in private space investments.

Chapter 4 is a regional analysis of the Australian and South Australian perspectives. In particular, this chapter assesses Australia's general attractiveness for venture capitalists and then presents the South Australian space environment with a focus on venture efforts, both governmental and private. Moreover, the profile of two South Australian companies (Fleet Space Technologies and Neumann Space) and an Australian Venture Capitalist (Blackbird Ventures) is presented, as well as information related to venture financing (amount of investments, future needs).

Chapter 5 contains the conclusion of the report. It concludes that decreasing costs of manufacturing/launching satellites and technological megatrends have contributed to make the access to space more affordable. Venture capital has proved to be fundamental for the establishment and/or growth opportunities of new space commercial companies, even if it is not easy to obtain and is characterized by a high variability.

1 VENTURE CAPITAL: AN OVERVIEW

The *Oxford Handbooks of Venture Capital* (OHVC)³ defines Venture Capital as follows:

‘Venture Capital (VC) refers to investments provided to early-stage, innovative, and high-growth start-up companies. Typically VC investments are seed-stage investments [...]. Also, depending on perspective, VC investments are start-up investments [...], other early-stage investments [...], and expansion-stage investments [...].’

Venture capital is thus a source of financing that aims to promote innovation in specific industrial sectors, which stand out for the extraordinary growth outlook and the opportunity to make substantial revenues. It may be linked to investments at different stages of a company’s lifecycle:

- **Seed-stage investments** are the first money flows available to new emerging firms. Entrepreneurs use them in order to finance the research, the assessment and the development of a project⁴, as well as assembling a management team and drawing up a business plan if the first steps are successful.⁵ They characterize the company’s lifecycle before the start-up phase.⁶ Seed money is provided not only by VCs, but also by angel investors⁷, relatives and friends.⁸
- **Start-up investments** address the product development and the initial marketing.⁹ They are provided before the commercialization of the product (it is usually in testing or pilot production), when a firm may be in the set-up phase or may have only been in business for a short time (three years or less).¹⁰
- **Other early-stage investments** are necessary for initiating commercial manufacturing and sales.¹¹ At this point of its lifecycle, the company has not realized any profit yet.¹²
- **Expansion-stage investments** focus on the growth of the firm, which may be interpreted as increased production capacity, further market or product development, additional working capital.¹³ This funding is usually carried out by more institutional investors than in the previous stages, who abandon the mere supportive task to shift to a more strategic role.¹⁴

³ D. Cumming, ‘Introduction’, in D. Cumming (ed.), *The Oxford Handbook of Venture Capital*, 2012. Available from: Oxford Handbook Online (accessed February 2017).

⁴ Ibid.

⁵ Thomson Reuters, ‘National Venture Capital Association 2016 Yearbook’, *NVCA Research Resources*, 2016, p. 104, <http://nvca.org/research/research-resources/> (accessed February 2017).

⁶ Cumming, ‘Introduction’, in *The Oxford Handbook of Venture Capital*.

⁷ An angel investor is ‘a wealthy individual that invests in companies in relatively early stages of development. Usually angels invest less than US\$1 million per start-up.’ Source: Thomson Reuters, ‘2016 Yearbook’, p. 83.

⁸ Thomson Reuters, ‘2016 Yearbook’, p. 94.

⁹ Cumming, ‘Introduction’, in *The Oxford Handbook of Venture Capital*.

¹⁰ Thomson Reuters, ‘2016 Yearbook’, p. 104.

¹¹ Cumming, ‘Introduction’, in *The Oxford Handbook of Venture Capital*.

¹² Ibid.

¹³ Ibid.

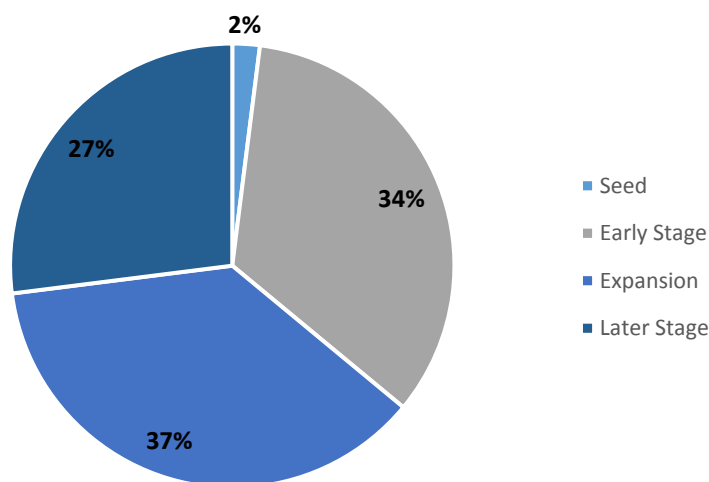
¹⁴ Thomson Reuters, ‘2016 Yearbook’, p. 104.

Although this definition frames the VC in a very straightforward way, the description suggested by Bob Zider¹⁵ in his 1998 article on the Harvard Business Review may be more appropriate. He wrote:

‘Contrary to popular perception, venture capital plays only a minor role in funding basic innovation. [...] Where venture money plays an important role is in [...] the period in a company’s life when it begins to commercialize its innovation.’¹⁶

Therefore, using the OHVC’s terminology, what really matters are the early-stage and the expansion-stage investments. Effectively, recent data seem to confirm his words. Looking at reports from the National Venture Capital Association¹⁷ (NVCA) and Invest Europe (formerly known as EVCA, European Venture Capital Association)¹⁸, seed investments represent only a very small share of the total amount of invested money. In 2015, the US recorded only a two percent share for seed investments, while the biggest amounts are linked to early-stage and expansion investments (Figure 1). The same trend is confirmed by European data¹⁹ (Figure 2): in the period 2007-2013 seed money has rarely exceeded the five percent share in each quarter (with the exception for Q3 in 2008 and 2011 and for Q4 in 2011 and 2012).). The majority of the deals are later-stage investments (see Box 1.1), which are supposed to include also expansion investments (terminology used by Invest Europe is a little bit different from the one used in this chapter).

Figure 1 – US venture capital investments in 2015 by stage (percentage of invested dollars).



Source: Thomson Reuters, ‘2016 Yearbook’, p. 13.

¹⁵ Bob Zider founded The Beta Group in 1983 with backing from The Boston Consulting Group. Beta Group is a firm that develops and commercializes new technology with funding from individuals, companies, and venture capitalists. Zider is the CEO of PorOsteon and Avantek. Source:

http://www.betagroupllc.com/background/partner_bios/

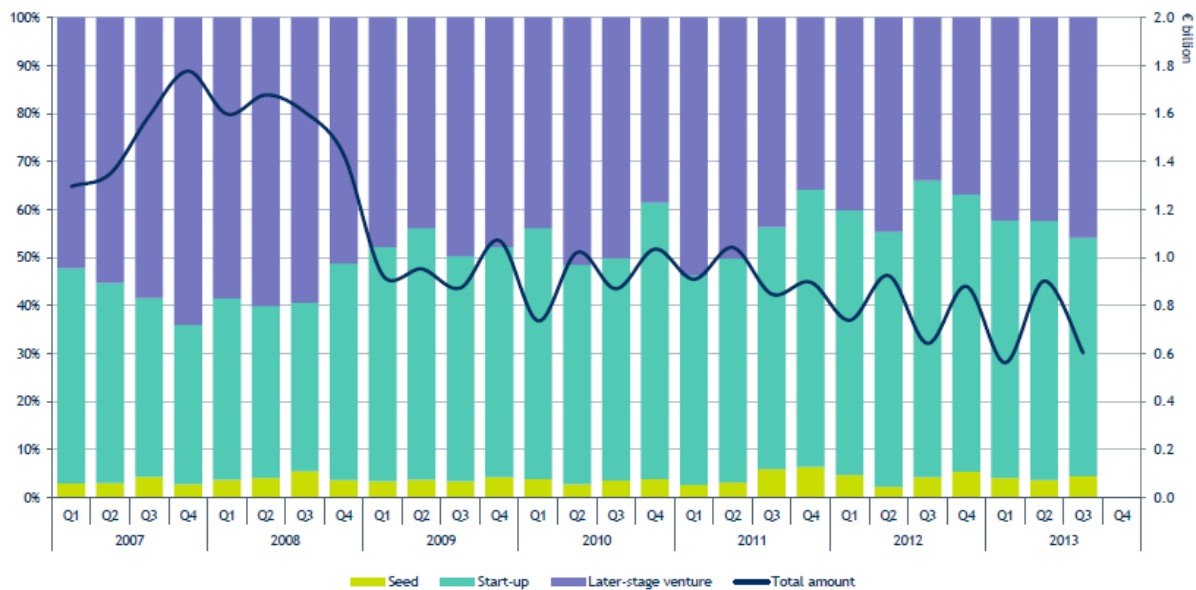
¹⁶ B. Zider, ‘How Venture Capital Works’, *Harvard Business Review*, vol. 76, no. 6, 1998, p. 132.

¹⁷ For further details: <http://nvca.org/>

¹⁸ For further details: <https://www.investeurope.eu/>

¹⁹ Data as of 1/11/2013.

Figure 2 – European venture capital investments by stage in 2007-Q3 2013 (distribution and total amount).



Source: Invest Europe, 'EVCA Quarterly Activity Indicator: Q1 2007- Q3 2013. Activity Data on Fundraising, Investments and Divestments', *Research Publications*, 2013, p. 13, <https://www.investeurope.eu/research/invest-europe-publications/#i> (accessed February 2017).

Box 1.1 – Other VC stage investments

The list of investments provided in the OHVC is not exhaustive, since there are other stage financings in which VCs may be involved. In particular:

- **Later-stage investments** address companies that have reached the maturity stage, characterized by a stable growth rate and positive cash flows. If performance is very good, they may start to realize a positive net income too. All these favourable economic conditions make later stage companies less risky than early stage ventures, so rate of returns for investors is lower than previous stages. Typically, a company at this point of its lifecycle will be involved in a liquidity event, such as an Initial Public Offering (IPO) or buyout, within 6-12 months.
- **Acquisition financing** consists in the acquisition of a firm's 49 percent stake or less by VCs with the goal of providing it with money.
- **Acquisition for expansion**, i.e. VCs provide funds to a company in order to acquire other companies or assets. This is a strategic choice aiming to consolidate the firm's position in specific industries.
- **Management/Leverage buyout** consists in picking up a product line or business. The main goal of this operation is to revitalize the business, which is often domestically managed. The Management Buyout (MBO) is controlled by the management team of the company (or its division), often in partnership with a buyout fund, while the Leverage Buyout (LBO) is carried out by an external financier who uses mostly borrowed capital.

- **Recapitalization** and **turnaround** are designed to address the financial difficulty of a company and improving its performance: the latter results in a considerable rise in the company's revenues, profits and reputation; the former consists of the reorganization of the company's capital structure.
- **Secondary buyout** is a buyout deal on top of a buyout deal. The secondary buyout is led by a different investor to the first one.

Sources: (a) Thomson Reuters, '2016 Yearbook', pp. 83-95; (b) Thomson Reuters, '2016 Yearbook', pp. 104-105.

1.1 Rise and Dynamics of Venture Capital Funding

The VC market exists in order to solve the lack of backing during the early stage of development, to 'fill a void'²⁰ created by the missing support from traditional funding sources. The void arises from the capital market structure and rules.²¹ Start-ups have no hard assets to use as collateral in contracting banking loans and banks cannot raise the interest rate above a certain threshold because of the usury laws.²² Then, there is no way to design a contract that makes the investment opportunity economically viable for banks. Moreover, other institutional investors such as investment banks and public equity cannot prejudice the public investors by putting money in very high-risk projects.²³

To compensate for the risk of failure, in dealing with the start-up the contract has to be designed in a way that guarantee to VCs both broad downside protection and a preferential chance for further investment if the company proves to be successful.²⁴ The protection is provided through the appointment to VCs of preferred stock, which gives them the first claim to the company's asset in case of liquidation, and through anti-dilution clauses, applied in case of a new financing round carried out at a lower stock value (the aim is to preserve each investor's equity share within the company).²⁵ In order to foster new investments, a firm may guarantee to its investors a predetermined price for new stocks in case of good performances.²⁶ This clause will benefit VCs, since they will be able to acquire new stakes in the company at below market price.²⁷

Vcs themselves also take some precautions in order to limit the damage in case of failure. For example, they hardly ever invest in a company individually. When VCs co-invest with other firms, typically there will be a "lead" investor and several "followers".²⁸ The lead investor is the partner or investor with the major portion of capital in the syndicated financing deal.²⁹ He is usually the venture capitalist who

²⁰ Zider, 'How Venture Capital Works', p. 132.

²¹ Ibid, p. 132.

²² Ibid, p. 132.

²³ Ibid, p. 132.

²⁴ Ibid, p. 134.

²⁵ Ibid, p. 134.

²⁶ Ibid, p. 134.

²⁷ Ibid, p. 134.

²⁸ Ibid, p. 135.

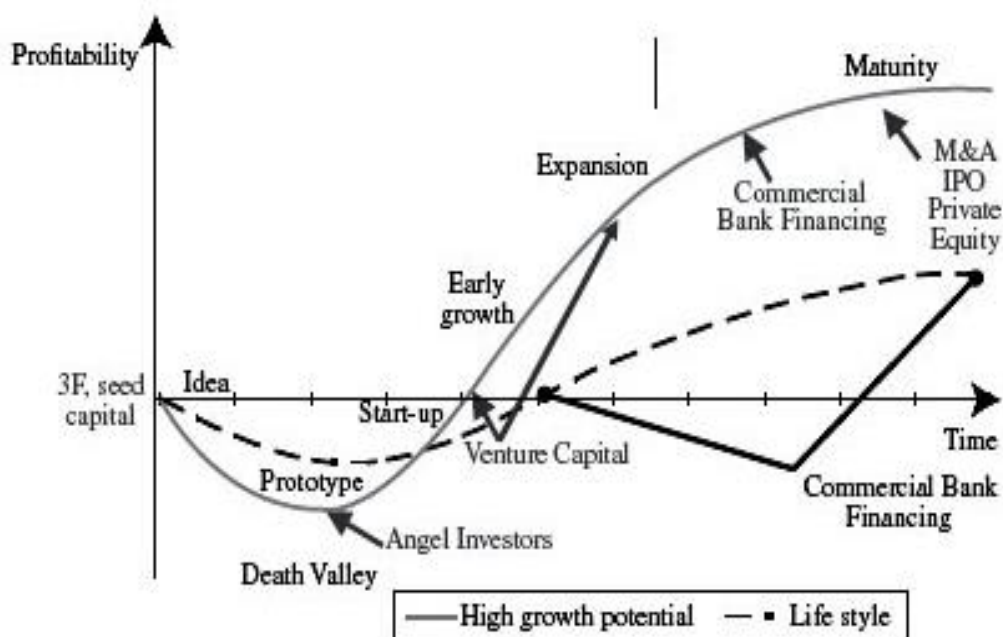
²⁹ Business Dictionary, 'Lead investor', *BusinessDictionary.com*, [website], <http://www.businessdictionary.com/definition/lead-investor.html> (accessed February 2017).

starts the negotiations, and who may also take an action on behalf of the other financiers.³⁰ Another strategy is differentiating the companies' portfolio: since VCs invest in a wide range of firms, it is sufficient that only few backed companies succeed in order to exceed the losses from the other investments.³¹

Before making an investment, VCs carry out two analyses: first, a detailed investigation of the market in which they want to search for opportunities, called "origination", in order to assess if that particular market provides high potential for growth and improvement for firms; secondly, a rigorous due diligence process aiming to determine the accuracy of the company's financial and commercial information, with the help of specialist teams, such as lawyers, accountants and, in some cases, environmental experts.³²

Referring to the backed-firm's profitability curve (Figure 3), VCs make their investment when the company's performance reflects the middle part of this curve. When investing during the firm's adolescent period, it is very hard to have a clear vision of which companies will be the winners or the losers, since their financial performance and growth rates look identical (the curve has a positive slope in both cases).³³ From here there is enormous risk associated with the investment.

Figure 3 – Financial alternatives along entrepreneurial lifecycle.



³⁰ Business Dictionary, 'Lead investor'.

³¹ Zider, 'How Venture Capital Works', p. 136.

³² Invest Europe, 'Guide to Private Equity and Venture Capital for Pension Fund', *Invest Europe Research Publications*, 2016, p. 5, <https://www.investeurope.eu/research/invest-europe-publications/#i> (accessed April 2017).

³³ Zider, 'How Venture Capital Works', p. 133.

Box 1.2 – Start-up funding

Figure 3 shows the different financial sources along the entrepreneurial life cycle.

After bootstrapping, where entrepreneurs collect money from their families, friends, their savings, and credit card loan, the first investors who start to provide money are Angel investors, during the prototype phase. These investors usually provide from US\$25,000 to US\$500,000. They acquire shares from the entrepreneurs, but their percentage is relatively small compared to the total ownership of the company.

When the venture starts to grow and enters in the start-up and early growth stages, early VCs begin to invest in them. The money invested at these stages from VCs range from US\$500,000 to US\$3 million. In these phases, groups of business angels could invest too.

In the expansion phase, VCs' investments range from US\$3 million to US\$30 million. Commercial bank financing could be phased starting from the early growth stage. However, the bulk of their investments are done in the maturity phase. Banks always have an indirect presence during the whole lifecycle, since they usually hold quotas of VC funds.

Each VC financing round is named with a letter, depending on the time of investment. For example, a Series A round refers to investment by angel groups and/or VCs in a fast growth company, subsequent to financing by founders and their friends and families (Seed stage).¹ A Series B round is the provision of further funds by VCs and organized angel groups after the A round of financing.² Subsequent rounds are called C, D and so on. The table³ below shows the typical size of each round.

Round	Range of investment
Series A	US\$2-US\$10 million
Series B	US\$11-US\$50 million
Series C	US\$51-US\$100 million

¹ Thomson Reuters, '2016 Yearbook', p. 83.

² Ibid, p. 83.

³ The Tauri Group, 'Start-Up Space: Rising Investment in Commercial Space Ventures', *Bryce Space and Technology Reports*, 2016, p. 7, <https://brycetechnology.com/reports.html> (accessed March 2017).

Investors can choose two different investment structures, the milestone financing or the round financing. The milestone financing consists of submitting the first investment and contextually scheduling the future money injections.³⁴ Follow-on investments are contingent upon the achievement of specific conditions provided for in the contract (they usually consist of technological or operational goals), and are made at a predetermined price.³⁵ However, failure to meet a milestone

³⁴ C. J. Cuny and E. Talmor, 'The Staging of Venture Capital Financing: Milestone vs. Rounds', *EFA 2005 Moscow Meetings Paper*, 2005, p. 1.

³⁵ Ibid, p. 1.

does not automatically imply that investors will not supply the promised money that is contingent on that milestone: VCs may decide to invest anyway, maybe trying to renegotiate the terms of the agreement.³⁶

If no milestones are included in the contract, then the investment structure is the round financing. In this case, the future investments will depend on the firm's performances.³⁷ In order to make a new round, VCs and the firm firstly have to agree upon the valuation of the company (the pre-money valuation³⁸).³⁹ When a value is set, the subscription value for the new shares is computed by dividing the pre-money valuation by the fully diluted number of shares of the company immediately prior to the time of completion.⁴⁰

VCs carry on investments in a firm until it hits a certain dimension in terms of value and credibility, i.e. the company reaches maturity.⁴¹ At this point, VCs search for a buyer in order to sell the firm and consequently realize the desired capital gains.⁴² Exit can be performed through the sale to another corporation or through IPO.⁴³ VCs may opt for secondary sales, where just the VC firm (and not the entrepreneur) sells its share to another company or another investor.⁴⁴ Other possibilities are

Box 1.3 – An example of round financing: Skybox Imaging

'Skybox Imaging is a space-based company founded in 2009 with the intention of building and launching small satellites in constellation form to provide frequent Earth imagery updates to customers around the globe. It received a multi-stage VC investment.'

Its first round of VC funding was a \$3 million Series A tranche (by Khosla Ventures) in 2009, followed by an \$18 million Series B funding (by Khosla Ventures and Bessemer Venture Partners) in 2010. In 2012, Canaan Partners and Norwest Venture Partners joined the original two firms, leading a Series C funding that raised an additional \$70 million (for a total of \$91 million in VC funding). The exit for these VCs took place in 2014 when Google bought Skybox Imaging for \$478 million.'

Source: The Tauri Group, 'Start-Up Space', p. 7.

³⁶ New Zealand Venture Capital Association, Inc. and Simpson Grierson, 'A Guide to Venture Capital Term Sheets', *New Zealand Investment Fund Publications*, 2013, p. 7, <http://www.nzvif.co.nz/media/publications/category/guide> (accessed March 2017).

³⁷ Cuny and Talmor, 'The Staging of Venture Capital Financing', p. 2.

³⁸ 'The pre-money valuation should be distinguished from the post-money valuation, which refers to the valuation of the company immediately following (and which includes the investment proceeds from) the new round.' Source: New Zealand Venture Capital Association and Simpson Grierson, 'A Guide to Venture Capital Term Sheets', p. 7.

³⁹ New Zealand Venture Capital Association and Simpson Grierson, 'A Guide to Venture Capital Term Sheets', p. 7.

⁴⁰ Ibid, p. 7.

⁴¹ Zider, 'How Venture Capital Works', p. 132.

⁴² Ibid, p. 132.

⁴³ Cumming, 'Introduction', in *The Oxford Handbook of Venture Capital*.

⁴⁴ Ibid.

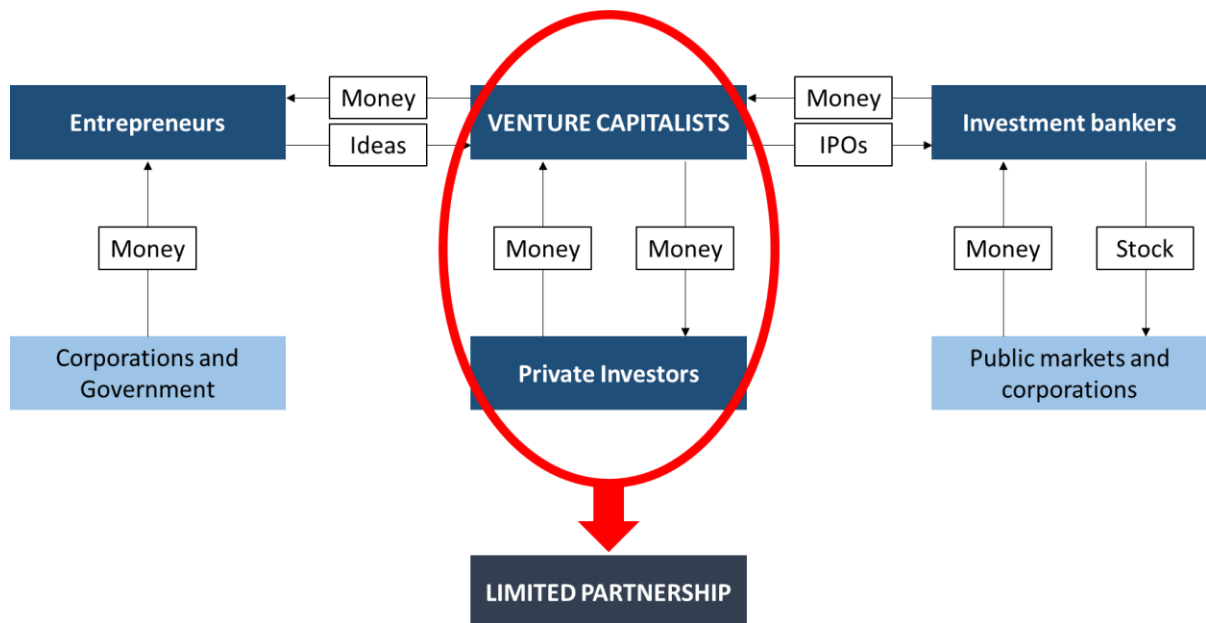
buybacks (repurchases of the VCs' stake by the entrepreneur), and write-offs or liquidations.⁴⁵ Usually only one company in six ever goes public and one in three is acquired.⁴⁶

1.2 Limited Partnership

Within the market, VCs serve as a catalyst between three different players (Figure 4):

- **Private Investors.** The first relationship to be established is between VCs and the institutional investors who want to put money into innovative projects.
- **Entrepreneurs.** They need funds in order to develop their projects and they will obtain the financing if what they propose looks attractive for VCs. They can receive money also from corporations and the government.
- **Investment bankers.** They act during the company's IPO. Their task is to place stocks for public investors and corporations.

Figure 4 – How the venture capital industry works.



Source: Zider, 'How Venture Capital Works', p. 135.

In the US market, between the VC firm and the investors a Limited Partnership is established. A Limited Partnership is a legal entity, within which investors act as Limited Partners (LPs) and the firm itself as the General Partner (GP).⁴⁷ Examples of LPs are public pension funds, corporate pension funds, insurance companies, family offices, endowments, and foundations.⁴⁸ Each time a VC firm wants to create a new fund, it has to gather money from its investors through what are referred to as "capital calls".⁴⁹ The GP manages the investments and bears all the risks from a legal point of view for the actions taken by the Partnership, while the LPs suffer only the capital losses in case of failure of the

⁴⁵ Cumming, 'Introduction', in *The Oxford Handbook of Venture Capital*.

⁴⁶ Thomson Reuters, '2016 Yearbook', p. 7.

⁴⁷ Ibid, p. 7; 90.

⁴⁸ Ibid, p. 7.

⁴⁹ Thomson Reuters, '2016 Yearbook', p. 7.

investment.⁵⁰ Regarding gain splitting, the LPs receive the invested capital plus 70 percent to 80 percent of the capital gains derived from the appreciation of the portfolio, as well as tax benefits.⁵¹ The GP takes only a management fee (two-three percent of the pool's total capital)⁵² and a percentage of capital gains, called carried interest.⁵³ Such percentage is equal to 20 percent at minimum, but it can reach the 25-30 percent when the fund has a strong reputation thanks to its successes.⁵⁴

Since this Limited Partnership structure exists, the allocation of resources involves a two-stage process. First, the private investors (LPs) choose which country they want to invest in and then which VC fund they will entrust money to.⁵⁵ Substantially, LPs have to assess the risk capital "absorption capacity" of a country, which is the probability for that country of new entrepreneurial activity.⁵⁶ The nature of the investment (multiple but small amount of money financing different start-ups) makes an indirect investment more viable, delegating transaction making, monitoring and value adding to the fund, which is more efficient in doing these tasks.⁵⁷ After receiving the commitment, the VC fund (GP) decides in which companies it will invest the money, differentiating the portfolio in order to minimize the risk of failure.⁵⁸ VC partners are usually actively involved in a company's life, typically occupying a board seat and providing strategic advice, as well a network of alliances for expertise and further funding.⁵⁹ This is the reason why VC investment is often called 'smart money'.⁶⁰

1.3 Ownership Structure

From the point of view of organizational structure, VC firms can differ for the type of ownership. At a more general level, they can be split in two main groups: independent VCs, who invest money provided by institutional investors and wealthy individuals; and captive VCs, who are controlled by or just linked to other institutions that can shape in a different way their funding and strategic decisions.⁶¹

Captive VCs have a more relevant role in non-US countries, where the VC market may not be mature or just in an embryonic phase.⁶² The three main types of captive VCs are related to corporations, banks and governments.

⁵⁰ Thomson Reuters, '2016 Yearbook', p. 90.

⁵¹ Zider, 'How Venture Capital Works', p. 135.

⁵² Ibid, p. 135.

⁵³ Thomson Reuters, '2016 Yearbook', p. 88.

⁵⁴ Ibid, p. 85.

⁵⁵ A. P. Groh, 'The Capital Flow from Institutional Investors to Entrepreneurs', in D. Cumming (ed.), *The Oxford Handbook of Venture Capital*, 2012. Available from: Oxford Handbook Online (accessed February 2017).

⁵⁶ Ibid.

⁵⁷ Ibid.

⁵⁸ Ibid.

⁵⁹ Thomson Reuters, '2016 Yearbook', p. 6.

⁶⁰ Cunny and Talmor, 'The Staging of Venture Capital Financing', p. 1.

⁶¹ M. Da Rin, T. F. Hellmann and M. Puri, 'A Survey of Venture Capital Research', *NBER Working Paper Series*, no. 17523, 2011, p. 49.

⁶² Da Rin, Hellmann and Puri, 'A Survey of Venture Capital Research', p. 49.

1.3.1 Corporate Venture Capital Firms

Corporations can generally invest in companies directly or, alternatively, through a separate but wholly-owned body, as in the case of Google Ventures and Intel Capital.⁶³ Such companies, which are the investment arms of large companies that want to make investments in the form of VC, are called Corporate VC firms (CVCs).

The CVCs share with the independent VCs the goal of maximizing investment returns, but differ from them in aiming to exploit the synergies that may exist between the parent company's activity and the backed firm.⁶⁴ For a clear understanding of the strategies that both CVCs and entrepreneurs may choose, it is better to outline first the dimensions along which strategic choices are made.⁶⁵

- a) The nature of the product offered by the backed firm in relation to the corporation's business. Specifically, if it is a complement or a substitute.⁶⁶
- b) The economic benefit in terms of valuation and added value.

In particular, if the product is a complement, CVCs have stronger incentives to offer a higher valuation for the product, considering the relevant exploitable synergies, and consequently are likely to put more effort in the value-adding process.⁶⁷ On the other hand, if the product is a substitute, a further distinction has to be made between mildly harmful products and very harmful ones for the corporation.⁶⁸ In the first case, the entrepreneur is faced with a trade-off: choosing a CVC means getting a higher valuation, since the potential threat of the product induces the corporation to offer more; choosing a VC results in getting more support in the process of product development and enhancement.⁶⁹ In the second case, CVC and VC will syndicate the deal⁷⁰, with the independent VC covering the role of "lead" investor, while the CVC is relegated to a more passive role.⁷¹ In fact, the CVC's main role is to hold as much equity as possible, in order to reduce the VC's stake in the new venture: this strategy narrows the VC's gain from supporting the company and thereby avoids an excessive cannibalization of CVC's products.⁷² The distinction between complement and substitute

⁶³ Da Rin, Hellmann and Puri, 'A Survey of Venture Capital Research', p. 49.

⁶⁴ T. Hellmann, 'A Theory of Strategic Venture Investing', *Journal of Financial Economics*, vol. 64, 2002, pp. 285-314, cited in M. Da Rin, T.F. Hellmann and M. Puri, *A Survey of Venture Capital Research*, p. 50.

⁶⁵ Ibid, p. 50.

⁶⁶ In consumer theory, substitute goods (or substitutes) are products that a consumer perceives as similar or comparable, so that having more of one product makes them desire less of the other product. Formally, X and Y are substitutes if, when the price of X rises, the demand for Y rises. On the other hand, complementary goods (or complements) are products that experience a joint demand: when the price of a good decreases, the demand for the other good increases. This means that if goods A and B are complements, an increase in the price of A will result in a lower demand for both the goods. Source: <https://en.wikipedia.org>.

⁶⁷ Hellmann, cited in M. Da Rin, T.F. Hellmann and M. Puri, *A Survey of Venture Capital Research*, p. 50.

⁶⁸ Ibid, p. 50.

⁶⁹ Ibid, p. 50.

⁷⁰ Ibid, p. 50.

⁷¹ R. Masulis and R. Nahata, 'Financial contracting with strategic investors: evidence from corporate venture capital backed IPOs', *Journal of Financial Intermediation*, vol. 18, 2009, pp. 599-631, cited in M. Da Rin, T.F. Hellmann and M. Puri, *A Survey of Venture Capital Research*, p. 53.

⁷² T. Hellmann, 'A Theory of Strategic Venture Investing', *Journal of Financial Economics*, vol. 64, 2002, p. 287.

also affects the assignation of the board seats: CVCs get more seats when the product is a complement.⁷³ These dynamics are confirmed by most of the literature about VCs.⁷⁴

The literature reveals another result of enormous interest: an analysis of a sample of 177 CVC-backed companies shows that 45 percent of them received money from CVCs whose parent companies have a competitive know-how.⁷⁵ This may be explained by two reasons: financial constraints (i.e. difficulty in finding money from other sources) and/or benefits from getting a certification from reputed incumbents.⁷⁶

Another distinctive characteristic concerns the timing of the investment and the targeted market: CVCs invest in earlier stage than VCs, and in less mature markets and more R&D intensive industries.⁷⁷ Therefore, they are more tolerant of failure, since a less mature market means greater uncertainty, which derives from the fact that consumers' preferences are not so clear in this case.⁷⁸

In the US, according to NVCA's data (Figure 5; see appendix 1 for further details), in a situation characterized by a general rise in the value and the number of VC agreements, the annual percent value of VC deals in which CVCs participated has risen since 2009 and it has reached a higher level than 2006. A similar trend is identifiable for the percentage of CVC deals, even if their share with respect to the total VC activity is now lower than 2006. This means that on average CVC deal values have increased and they worth a lot compared to the other VC activities. The situation is different in Europe: even with a general growth in value and number, CVC investments have fluctuated more in the last seven years than in the US and (in percentage of the total VC activity) they have showed a downward trend in 2012-2015 (Figure 6; see appendix 1 for further details).

⁷³ Masulis and Nahata, cited in M. Da Rin, T.F. Hellmann and M. Puri, *A Survey of Venture Capital Research*, p. 53.

⁷⁴ See also P. Gompers and J. Lerner, 'The Determinants of Corporate Venture Capital Success', in R. Morck (ed.), *Concentrated Corporate Ownership*, Chicago, University of Chicago Press, 2000.

⁷⁵ Masulis and Nahata, cited in M. Da Rin, T.F. Hellmann and M. Puri, *A Survey of Venture Capital Research*, p. 53.

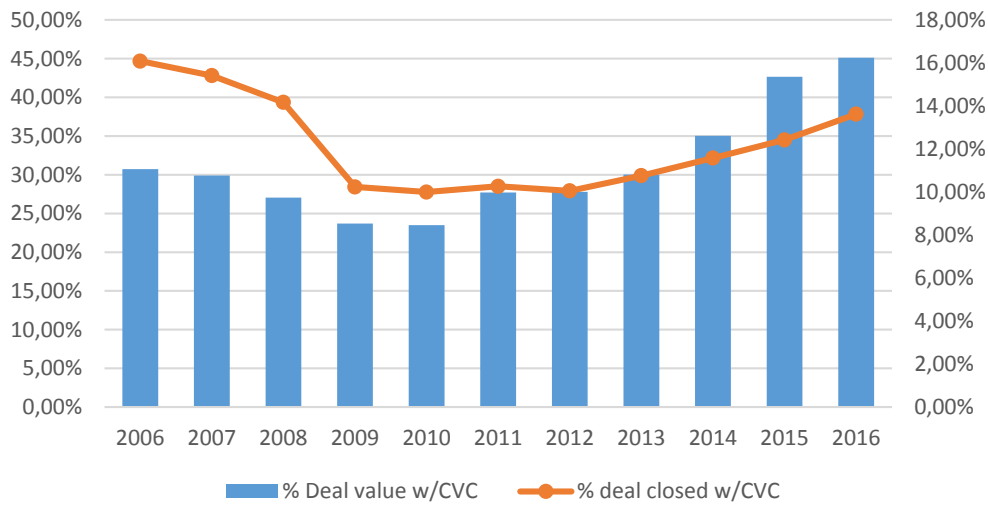
⁷⁶ Ibid, p. 53.

⁷⁷ T. Chemmanur, E. Loutskina and X. Tian, 'Corporate venture capital, value creation, and innovation', unpublished working paper, 2011, cited in M. Da Rin, T.F. Hellmann and M. Puri, *A Survey of Venture Capital Research*, p. 54.

⁷⁸ Ibid, p. 54.

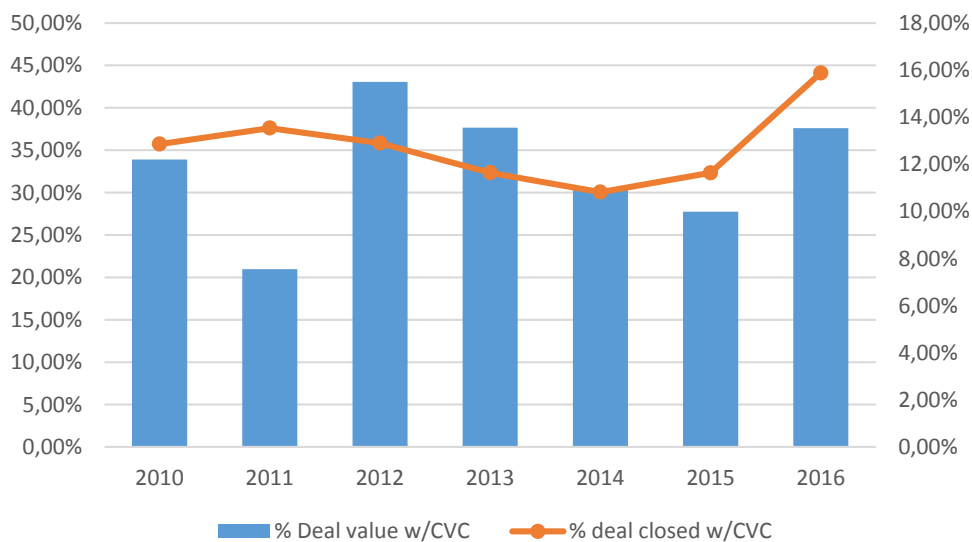
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Figure 5 – Annual total values and number of CVC deals in the US (as percentage of total VC deals).



Source: PitchBook Data, Inc., 'VC Valuation Report: 2016 Annual', *PitchBook Reports*, 2017, pp. 4; 17, <http://pitchbook.com/news/reports> (accessed April 2017).

Figure 6 – Annual total values and number of CVC deals in the Europe (as percentage of total VC deals).



Source: PitchBook Data, Inc., 'European Venture Report: 2017 1Q', *PitchBook Reports*, 2017, pp. 4; 7, <http://pitchbook.com/news/reports> (accessed April 2017).

1.3.2 Bank-owned Venture Capital Firms

Banks can use structure similar to corporations in order to make VC investments (e.g. Citigroup's "Citi Venture Capital International").⁷⁹ However, for the bank-owned VC firms (BVCs) the distinction between complement and substitute product no longer holds, since there is no competition between portfolio companies and the bank (banks only look at return on investments and maximization of the

⁷⁹ Da Rin, Hellmann and Puri, 'A Survey of Venture Capital Research', p. 49.

portfolio value, they do not conduct businesses that may be in conflict with the backed enterprises).⁸⁰ An analysis conducted on the deals reached by BVCs in the US between 1980-2000 has revealed some differences between BVCs and independent VCs, which can be summarized as follows: preference for investments in later stages, deals characterized by larger syndicates, more investments in industries with high debt and leverage level.⁸¹ The preference for investments in later stages holds also for non-US countries, such as Germany, Israel, Japan and UK.⁸² Other results from the literature show that past investments from BVCs in a company affect the ability of that company to get a future loan from the same bank.⁸³ These loans are also granted at lower interest rates.⁸⁴ The BVCs have a greater role in non-US markets, although it remains unclear how effectively banks are promoting the VC market.⁸⁵

1.3.3 Government-sponsored Venture Capital Firms

Even the government can support companies through development banks (e.g. Business Development Bank of Canada) or through indirect programs (e.g. Australia's Innovation Investment Fund Program).⁸⁶ As well as the direct ownership of VC funds, government can support VC firms through tax credits or matching funds that increase private capital commitments.⁸⁷ It is not clear how the government may influence investment decisions of these VCs (it may vary according to the program).⁸⁸ It is also possible that the Government-sponsored VC firms (GVCs) have to pursue not only financial returns, but also other policy goals, such as investing in the local economy, creating jobs and supporting the development of national or regional technology hubs.⁸⁹

With regards performance, the literature shows that firms funded by both VCs and GVCs usually raise more money than companies backed only by VCs, while those whose stakes are held just by GVCs raise significantly less.⁹⁰ The former also has higher exit rates.⁹¹ When companies are backed only by government, they show very low performance.⁹² At an aggregate level, a very important result is that

⁸⁰ Da Rin, Hellmann and Puri, 'A Survey of Venture Capital Research', pp. 55-56.

⁸¹ T. Hellmann, L. Lindsey and M. Puri, 'Building Relationships Early: Banks in Venture Capital', *Review of Financial Studies*, vol. 21, 2008, pp. 513-541, cited in M. Da Rin, T. F. Hellmann and M. Puri, *A Survey of Venture Capital Research*, p. 56.

⁸² C. Mayer, K. Schoors and Y. Yafeh, 'Sources of funds and investment activities of venture capital funds: evidence from Germany, Israel, Japan and the United Kingdom', *Journal of Corporate Finance*, vol. 11, 2005, pp. 586-608, cited in M. Da Rin, T. F. Hellmann and M. Puri, *A Survey of Venture Capital Research*, p. 56.

⁸³ Hellmann, Lindsey and Puri, cited in M. Da Rin, T. F. Hellmann and M. Puri, *A Survey of Venture Capital Research*, p. 56.

⁸⁴ Ibid, p. 56.

⁸⁵ Da Rin, Hellmann and Puri, 'A Survey of Venture Capital Research', p. 56.

⁸⁶ Da Rin, Hellmann and Puri, 'A Survey of Venture Capital Research', p. 57.

⁸⁷ Ibid, p. 57.

⁸⁸ Ibid, p. 57.

⁸⁹ Ibid, p. 57.

⁹⁰ J. Brander, Q. Du and T. Hellmann, *The effects of government-sponsored venture capital: international evidence*, unpublished working paper, 2011, cited in M. Da Rin, T. F. Hellmann and M. Puri, *A Survey of Venture Capital Research*, p. 57.

⁹¹ Ibid, p. 57.

⁹² J. Brander, Q. Du and T. Hellmann, *Governments as venture capitalists: striking the right balance*, 2010, cited in M. Da Rin, T. F. Hellmann and M. Puri, *A Survey of Venture Capital Research*, p. 58.

investments by GVCs predict subsequent increases in the investments of private VCs.⁹³ So GVC support does not seem to be a substitute for independent VC financing.

Box 1.4 – The Innovation Investment Fund Program

The Innovation Investment Fund (IIF) is an Australian VC program launched in 1998 that provided new innovation funds and fund managers with expertise in early-stage VC funding.¹ Its mission was to support early-stage firms until to the commercialization of their R&D projects, also with the help of co-investments from private investors.²

The IIF aimed to address the entrepreneurial obstacles linked to capital/management constraints and to boost the rise of new companies that want to commercialise research and development.³

Other goals were developing fund managers with experience in the early stage venture capital industry and building a self-sustaining, early stage VC industry in Australia.⁴

Until 2010 it had licensed 13 VC innovation funds that had helped 99 Australian companies to commercialise their original products.⁵ In particular, it gathered US\$524 million of government and private capital to address very interesting early-stage companies.⁶ SEEK and Pharmaxis are among the firms backed by the Program.

Unfortunately, the Program was cut in 2014 because it did not respond anymore to the market needs. As written by Adrian Bunter, the executive director of Venture Advisory and member of the Executive Committee of Sydney Angels:

‘In the late 90s and early 2000s it was expensive to start companies and build them, especially in the tech space, and the program structure assisted by creating venture capital funds that could. However, the development of the internet and technological change has greatly reduced the costs associated with launching many companies [...] The ability to raise funds for commercialising tech business has changed significantly since 1998. The early stage space has significantly improved with a number of formal angel groups around the country providing funds to high potential companies. There are a number of sources for larger funding.’⁷

¹ Bulletpoint, ‘Innovation Investment Fund’, *Bulletpoint*, [website], <http://www.bulletpoint.com.au/iif/> (accessed April 2017).

² Ibid.

³ Ibid.

⁴ Ibid.

⁵ Pattens Group, ‘Innovation Investment Fund Report’, *Pattens Group*, [website], <http://www.pattens.com/innovation-and-rd-grants/innovation-investment-fund-report/285/> (accessed April 2017).

⁶ Ibid.

⁷ A. Bunter, ‘How the Innovation Investment Fund failed to innovate and contributed to the funding gap... plus a solution’, *LinkedIn*, [social network], <https://www.linkedin.com/pulse/20140531061859-48894057-how-the-innovation-investment-fund-failed-to-innovate-and-contributed-to-the-funding-gap-plus-a-solution> (accessed April 2017).

1.4 Investment criteria

As already mentioned previously, the allocation of capital from institutional investors to entrepreneurs takes place within a two-step process. In the first stage, investors (LPs) decide in which country they will invest and to which fund they will entrust their money, according to criteria that refers respectively to the country's economic, financial and legal framework, and the fund's performance. In the second stage, after receiving the commission from investors, the fund selects the most attractive and potentially successful business plans among those submitted to it.

The literature about VC activity has tried to clearly define the decision-making criteria used in both stages of the capital allocation, through different analytic approaches and sampling methods. However, it is very challenging to arrange the decision-making process within a well-defined scheme, since some results may contradict previous research and adopted criteria may change over time. Despite these problems, literature gives us a useful guideline to understand how players within the market decide.

1.4.1 From LPs to VC funds

The most straightforward index to make a good prediction about the VC market is a country's economic growth.⁹⁴ Investors have more incentives to bring their money into a territory that is experiencing great progress, since it pre-empts more business opportunities for entrepreneurs and higher investment returns.⁹⁵

However, economic growth is the result of the combination of a wider range of factors, that may individually concur with the formation of a vibrant VC market. Some of these factors recur many times in the literature. They include:

- **Strong public stock market.** VCs always plan the future exit from their investments. The preferred method of disinvestment is the IPO, i.e. the allocation of company's share to the public.⁹⁶ If the market is liquid, i.e. the shares can be easily sold, the IPO has a high probability of success.⁹⁷ Consequently, investors have more chance to realize capital returns. Countries characterized by a bank-centred system do not benefit from a strong stock market, so they do not provide the proper environment for the creation of an efficient VC infrastructure.⁹⁸ Moreover, relying just on banks for the support to businesses is damaging for the entrepreneurial activity, since they reward entrepreneurs less richly and penalize failure more severely.⁹⁹

⁹³ B. Leleux and B. Surlemont, 'Public versus private venture capital: seeding or crowding out? A pan-European analysis', *Journal of Business Venturing*, vol. 18, 2003, pp. 81-104, cited in M. Da Rin, T. F. Hellmann and M. Puri, *A Survey of Venture Capital Research*, p. 58.

⁹⁴ Groh, 'The Capital Flow from Institutional Investors to Entrepreneurs', *The Oxford Handbook of Venture Capital*.

⁹⁵ Ibid.

⁹⁶ Ibid.

⁹⁷ Ibid.

⁹⁸ A. P. Groh et al., 'The Venture Capital and Private Equity Country Attractiveness Index: 2016 Annual', *IESE Blog Network*, 2016, p. 9, <http://blog.iese.edu/vcpeindex/> (accessed March 2017).

⁹⁹ Ibid, p. 9.

- **Maturity of the VC market.** Annual VC investments seems to be a function of investments in the previous year.¹⁰⁰ So if a country shows a big fundraising volume, it is reasonable to expect that this trend will continue next year. Another indicator of the maturity of the market is the number of players and deal-supporting institutions, such as law firms, investment banks, mergers and acquisitions boutiques, auditors, and consultants.¹⁰¹
- **Public investments.** A high level of public investment narrows the investment chances for VCs, fostering tougher competition with higher valuation and diminishing returns.¹⁰² Public subsidies are less costly than VC money and if policymakers want to boost local VC activity, they need to carry out specific policies to improve start-up and investment conditions.¹⁰³
- **Country's legal framework.** A better regulatory system and strong law enforcement facilitates investment. In particular, weak property rights curb the reinvestment of profits in start-ups.¹⁰⁴ The bankruptcy law affects the level of investments too: if it is more favourable to entrepreneurs, it facilitates entrepreneurial activity, so there are more opportunities to invest.¹⁰⁵ Finally if the level of investor protection is high, the cost of capital is lower.¹⁰⁶
- **Conditions of national labour market.** Investors have less presence in countries with high protection in the labour market.¹⁰⁷
- **Bureaucracy.** It takes the form of excessive rules and procedural requirements, multiple institutions from which approvals are needed, and numerous documentation requirements.¹⁰⁸ A high level of bureaucracy discourages entrepreneurs and demand for risk capital.¹⁰⁹
- **Tax regime.** The tax system affects both market entries and exit, i.e. it changes entrepreneurs' incentives.¹¹⁰ On the other hand, it is more difficult to spot the dynamics that link it to VC

¹⁰⁰ M. Balboa and J. Martí, 'An integrative approach to the determinants of private equity fundraising', *SSRN Working Paper*, no. 493344, 2003, cited in Groh, 'The Capital Flow from Institutional Investors to Entrepreneurs', *The Oxford Handbook of Venture Capital*.

¹⁰¹ Groh, 'The Capital Flow from Institutional Investors to Entrepreneurs', *The Oxford Handbook of Venture Capital*.

¹⁰² J. Armour and D. Cumming, 'The legislative road to Silicon Valley', *Oxford Economic Papers*, vol. 58, 2006, pp. 596–635, cited Groh, 'The Capital Flow from Institutional Investors to Entrepreneurs', *The Oxford Handbook of Venture Capital*.

¹⁰³ Groh, 'The Capital Flow from Institutional Investors to Entrepreneurs', *The Oxford Handbook of Venture Capital*.

¹⁰⁴ S. H. Johnson, J. McMillan and C. M. Woodruff, 'Property rights, finance and entrepreneurship', *SSRN Working Paper*, no. 198409, 1999, cited in Groh, 'The Capital Flow from Institutional Investors to Entrepreneurs', *The Oxford Handbook of Venture Capital*.

¹⁰⁵ D. Cumming, 'Adverse selection and capital structure: Evidence from venture capital', *Entrepreneurship Theory and Practice*, vol. 30, 2006, pp. 155–183, cited in Groh, 'The Capital Flow from Institutional Investors to Entrepreneurs', *The Oxford Handbook of Venture Capital*.

¹⁰⁶ R. La Porta, F. Lopez-de-Silanes, A. Shleifer and R. Vishny, 'Investor protection and corporate valuation', *Journal of Finance*, vol. 57, 2002, pp. 1147–1170, cited in Groh, 'The Capital Flow from Institutional Investors to Entrepreneurs', *The Oxford Handbook of Venture Capital*.

¹⁰⁷ Groh, 'The Capital Flow from Institutional Investors to Entrepreneurs', *The Oxford Handbook of Venture Capital*.

¹⁰⁸ C. C. Baughn, and K. E. Neupert, 'Culture and national conditions facilitating entrepreneurial start-ups', *Journal of International Entrepreneurship*, vol. 1, 2003, pp. 313–330, cited in Groh, 'The Capital Flow from Institutional Investors to Entrepreneurs', *The Oxford Handbook of Venture Capital*.

¹⁰⁹ Ibid.

¹¹⁰ Groh et al., 'The VCPE Country Attractiveness Index', p. 10.

investments.¹¹¹ In fact, some countries show both a relatively high corporate income tax rates and a very large VC investments, and vice versa.¹¹² In general, developed countries are characterized by higher tax brackets, but also more VC investments: it seems that taxes do not strongly affect VC activity¹¹³, unless taxes are on capital gains.¹¹⁴

- **Access to viable investments.** Managing a fund is costly, so if the expected deal flow is not large, incentives to invest are lower, since covering all the management fees becomes more challenging.¹¹⁵
- **R&D culture.** It plays a vital role, especially in universities and international laboratories.¹¹⁶

Both industrial and academic R&D expenditure is significantly correlated with VC.¹¹⁷

Some of the criteria identified by the literature have been confirmed by Groh and Liechtenstein through a survey conducted on institutional investors in 2011. In particular, investors' answers showed that the most important factors for them are primarily the legal system, followed by the level of human capital (as presence of qualified GP and quality of company's management) and the expected deal flow.¹¹⁸

The survey was also a basis for the construction of the Venture Capital Country Attractiveness Index. The index is based on six key drivers (Table 1), reflecting some of the criteria mentioned above.

Table 1 – Key drivers of the VCPE Country Attractiveness Index.

Key Drivers	Description
Economic Activity	It captures the state of a country's economy (i.e. the GDP, inflation levels and unemployment levels).
Entrepreneurial Culture and Deal Opportunities	It reflects the country's capacity for innovation and R&D, as well as the ease of starting and running and closing businesses in terms of time, costs and administrative requirements, and the quality of the IT infrastructure. It is constructed also taking into account the number of articles from scientific and technical journal and the amount of corporate investment in R&D.

¹¹¹ Groh et al., 'The VCPE Country Attractiveness Index', p. 10.

¹¹² Ibid, p. 10.

¹¹³ Ibid, p. 10.

¹¹⁴ P. Gompers and J. Lerner, 'What drives venture fundraising?', *Brooking Papers on Economic Activity, Microeconomics*, July 1998, pp. 149–192, cited in Groh, *The Oxford Handbook of Venture Capital*.

¹¹⁵ G. Chemla, 'The determinants of investment in private equity and venture capital: Evidence from American and Canadian pension funds', *SSRN Working Paper*, no. 556421, 2005, cited in Groh, 'The Capital Flow from Institutional Investors to Entrepreneurs', *The Oxford Handbook of Venture Capital*.

¹¹⁶ W. Megginson, 'Toward a global model of venture capital?', *Journal of Applied Corporate Finance*, vol. 16, 2004, pp. 89–107, cited in Groh, 'The Capital Flow from Institutional Investors to Entrepreneurs', *The Oxford Handbook of Venture Capital*.

¹¹⁷ Gompers and Lerner, cited in Groh, 'The Capital Flow from Institutional Investors to Entrepreneurs', *The Oxford Handbook of Venture Capital*.

¹¹⁸ A. P. Groh and H. Liechtenstein, 'International allocation determinants for institutional investments in venture capital and private equity limited partnerships', *International Journal of Banking, Accounting and Finance*, vol. 3, no. 2–3, 2011, pp. 176–206, cited in in Groh, *The Oxford Handbook of Venture Capital*.

Depth of Capital Markets	It captures the size (as a function of market capitalization and number of listed domestic companies) and liquidity of the stock market, and level of IPO and M&A, computed through data on market volume and number of deals.
Investor Protection and Corporate Governance	It takes into account the level of corporate governance, security of property rights, quality of legal enforcement and regulatory quality within a country.
Taxation	It assesses a country's tax incentives and administrative tax burdens. It is built on the number of tax payments and the time spent on tax issues.
Human and Social Environment	It incorporates the quality of education and human capital, labour market rigidities, levels of bribery and corruption and costs of crime within a nation. In particular, labour market rigidities take into account: difficulty of hiring and firing, rigidity of hours, and firing costs.

Sources: (a) A. P. Groh, H. Liechtenstein and K. Lieser, 'What Makes a Country Attractive to VC Investors?', in *From Back to Basics: Global Venture Capital Insights and Trends Report 2010*, 2010, pp. 21-22.; (b) Groh et al., 'The VCPE Country Attractiveness Index', p. 17-21.

Regarding criteria used by LPs in selecting VC funds, the literature is very sparse. However, the results of the little research conducted can be summarized in the following points:¹¹⁹

- Historic fund performance.
- Firm's age and size: they positively affect fundraising.
- Fund's reputation: gained by successful exiting transactions via IPOs, it is used like a proxy for future performance.
- People and teamwork.

1.4.2 From VC funds to entrepreneurs

The second step of the process consists of the choice of an attractive business plan by the VC fund, who have received the commitment from the investors. Literature has detected some decisional criteria also at this stage of the allocation process.

VCs are generally more interested in the entrepreneur than the project itself: so the entrepreneur/team management quality is an aspect that may drive VC decisions.¹²⁰ In particular, the entrepreneur has to stand out for personal motivation, organizational/managerial skills, and executive/managerial experience.¹²¹ Moreover, VCs require that a start-up has a clear vision, that its project rides "megatrends" and can potentially conquer the market in an easy and quick way.

¹¹⁹ Groh, 'The Capital Flow from Institutional Investors to Entrepreneurs', in *The Oxford Handbook of Venture Capital*.

¹²⁰ I. C. Macmillan, R. Siegel and P. N. S. Narasimha, 'Criteria used by venture capitalists to evaluate new venture proposals', *Journal of Business Venturing*, vo. 1, no. 1, 1985, pp. 119–128, cited in Groh, 'The Capital Flow from Institutional Investors to Entrepreneurs', *The Oxford Handbook of Venture Capital*.

¹²¹ R. B. Robinson, Jr, 'Emerging strategies in the venture capital industry', *Journal of Business Venturing*, vol. 2, 1987, pp. 53–77, cited in Groh, 'The Capital Flow from Institutional Investors to Entrepreneurs', *The Oxford Handbook of Venture Capital*.

However, there are many difficulties in detecting a list of parameters: some authors try to find specific parameters, while others focus on designing a general decision-making process.

Box 1.5 – Profile of the ideal entrepreneur

‘From a venture capitalist’s perspective, the ideal entrepreneur:

- *is qualified in a “hot” area of interest,*
- *delivers sales or technical advances such as FDA approval with reasonable probability,*
- *tells a compelling story and is presentable to outside investors,*
- *recognizes the need for speed to an IPO for liquidity,*
- *has a good reputation and can provide references that show competence and skill,*
- *understands the need for a team with a variety of skills and therefore sees why equity has to be allocated to other people,*
- *works diligently toward a goal but maintains flexibility,*
- *gets along with the investor group,*
- *understand the cost of capital and typical deal structures and is not offended by them,*
- *is sought after by many VCs,*
- *has realistic expectations about process and outcome.’*

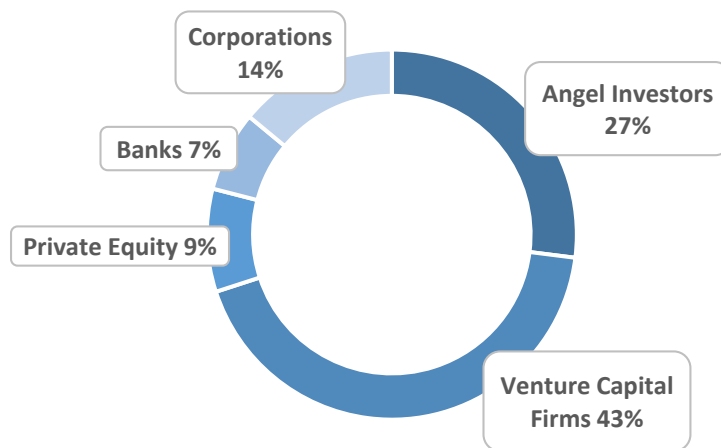
Source: Zider, ‘How Venture Capital Works’, p. 132.

2 VENTURE CAPITAL IN THE NEWSPACE ECONOMY

Since its creation in 2002, SpaceX (the famous American rocket and spacecraft manufacturer founded by Elon Musk) has proved to be a pioneer of a new business stream, which has been carried on by other well-known companies like OneWeb and Blue Origin. NewSpace is a non-traditional commercial-minded way of thinking about space, especially as a place to find fresh solutions to old problems – like the prevention of natural disasters – relying on increasingly low-cost technologies.¹²² In particular, nanotechnologies and new materials have provided innovative products and services that have reduced the costs associated with accessing space and have increased opportunities to gain socio-economic benefits through space exploitation. NewSpace is probably the future of our daily life: it will enable improved human activities for a wide range of fields (e.g., agriculture); it will bridge the “digital gap” by solving the problem of internet access in those regions not reached by broadband; and it will make the Internet of Things¹²³ (IoT) real.

To date big steps have been made towards the pictured situation. In fact, since 2000 a large number of new space start-ups investing in these new and relatively cheap tech projects has been founded. The sources of funding are diverse and include: Angel investors, VC firms, private equity firms, corporations, banks and public market. Venture Capitalists and Angel investors are the most substantial groups of investors: they account for 43 percent and 27 percent of all the investors active in the space sector respectively (Figure 7).

Figure 7 – Share of investors by type.



Source: The Tauri Group, ‘Start-Up Space’, p. 17.

These sources differ not only ontologically (they have different structures), but also for the amount of invested money and for the required return from the investment. Table 2 shows more deeply all investors’ characteristics, making easier the comparison.

¹²² Wikipedia, ‘New Space’, *Wikipedia*, [website], <https://en.wikipedia.org/wiki/NewSpace> (accessed March 2017).

¹²³ ‘Simply put, this is the concept of basically connecting any device with an on and off switch to the Internet (and/or to each other). This includes everything from cell phones, coffee makers, washing machines, headphones, lamps, wearable devices and almost anything else you can think of.’ For further details, see <https://www.forbes.com/sites/jacobmorgan/2014/05/13/simple-explanation-internet-things-that-anyone-can-understand/#5fc2c9281d09>

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Table 2 – Overview of Space Investors.

Type of Investor	Characterization of Investors	Typical Space Industry Investment	Investment Type	Examples of Transactions	Expected Return/ Exit Horizons
Angel Investors	High-wealth individuals or families seeking high returns through early stage investment	US\$50K - US\$1M	Equity	Space Angels Network and NanoRacks	5-10X investment/ 5-7 years
Venture Capital Firms	Groups of investors focusing on early stage, high growth ventures and accept a significant degree of risk	US\$2M - high tens of millions	Equity, preferred stock in several tranches (e.g., Series A, B, C)	Skybox Imaging with multiple VCs investing US\$91M	5X investment/5 years
Private Equity Firms	Large investment houses, which have multi-billion dollar investment funds - focus on established companies	US\$100M - US\$1B	Equity	Blackstone US\$200M investment in Sirius Sat Radio	3-5X investment/3-5 years
Corporations	<ul style="list-style-type: none"> – Large companies providing strategic investments to support large CapEx space projects – Internal R&D for special projects – Independent R&D as government contractor – M&A activity – Venture investing 	US\$100M - US\$1B	Equity and sometimes debt	Google US\$900M investment in SpaceX; SES investing US\$75M in O3b	Significantly less returns than for PE firms/horizon is over a long term
Banks	Private and government-backed banks providing substantial debt funding layered over equity	US\$100M - US\$1B	Debt, sometimes convertible into equity	Ex-Im Bank providing US\$525M in debt to finance ViaSat satellites	Straight-line interest rates (e.g., 5-10%)
Public Markets	Later stage funding vehicle for supplementary funding	US\$100M - US\$2B	Equity	Iridium raising US\$170M in an IPO	Serves as a vehicle to allow the earlier investors to exit

Source: The Tauri Group, 'Start-Up Space', p. 11.

The focus of investors, and in particular of VCs and angels, is on those companies that:

- *'Manufacture satellites, launch vehicles, or other space-based systems,*
- *Manufacture ground equipment,*
- *Provide services that rely on these systems, such as satellite TV, radio, and broadband,*
- *Provide analytic services based on data collected from space-based systems, either alone or in combination with terrestrial systems.'*¹²⁴

It is clear that the main part of investments relates to the manufacture of satellites (especially miniature satellites, as we will see later) and the launch-related services. The focus is in particular on the Low Earth Orbit (LEO). The term refers to an orbit altitude between 80 km and 2000 km.¹²⁵ The International Space Station¹²⁶ (ISS) is situated in LEO at an orbit altitude of 370-460 km.¹²⁷ The ISS represent a great opportunity to develop related-space commercial businesses, for this reason LEO is having a great success among the VCs.¹²⁸ In particular LEO has been primarily responsible for the 40 percent growth of number of satellites on orbit in the period 2011-2015 (there were 1381 operational satellites as of December 2015).¹²⁹

The satellite industry (which represents more than 60 percent of the global space revenues)¹³⁰ has experienced an incredible growth in the last years. Just for giving an idea, in 2015 investments in satellite manufacturing far exceeded investment in 2014. This is even more true for launch services linked to satellites (Figure 8). Making a comparison with the other space branches, it is straightforward to see that satellites and launches represent the relevant part of the VCs' and angels' investments. While launches have remained quite constant in the period 2011-2015 (with the exception of the aforementioned increase in 2015 compared to 2014), satellites increased considerably (with the exception of 2014, when the branch showed a deep decline in invested money). Figure 9 is quite profound: in 2011 the total amount did not exceed the US\$200 million, while in 2015 it was over US\$800 million.

Why is there this increasing interest in the LEO sector? The answer to this question lies in the technological trends that have characterized the recent years: the rise of miniature satellite technology allowing medium- and high-resolution images from earth observation activities to be achieved, together with the higher number of opportunities for launch, has met the new and growing

¹²⁴ The Tauri Group, 'Start-Up Space', p. 2.

¹²⁵ J. Lerner, A. Leamon and A. Speen, 'Venture Capital Activity in the Low-Earth Orbit Sector', in P. Besha and A. MacDonald (ed.), *Economic Development of Low Earth Orbit*, National Aeronautics and Space Administration, 2016, p. 68. Available from: NASA e-Books (accessed March 2017).

¹²⁶ 'The International Space Station (ISS) is a space station, or a habitable artificial satellite, in Low Earth Orbit. [...] The ISS serves as a microgravity and space environment research laboratory in which crew members conduct experiments in biology, human biology, physics, astronomy, meteorology, and other fields. The station is suited for the testing of spacecraft systems and equipment required for missions to the Moon and Mars.' For further details, see https://en.wikipedia.org/wiki/International_Space_Station.

¹²⁷ Lerner, Leamon and Speen, 'Venture Capital Activity in the Low-Earth Orbit Sector', in *Economic Development of Low Earth Orbit*, p. 68.

¹²⁸ Ibid, p. 64.

¹²⁹ K. Leininger, 'VCs in Space', *Audacy*, [website], 21 October 2016, <http://audacy.space/blog/2016/10/21/vcs-in-space> (accessed March 2017).

¹³⁰ The Tauri Group, 'State of the Satellite Industry Report', *SIA Website*, September 2014, p. 6, http://www.sia.org/wp-content/uploads/2014/05/SIA_2014_SSIR.pdf (accessed April 2017).

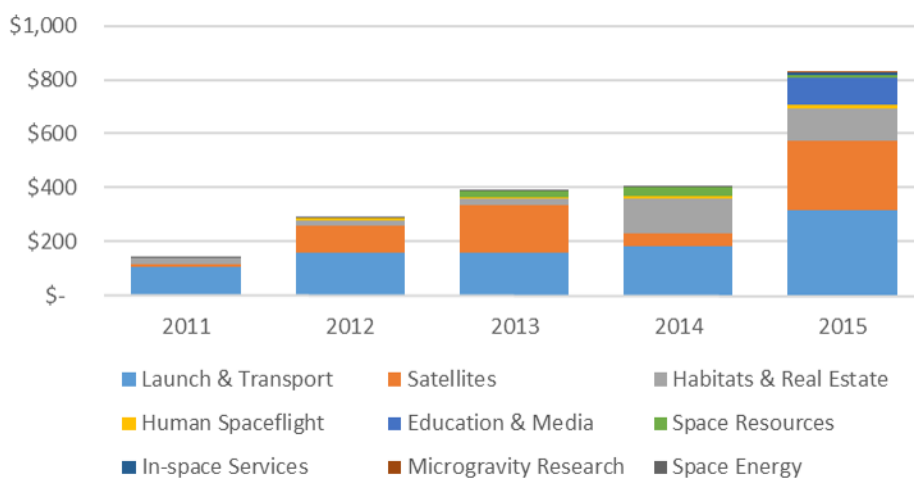
interest for “big data” analytics, that can be applied to a wide range of activities (e.g. agriculture, maritime, mining).¹³¹

Figure 8 – Investments in satellites and launch & transports (2014 vs. 2015).



Source: C. Anderson, ‘2015 An Epic Year For The Space Industry’, *Space Angels Network*, [website], 21 January 2016, <http://spaceangelsnetwork.com/2016/01/21/2015-an-epic-year-for-the-space-industry/> (accessed March 2017).

Figure 9 – VC and Angel investments in 2011-2015.



Source: Anderson, ‘2015 An Epic Year For The Space Industry’.

These points are in contrast with the historical trends that made the LEO sector unattractive to VCs, due in particular to the infrequent launch opportunities that made the huge financial effort completely prohibitive; high capital provision for satellite designs; regulatory barriers, and a lack of commercially viable applications.¹³²

These points will be developed in the next section.

2.1 A comparison between historic and recent drivers of LEO investments

As already discussed, many things have changed in the space sector with respect to a few years ago: the landscape that relied once on government money since economic opportunities for private investments were very scarce has been replaced by a new vibrant ecosystem, where VCs are increasingly putting money into new start-ups.

¹³¹ Lerner, Leamon and Speen, ‘Venture Capital Activity in the Low-Earth Orbit Sector’, in *Economic Development of Low Earth Orbit*, p. 62.

¹³² Ibid, p. 62.

Historically, investors' scepticism was justified by economic, legal and technological reasons. In particular, the main obstacles were the following.¹³³

- **High costs to access LEO.**¹³⁴ This is perhaps the major barrier that investors had encountered in the recent past. It was not only a matter of designing and manufacturing costs or launch-related expenditures, but also of the possibility of launch failure, which was not negligible. LEO launch failure had such enormous burden on companies' given that it could instantly bankrupt a young player in the market.
- **Launch Challenges.**¹³⁵ They were linked mostly to miniature satellites brought in orbit as "secondary payloads". In other words, they benefitted from a rideshare, joining a primary mission.¹³⁶ Being just a secondary payload on the launch vehicles, miniature satellites must adapt to primary mission's timetable and parameters.¹³⁷ However, secondary payloads were allowed only when there was extra capacity on the vehicle. Because of logistical problems, such as incompatible orbit destinations and a lack of available capacity, secondary payload launch opportunities have traditionally been "limited and sporadic".¹³⁸
- **Price opacity associated with launch.**¹³⁹ Opacity was another issue that increased the risk related to space investments and that consequently reduced the sector attractiveness for VCs.
- **Regulatory risks.**¹⁴⁰ There were a lot of regulatory uncertainty and compliance costs. For example, in the US the International Traffic in Arms Regulations (ITAR) made the space sector less competitive, since in order to export technology (or simply data related to that technology), an export license was necessary.¹⁴¹ This was very problematic for US global corporations and led to narrowing the global market share of the US in satellite manufacturing and launch services.¹⁴²
- **Uncertain exit routes and financing risks for the sector.**¹⁴³ LEO is a relatively young sector and probably the first successful exit was the one corresponding to the acquisition of Skybox Imaging by Google. Since investors want to plan their future exit also, the lack of an outstanding example of successful divestment has historically made the sector unattractive to venture capitalists. In addition to this, there were a lot of examples of investment failures:

¹³³ The information contained in the subsequent list, if not differently specified, comes entirely from Lerner, Leamon and Speen, 'Venture Capital Activity in the Low-Earth Orbit Sector', in *Economic Development of Low Earth Orbit*, pp. 70-74.

¹³⁴ See note 130.

¹³⁵ See note 130.

¹³⁶ Lerner, Leamon and Speen, 'Venture Capital Activity in the Low-Earth Orbit Sector', in *Economic Development of Low Earth Orbit*, p. 68.

¹³⁷ Ibid, p. 68.

¹³⁸ J. Andrews and J. Cannon, 'Routine Scheduled Space Access for Secondary Payloads', *Technical Session IX: From Earth To Orbit. SSC10-IX-8*, proceedings of the 24th Annual AIAA/USU Conference on Small Satellites, 2010, 1, cited in Lerner, Leamon and Speen, 'Venture Capital Activity in the Low-Earth Orbit Sector', *Economic Development of Low Earth Orbit*, p. 71.

¹³⁹ See note 130.

¹⁴⁰ See note 130.

¹⁴¹ WhatIs?.com, 'ITAR and EAR compliance', *WhatIs?.com*, [website], <http://whatis.techtarget.com/definition/ITAR-and-EAR-compliance> (accessed March 2017).

¹⁴² H. Davidson, J. Stone and I. Fichtenbaum, 'Part 2: Support Alternatives Versus NASA Commercialization Priorities', in *Supporting Commercial Space Development*, New York, NY: Near Earth LLC, November 2010, p. 8, cited in Lerner, Leamon and Speen, 'Venture Capital Activity in the Low-Earth Orbit Sector', *Economic Development of Low Earth Orbit*, p. 72.

¹⁴³ See note 130.

in fact, all the three largest LEO satellite firms of the late 1990s (Iridium, Globalstar, and ORBCOMM) had filed for bankruptcy.¹⁴⁴

Today, the picture has changed, some trends has made access to space easier and consequently more painless to capitalize returns.¹⁴⁴ These trends are explored further below.

First of all, **new opportunities have been enabled by decreased costs in manufacturing and launch services.** The “Small satellite” revolution has led to decreasing costs and so to an increase in investment opportunities.¹⁴⁵ Since small satellites are built in an easy and quick way (i.e. the time-lag between designing a satellite and making it fully operative has significantly reduced), investors can now benefit from decreasing costs of production (which make venture investing feasible for space) and by narrowing the time necessary to realize returns on their investments.¹⁴⁶ Quantifying this change, it is now possible to deploy a space system for tens of millions of dollars, while before it was necessary to employ hundreds of millions or billions of dollars for the same task.¹⁴⁷

Launch costs have decreased as well. Falcon 9, the SpaceX’s rocket for satellite payloads,¹⁴⁸ costs US\$61.2 million per launch, which is the lowest figure in the industry according to sectorial experts, and allows orbit payloads up to 15 tons (equal to 13,607.8 kg).¹⁴⁹ At best the cost per kilo is thus approximately US\$4,500. As of January 2015, Falcon 9 had accomplished 14 successful missions, including five missions for resupplying the ISS.¹⁵⁰ However, it has to be admitted that prices could still be prohibitive for entrepreneurs who want to use space for commercial purposes.¹⁵¹ For this reason, SpaceX grants secondary launch services for miniature satellites (as secondary payloads) if primary payloads do not exceed 80 percent of the capacity.¹⁵² SpaceX is not an isolated case. There is in fact a network of coordinators specializing in miniature satellite: one of them is Spaceflight Industries, who offers fixed prices according to weight/size of the payload and orbit destination.¹⁵³ For example, a CubeSat¹⁵⁴ (approximate weight of 5 kg) can be brought in orbit for US\$295,000, while 100 kg microsatellites for less than US\$4 million.¹⁵⁵ It can be seen that the trend of decreasing costs goes together with **more transparent prices.**¹⁵⁶

Nowadays there are **more frequent launch options.** Launch recurrence remains still suboptimal: miniature satellites that search for a rideshare opportunity have to face the problem of the delays of these launches.¹⁵⁷ Nevertheless there are two drivers that are leading towards better functioning of the market: a) *miniature satellite launch brokerage* and b) *low-cost miniature satellite dedicated*

¹⁴⁴ The Tauri Group, ‘Start-Up Space’, p. 35.

¹⁴⁵ Ibid, p. 35.

¹⁴⁶ Ibid, pp. 35-36.

¹⁴⁷ Ibid, p. 36.

¹⁴⁸ For further details, see <http://www.spacex.com/falcon9>.

¹⁴⁹ Lerner, Leamon and Speen, ‘Venture Capital Activity in the Low-Earth Orbit Sector’, in *Economic Development of Low Earth Orbit*, p. 75.

¹⁵⁰ Ibid, p. 74.

¹⁵¹ Ibid, p. 75.

¹⁵² Ibid, p. 75.

¹⁵³ Ibid, p. 75.

¹⁵⁴ ‘A CubeSat (U-class spacecraft) is a type of miniaturized satellite for space research that is made up of multiples of 10×10×10 cm cubic units.’ Source: <https://en.wikipedia.org/wiki/CubeSat>.

¹⁵⁵ Lerner, Leamon and Speen, ‘Venture Capital Activity in the Low-Earth Orbit Sector’, in *Economic Development of Low Earth Orbit*, p. 75.

¹⁵⁶ Ibid, p. 75.

¹⁵⁷ Ibid, p. 75.

launches.¹⁵⁸ We have already talked about the first point, introducing the example of Spaceflight Industries: some companies serve as broker in the market, connecting launch services for primary payloads with those who are searching for an opportunity of rideshare.¹⁵⁹ The second point tries to address problems linked to secondary payloads: where timetable and parameters of primary missions cannot be modified by the secondary payloads, and where the orbit may be suboptimal with respect to the need of the miniature satellite.¹⁶⁰ A company that offers this kind of services is Rocket Labs: for the same price of a rideshare it is possible to choose how to carry out your own mission (US\$4.9 million for 110 kg microsattellites more or less).¹⁶¹

Moreover, **miniature satellites with commercial applications are emerging**. The growing interest in small-size satellites is in fact driven by the possibility to apply their technology in a non-traditional field: “big data”. Satellites are able to provide a large amount of data, which are useful for example to track and analyse economic activities or to predict weather on a frequent, detailed and local basis.¹⁶² This particular application of satellite technology finds users also in other high-value sectors such as agriculture, transport, TV, telecommunications, defence, etc. Therefore, thanks to the access to these very informative datasets it will be feasible to monitor much human activity and even to better manage the unpredictability of nature. Datasets are the result of a vertically integrated business: upstream, companies build, launch and manage constellations, which ensure global coverage thanks to their thick satellite network; downstream, they manage the datasets.¹⁶³ Examples of those firms are Spire, Planet Labs, Mapbox, BlackSky Global, and Orbital Insight. Investors most attracted to this opportunity are those who have already dealt with data analytics-driven businesses, such as IT and web companies.¹⁶⁴

A further aspect that has changed investor’s minds about space concerns **successful exits**: just to make an example, Google acquired Skybox Imaging for US\$478 million in 2014.¹⁶⁵ If an investor knows that he can successfully exit from a space company, realizing strong capital gains, he is more inclined to invest money in it.

2.2 What investors are looking for when they invest

Before securing their financial support, investors want to be sure that the company that they will ‘bet on’ has all the qualities and features to be successful. What space investors seek is not so different from the general criteria identified by the literature (see § 1.4.2). In particular, they require that start-ups:

- a) **Have a quality team**. This is perhaps the most important feature that makes a “winner”.

¹⁵⁸ Lerner, Leamon and Speen, ‘Venture Capital Activity in the Low-Earth Orbit Sector’, in *Economic Development of Low Earth Orbit*, pp. 76-77.

¹⁵⁹ Ibid, p. 76.

¹⁶⁰ Ibid, p. 76.

¹⁶¹ Ibid, p. 76.

¹⁶² The Tauri Group, ‘Start-up Space’, p. 36.

¹⁶³ C. Dillow, ‘VCs Invested More in Space Startups Last Year Than in the Previous 15 Years Combine’, *Fortune*, [website], 22 February 2016, <http://fortune.com/2016/02/22/vcs-invested-more-in-space-startups-last-year/> (accessed March 2017).

¹⁶⁴ The Tauri Group, ‘Start-up Space’, p. 36.

¹⁶⁵ Ibid, p. 36.

- b) **Have a clear vision.** It requires strong planning and organizational skills, as well as the capacity to “see beyond”, to think about something that other people cannot even imagine.
- c) **Ride a megatrend.** In the specific case of space, the two megatrends that have triggered this “NewSpace race” are the decreasing costs of manufacturing satellites and their application in data analysis tasks. Looking at the near future, a new trend is emerging: The Internet of Things.
- d) **Are “explosive”.** The project has to be able to rapidly bring a product to market and generate revenue in the relatively near term. The current market trend is the digitization of all the activities, so it is important that the project has enormous potential digital applications.

The 2016 report of The Tauri Group confirms the aforementioned criteria. On the basis of the interviews that they conducted on a large group of VCs (mostly senior partners in the backed companies), investors look primarily at:¹⁶⁶

- Strength of management team
- Strength of the technical solution
- Potential demand for the product or service

The report shows also that an already established relationship with the investor could make it easier for the entrepreneur to obtain money.¹⁶⁷ This means that VCs like to invest in management teams that they know or that have recognized achievements.¹⁶⁸ Two other important aspects that come out from the interviews are: a) the possibility of forming a new market and b) the threats from government and large companies.¹⁶⁹

Another interesting interview has been conducted by the LA Times.¹⁷⁰ The interviewee, Mr. Chad Anderson, who is the managing director of Space Angels Network¹⁷¹, discussed the growing interest for space and what is next for the industry. Anderson said that as a company they look for ‘*a lot of things that a typical angel or VC [venture capitalist] would look for*’, such as ‘*really great teams, really big bold ideas, people that can work effectively in a dynamic landscape [and] people with ambitious business plans, but a practical route to near-term revenue*’.¹⁷² According to him the idea that ‘*space has really long development times and is capital intensive*’ applies probably just for ‘*launch companies but there is a lot of different companies in space, from satellites to software to observation to other things, that is less true for*’.¹⁷³ Space is perceived like ‘*the new Internet boom and everyone is looking to invest in the next Microsoft*’.¹⁷⁴

¹⁶⁶ The Tauri Group, ‘Start-up Space’, p. 38.

¹⁶⁷ Ibid, p. 38.

¹⁶⁸ Ibid, p. 38.

¹⁶⁹ Ibid, p. 39.

¹⁷⁰ S. Masunaga, ‘Why investment in space companies is heating up’, *LA Times*, [website], 7 July 2016, <http://www.latimes.com/business/la-fi-qa-space-investment-20160707-snap-story.html> (accessed March 2017).

¹⁷¹ Space Angels Network is a New York-based investor in early-stage private space companies, with investor members all over the world. Founded in 2007, Space Angels Network has been supporting space start-ups since before the first successful SpaceX launch, and are uniquely positioned to support the continued growth of the industry.

¹⁷² Masunaga, ‘Why investment in space companies is heating up’.

¹⁷³ Ibid.

¹⁷⁴ Ibid.

2.3 Space sector's investments and outlook

Since 2000 venture-backed space companies have recorded a total fundraising activity of over US\$13 billion (Table 3). This money came through different types of investment structures, including seed, venture capital, private equity, acquisition and public offering. Debt financing is also an important source for space investments, even if it has decreased during the temporal window from 2011 to 2015 respect to the previous five-year period. The decisive boost for space funding realized during the period 2011-2015, when nearly two-thirds of investment in space ventures since 2000 has been registered (excluding debt financing). Almost half of this money can be linked to VC.

Looking at the average data, seed funding, venture capital and acquisition show an upward trend, while private equity is trending down (Table 4). Venture capital is confirmed as one of the most important sources of financing.

Table 3 – Magnitude of space investments by type (US\$).

Investment Type	2000-2005 (millions)	2006-2010 (millions)	2011-2015 (millions)	Total 2000-2015 (millions)
Seed/Prize/Grant	\$640	\$286	\$328	\$1,254
Venture Capital	\$186	\$373	\$2,300	\$2,859
Private equity	\$240	\$900	\$695	\$1,835
Acquisition	\$0	\$568	\$1,651	\$2,219
Public Offering	\$0	\$0	\$23	\$23
Total Investment	\$1,066	\$2,127	\$4,997	\$8,190
Debt Financing	\$0	\$3,969	\$1,098	\$5,067
Total with Debt	\$1,066	\$6,096	\$6,095	\$13,257

Source: The Tauri Group, 'Start-up Space', p. 14.

Table 4 – Annual average of space investments by type (US\$).

Investment Type	Average 2000-2005 (millions)	Average 2006-2010 (millions)	Average 2011-2015 (millions)	Average 2000- 2015 (millions)
Seed/Prize/Grant	\$107	\$57	\$65	\$78
Venture Capital	\$31	\$74	\$460	\$179
Private equity	\$4	\$180	\$139	\$115
Acquisition	\$0	\$114	\$330	\$139
Public Offering	\$0	\$0	\$5	\$1
Total Investment	\$178	\$425	\$999	\$521
Debt Financing	\$0	\$794	\$220	\$317
Total with Debt	\$178	\$1,219	\$1,219	\$829

Source: The Tauri Group, 'Start-up Space', p. 15.

These investments are justified by the extraordinary performances of the space sector, as underlined by the analysis conducted by Space Angel Networks.¹⁷⁵ Space is in fact the most performing sector

¹⁷⁵ Anderson, '2015 An Epic Year For The Space Industry'.

among those swarming with innovative start-ups. It showed a CAGR¹⁷⁶ equal to 180 percent during the period 2012-2015.¹⁷⁷ Using the words of Steve Jurvetson¹⁷⁸: *‘Compared to other industries, I have never seen such an enormous margin for improvement. There’s this canonical thing about a startup needing to pitch a 10X improvement to be a worthwhile investment. You rarely see an entrepreneur pitch a 100X improvement. But in space we’ve seen 1,000X, and really we’ve seen 10,000X.’*¹⁷⁹ Figure 10 shows the growth rate for the other start-up sectors. In particular, space is followed by bitcoin, photo sharing and physical storage (which includes moving and self-storage companies).

The year 2015 in particular was a record-setting year for start-up space ventures, with a total private funding of US\$2.3 billion (Figure 11). This evidence comes from CB Insights’ blog¹⁸⁰, the only source among the ones used for this report that provides annual aggregate data (i.e. considering all funding sources), at least for the period 2012-2015. Unfortunately, it seems that there are some discrepancies between information presented by different sources, so it is appropriate to be careful approaching these data. In particular, CB Insights’ blog shows for the period 2012-2015 a total space funding of almost US\$3,290 million, considering all sources of investment. But according to Tauri Group’s data, the total funding for period 2011-2015 amounts to US\$4,997 million. Since the difference between the two dataset (almost US\$1,710 million) is not likely to be attributed to a single year (i.e., 2011, not covered by CB Insights), it may be plausible to assume that CB Insights’ data do not include any information about M&A operations, i.e. acquisitions and public offerings (amounting to US\$1,674 million in Tauri Group’s data). This assumption relies on the fact that CB Insights reports a US\$131 million funding during the last quarter of 2013, and yet in November 2013 the Climate Corporation was acquired by Monsanto for US\$930 million. However, this is just an assumption, since data comes from CB Insights’ blog (a secondary source) and cannot be checked or more deeply analysed because of the inability to access the original database. Moreover, it is not a very solid assumption, since CB Insights seems to include the acquisition of Skybox by Google in the third quarter of 2014: the US\$525 million funding is not in line with other quarters, which do not individually exceed the US\$30 million investments, and the inclusion of the aforementioned acquisition seems to be the most plausible reason behind this sharp difference. Consequently, it is hard to make a clear analysis on these data. However, we assume that CB Insights does not cover acquisitions and public offerings, and so the subsequent analysis will take into account only seed, VC and private equity investments from Tauri Group’s data (Table 2 and 3) and will refer to them as “total (private) investments”, in order to make the two datasets comparable.

¹⁷⁶ CAGR is the mean annual growth rate of an investment over a specified period longer than one year. Source: <http://www.investopedia.com/terms/c/cagr.asp>.

¹⁷⁷ Anderson, ‘2015 An Epic Year For The Space Industry’.

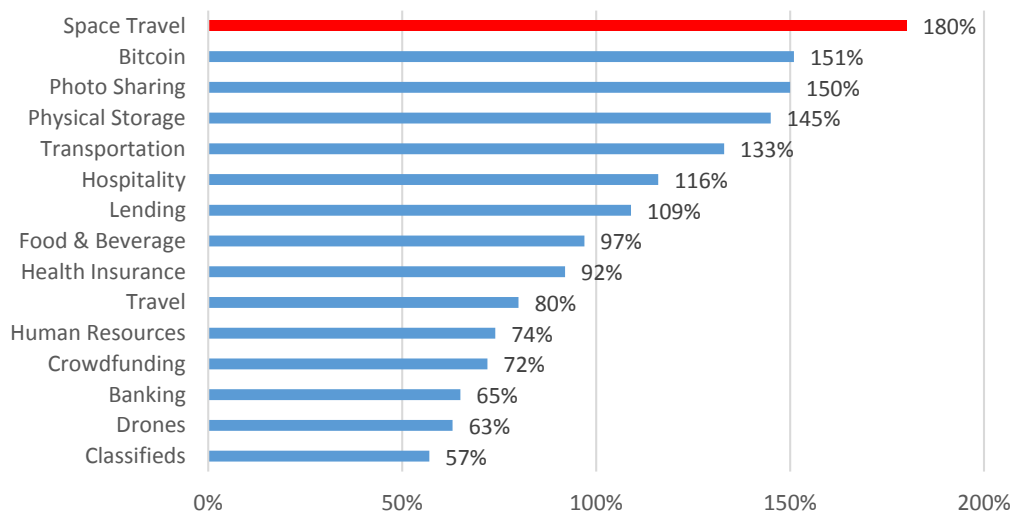
¹⁷⁸ Steve Jurvetson (born March 1, 1967) is an American businessman and venture capitalist. He is currently a partner of Draper Fisher Jurvetson.

¹⁷⁹ C. Dillow, ‘Here’s why small satellites are so big right now’, *Fortune*, [website], 04 August 2015, <http://fortune.com/2015/08/04/small-satellites-newspace/> (accessed March 2017).

¹⁸⁰ CB Insights, ‘Funding And Deals To Space Startups In A Slump’, *CB Insights*, [web blog], 23 August 2016, https://www.cbinsights.com/blog/space-startups-funding-trends/?utm_content=35961698&utm_medium=social&utm_source=twitter (accessed March 2017).

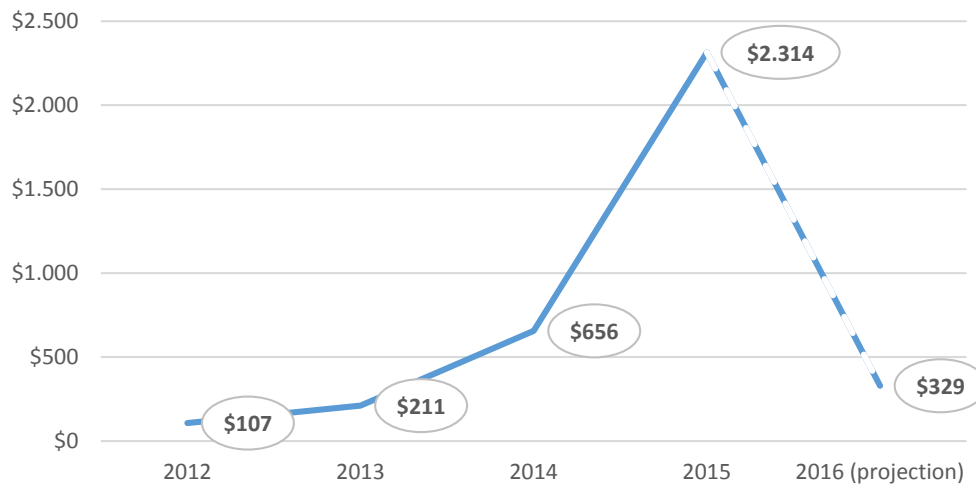
Venture Capital in the NewSpace Economy

Figure 10 – CAGR for innovative sectors (2012-2015).



Source: Anderson, '2015 An Epic Year For The Space Industry'.

Figure 11 – Private investments in space industry from 2012 to 2016 (US\$ million).



Source: CB Insights, 'Funding And Deals To Space Startups In A Slump'.

Returning to 2015 trends, US\$1.8 billion of the total US\$2.3 billion can be ascribed to VC.¹⁸¹ More than 50 VCs invested in space deals in 2015, the highest number in any year during the 15-year period 2000-2015.¹⁸² However, despite these excellent numbers, it is recommended to be careful in making conclusions. In fact, this large amount of VC funding is largely due to two big transactions:

- A US\$1 billion investment in Elon Musk's SpaceX by corporate investors Google and Fidelity;
- A US\$0.5 billion investment in the satellite communications company OneWeb by corporate and private equity investors Qualcomm Technologies Inc. and Virgin Group.¹⁸³

¹⁸¹ Tauri Group, 'Start-up Space', p. 13.

¹⁸² Ibid, p. iv.

¹⁸³ Dillow, 'VCs Invested More in Space Startups Last Year'.

In addition to these two mega-rounds, significant investments by Amazon's founder Jeff Bezos in space launch start-up Blue Origin have to be added.¹⁸⁴ Excluding these investments, space related funding in 2015 is just around US\$300 million.

The same dynamics characterize the 2016. In fact, the first quarter of 2016 registered total private investments (not only VC, but also seed and private equity) amounting to US\$103 million, which increased to US\$201 million by August 2016.¹⁸⁵ There was concern about these figures since, based on these first two quarters, the projections for the whole year were not favourable: in fact, experts had forecasted about US\$329 million total private investment by the end of the year (see Figure 11).¹⁸⁶ This meant that, assuming the same VC proportion over total investments observed in 2011-2015 (i.e. 69 percent, check on Table 2), the projection for the VC financing would have been of slightly more than US\$227 million by the end of the year, well below the average of 2011-2015 (amounting to US\$460 million, see Table 3). Updated data of VC investments for the entire 2016 are not available from the sources employed for this report, but it is known that Softbank invested US\$1,200 million as a venture funding in OneWeb in December 2016. Consequently, VC investments for 2016 are at least US\$1.4 billion and consequently very closed to the 2015 levels. This proves once again how much space investments are affected by corporation financing, which is highly variable.

If someone was worried about a possible decline in future investments in space, the dynamics described above have demonstrated this is now not the case. Moreover, there are another two reasons for not being excessively concerned. Firstly the space sector is a capital-intensive industry and therefore is more subject to high variability investments.¹⁸⁷ The second reason is that space so far has been exploited only partially. Although the Earth Observation (EO) sector is saturated, space offers other opportunities that VCs are already exploiting or may pick in the future.

In particular, the three most promising areas are:¹⁸⁸

- **Manufacturing technologies.**¹⁸⁹ Patenting methods for a more efficient construction of space technology components is a field that has not been completely exploited yet. Recently, many start-ups have distinguished themselves for having revolutionized the manufacturing methods. For example, Rocket Lab – a company based in New Zealand – developed the first 3D-printed rocket engine, which is cheaper and lighter than other engines. In addition to this, the interest in developing asteroid and moon mining technologies is rising, in order to locate and recover fuel and building materials (for example, an active firm in this field is Planet Resources). Moreover, some companies such as Made in Space and Space Pharma are focusing on in-space manufacturing.

¹⁸⁴ Dillow, 'VCs Invested More in Space Startups Last Year'.

¹⁸⁵ CB Insights, 'Funding And Deals To Space Startups In A Slump'.

¹⁸⁶ Ibid.

¹⁸⁷ Ibid.

¹⁸⁸ The information contained in the subsequent list, if not differently specified, comes entirely from V. Komissarov, 'Space tech's 3 hottest areas for investing', *VentureBeat*, [website], 10 September 2016, <https://venturebeat.com/2016/09/10/space-techs-3-hottest-areas-for-investing/> (accessed March 2017).

¹⁸⁹ See note 185.

- **Satellite imagery analytics.**¹⁹⁰ In 2012-2015 imagery represented only 19 percent¹⁹¹ of the VC investments, but it is likely to grow. It used to be that only constellations of satellites provided raw pictures of the Earth. The Earth Observation (EO) market had mainly defence and governmental agencies as customers, who used to ask for Very High Resolution (VHR) data.¹⁹² Considering that VHR data represented 78 percent of the EO market¹⁹³, defence and government contributed to the main part of the revenues: according to 2015 Euroconsult's report¹⁹⁴, 65 percent of global EO revenues come from purchases by defence/intelligence agencies. In addition to this, market was very concentrated: Digital Globe accounted for a 70 percent share in the VHR data segment.¹⁹⁵ All these characteristics may make the market very static and not suitable for the new coming capacity brought by the launch of more than 2000 satellites by 2020.¹⁹⁶ In fact, if the new start-ups were not able to sell their data to such customers, the launch of new satellites would be useless only considering the EO sector.¹⁹⁷ However, no problems seem to exist since there is no such market stagnation (recently a partnership between Urthecast and the National Geospatial Agency was established)¹⁹⁸ and EO is meeting a rising technological trend: Artificial Intelligence (AI). Nowadays, raw pictures of Earth are no longer sufficient: there are margins, but especially the need to transform these images into useful data for planning and analysing human activities. We are talking about a development in the downstream segment of EO. Combining EO with AI, start-ups such as Orbital Insight and Descartes Labs are applying object recognition algorithms and data science to satellite imagery: in other words, we are moving from raw images to information. Unfortunately, there is a problem: the cost of access. Currently contracts for imagery require "minimum orders" (up to 5000 km² of coverage).¹⁹⁹ Therefore, contracts are not accessible or suitable for small customers, such as individual farmers or share oil producers.²⁰⁰ But, it is moving towards contracts designed for Areas of Interest (AOI), selected by customers and priced according to square meters.²⁰¹ In addition to this, new web-interfaces will provide better outcomes than e-mails or phone calls.²⁰² A successful example is The Climate Corporation (see § 3.1.1). It can be forecast that new start-ups are going to replace traditional satellite imagery distribution when it relates to the B2B (Business to business) market and the

¹⁹⁰ See note 185.

¹⁹¹ CB Insights, 'The Future of Frontier Tech: Analyzing Trends in Drones, Space, and AR/VR Technology', *CB Insights Website*, 2015, p. 16, <https://www.cbinsights.com/research-frontier-tech-report> (accessed March 2017).

¹⁹² V. Komissarov, 'Earth Observation Microsatellites Are Overdone?', *Medium*, [website], 17 August 2016, <https://medium.com/@V.K.Komissarov/earth-observation-microsatellites-are-overdone-847a4fa7db64> (accessed March 2017).

¹⁹³ Ibid.

¹⁹⁴ Euroconsult, 'Satellite Value Chain: Snapshot 2015. Key Trends And Indicators On Supply & Demand Of The World Commercial Satellite Industry – An Extract', *Euroconsult Industry Research*, 2015, <http://www.euroconsult-ec.com/research/satellite-value-chain-2015-extract.pdf> (accessed March 2017).

¹⁹⁵ Komissarov, 'Earth Observation Microsatellites Are Overdone?'.

¹⁹⁶ CB Insights, 'The Future of Frontier Tech', p. 20.

¹⁹⁷ Komissarov, 'Earth Observation Microsatellites Are Overdone?'.

¹⁹⁸ Ibid.

¹⁹⁹ Ibid.

²⁰⁰ Ibid.

²⁰¹ Ibid.

²⁰² Ibid.

B2C (Business to consumer) market, while traditional companies will remain in the market for B2G (Business to government).²⁰³

- **Ground station networks.**²⁰⁴ *'Ground stations are terrestrial radio stations designed for extra-planetary telecommunication with spacecraft (constituting part of the ground segment of the spacecraft system), or reception of radio waves from astronomical radio sources.'*²⁰⁵ In short, they are the receptacles of data coming from space. The problem linked to ground station networks is that they are geographically dispersed (this aspect sometimes obliges satellite to send gathered data during the next orbital round, with a consequent loss of time) and run by slow-moving incumbents, which prove to be incompatible with the needs of the new space start-ups that want to launch over 100 satellite constellations. Some companies (e.g. RBC Signals and Atlas Space Operations) are applying software business models, as well as a Silicon Valley mentality, to this problem: basically, *'they merge existing ground station infrastructure with a revenue-share approach (no CAPEX) and take advantage of unused capacity, commercializing it via subscription-based models.'* Such global ground station networks would permit real-time imagery data, that would significantly lead to an increase in value of both data themselves and the related services/products.

2.4 Venture Capitalists and Angel Investors across the world

Venture Capitalists

Venture capitalists that invest in space companies are mostly concentrated in the US. Another cohort is present in the United Kingdom. A deeper insight in the VCs' profile will reveal that 74 percent of the VCs are based in the US, in particular along the pacific coast. In fact, California hosts 53 percent of the American VCs, while the remaining 47 percent is located in other regions, such as New York and Maryland. The non-US VC firms are situated in 15 countries across the world. The major hubs at a country-level are UK, Canada, Hong Kong and Jordan. UK hosts about one third of non-US VC firms.²⁰⁶ Table 5 shows the list of VCs that have stakes in space start-ups.

Among the listed VCs, some of them stand out for the remarkable concentration in the space environment. In particular, these VC firms have invested in several companies (for example, a single VC has stake in five firms at the same time) and they also share some of these investments. Obviously, sharing VCs have not necessarily entered in the same financing rounds (they may have chosen to invest in different stages of the company's lifecycle). However, the fact that a company is able to keep the attention of the most active – and presumably successful – VCs is an index of its potential and attractiveness. The most active space-related VCs and their investments are mentioned in the 2015 report by CB Insights²⁰⁷ and are also listed below in Table 6, in addition to other two very interesting VC firms (namely Draper Fisher Jurvetson and First Round Capital).

²⁰³ Komissarov, 'Earth Observation Microsatellites Are Overdone?'.

²⁰⁴ See note 185.

²⁰⁵ Wikipedia, 'Ground Station', *Wikipedia*, [website], https://en.wikipedia.org/wiki/Ground_station (accessed March 2017).

²⁰⁶ The Tauri Group, 'Start-Up Space', p. 18.

²⁰⁷ CB Insights, 'The Future of Frontier Tech', p. 13.

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Table 5 – Lists of VCs investing in space companies for regions.

United States	Y Combinator	OS Fund
	Colorado	Vulcan Capital
California	Foundry Group	Americas
AME Cloud Ventures	Georgia	
Amplify.LA	Kinetic Ventures	Argentina
Asset Management Ventures	Hawaii	NXTP Labs
Base Ventures	HMS Hawaii Management	Brazil
Cambrian Ventures	Illinois	Pitanga Fund
Canaan Partners	Jump Capital	Canada
Capricorn Investment Group	Pritzker Group	
Cardinal Venture Capital	Promus Ventures	FIER CPVC - Montreal L.P.
citizen.vc	Indiana	Pangaea Ventures
CrunchFund	Innovate Indiana Fund	Vanedge Capital
Data Collective	Maryland	Asia/Africa/Oceania
DBL Partners	CNF Investments	
Draper Associates	Maryland Venture Fund	Hong Kong
Draper Fisher Jurvetson	Massachusetts	Bright Success Capital
Felicis Ventures	Fidelity Investments	Fresco Capital
Formation 8	Founder Collective	Radiant Venture Capital
Founders Fund	General Catalyst Partners	Japan
Industry Ventures	North Bridge Venture Partners	Mistletoe
Innovation Endeavors	New Mexico	Mitsui & Co. Global Investment
Khosla Ventures	Cottonwood Technology Fund	Singapore
Kleiner Perkins Caufield & Byers	New York	JAFCO
Lemnos Labs	Bessemer Venture Partners	McLean Watson Capital
Merus Capital	Grishin Robotics	Middle East
New Enterprise Associates	I2BF Global Ventures	
NewGen Venture Partners	Lux Capital	Jordan
Norwest Venture Partners	Raymonds Capital	MENA Venture Investments
Redpoint Ventures	Richmond Global	Europe
Rothenberg Ventures	RRE Ventures	
Sequoia Capital	Thrive Capital	Russia
Shasta Ventures	Valor Capital Group	DTS Global
Sherpalo Ventures	Pennsylvania	United Kingdom
Slow Ventures	First Round Capital	Anthemis Group
TenOneTen Ventures	Osage University Partners	Atomico
Translink Capital	Virginia	Index Ventures
VantagePoint Venture Partners	In-Q-Tel	IQ Capital
Venrock	RedShift Ventures	Longwall Venture Partners
Wavemaker Partners	Washington	Par Equity
Western Technology Investment	Ignition Partners	Rainbow Seed Fund
		Seraphim Capital

Source: The Tauri Group, 'Start-Up Space', p. 24. The list is not exhaustive.

Table 6 – Most active VCs in space investments.

Investor	Investments
Lux Capital	Kymeta Orbital Insight Planet Labs
RRE Ventures	Accion Systems Spaceflight Industries Spire Global
Bessemer Venture Partners	Rocket Lab Skybox Imaging Spire Global
Khosla Ventures	Rocket Lab Skybox Imaging The Climate Corporation
Promus Ventures	Mapbox Spire
Founders Fund	Accion Systems Moon Express Planet Labs SpaceX The Climate Corporation
Draper Fisher Jurvetson	ALOHA Networks HuaXun Microelectronics Mapbox Planet Labs SpaceX
First Round Capital	Planet Labs Swift Navigation The Climate Corporation

For the sake of completeness, Table 7 reports the most well-funded space companies until the second quarter of 2016.²⁰⁸ SpaceX and OneWeb are the two firms that raised the highest financing amount, considering also that recently they have been the protagonists of two mega-rounds (respectively US\$1 billion and US\$1.2 billion²⁰⁹). They have received venture capital, but the main contributors to these rounds are corporations, namely Google for SpaceX and SoftBank for OneWeb. It is true that usually a company is highly valued in later-stage rounds, since the related risk is lower than early stages. And yet, it was shown that the valuation of a corporate-backed business in later-stage rounds is typically greater than in companies at a similar stage with no corporate investor.²¹⁰ It demonstrates that although VCs represent the most relevant investors together with angels by number of deals, corporations have bigger financial power, which allows them to participate in few but very high-valued agreements.

²⁰⁸ CB Insights, 'Funding And Deals To Space Startups In A Slump'.

²⁰⁹ PwC and CB Insights, 'MoneyTree™ Report: Q4 and Full-year 2016', *CB Insights Website*, 2017, <https://www.cbinsights.com/research-venture-capital-reports-q4-2016> (accessed March 2017), p. 10.

²¹⁰ Ernst & Young, 'Turning the Corner: Global Venture Capital Insights and Trends 2013', *EY Library*, 2013, p. 5, <http://www.ey.com/library> (accessed March 2017).

Moreover, it has to be underlined that the majority of these companies are American (with the exception of Astroscale that is based in Singapore). The reason can be twofold: it may depend on the better developed US VC market or that American entrepreneurs have better ideas than their overseas colleagues. For sure, the first factor has a big impact (companies have more chances to find investors), but probably the presence of numerous technological clusters (with their spill-over effects) helps the American Space industry to progress more than the others across the world.²¹¹

*Table 7 – Most well-funded space start-ups up to Q2 2016.*²¹²

Rank	Company	Equity financing raised (US\$M)
1	SpaceX	\$1,185
2	OneWeb	\$519
3	Blue Origin	\$500
4	Planet Labs	\$171
5	Kymeta	\$144
6	Spire	\$67
7	MapBox	\$61
8	Spaceflight Industries	\$45
9	Astroscale	\$43
10	Collecte Localisation Satellites	\$41

Source: CB Insights, 'Funding And Deals To Space Startups In A Slump'.

Angel Investors

The years 2013 and 2015 has recorded the highest funding activity to date in the space sector conducted by Angel investors. In particular, the increase commenced in 2011, when 14 angel investments were carried out (Figure 12). The focus of these investments has been on early-stage space companies.

But who are the angel investors? Basically, they are accredited individual investors or group of investors, whose income exceeds US\$200,000 (or US\$300,000 if married) per year or who has a net worth over US\$1 million.²¹³ Group of angels, such as Boston Harbor Angels (stake in XCOR Aerospace), Green Angel Syndicate (Global Surface Intelligence) and Space Angels Network (more than 12 deals in the period 2006-2015) are often called syndicates.²¹⁴ Two examples of individual investors who have

²¹¹ M. Paone, 'Aerospace Clusters: World's Best Practise and Future Perspectives', Defence SA: Internship Program, September 2016, <http://www.defencesa.com/capabilities/space/internship-program> (accessed March 2017).

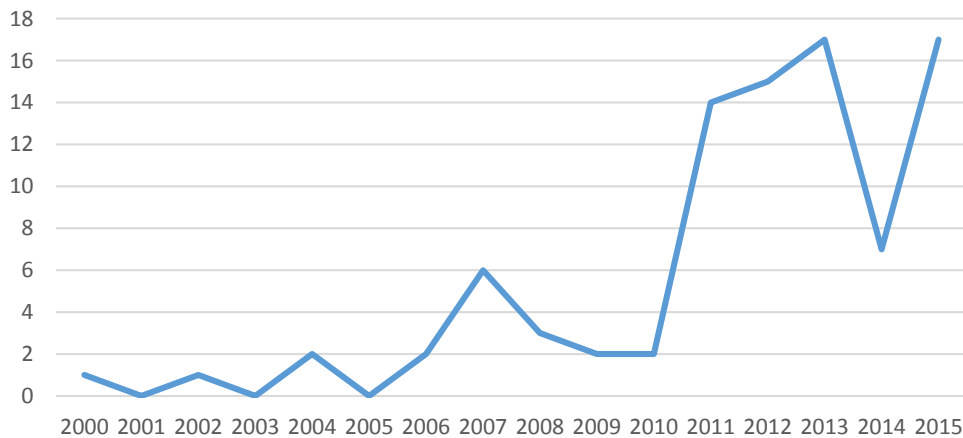
²¹² The rank is not updated, since during the last quarter of 2016, OneWeb has raised US\$1.2 billion from SoftBank.

²¹³ The Tauri Group, 'Start-Up Space', p. 19.

²¹⁴ Ibid, p. 20.

put a lot of effort in space sector are Dylan Taylor²¹⁵ and Esther Dyson²¹⁶, who have invested respectively in six different space start-ups, and in Space Adventures and XCOR Aerospace.²¹⁷

Figure 12 – Angel Investors' investments in space start-ups (2000-2015).



Source: The Tauri Group, 'Start-Up Space', p. 22.

Some of them are called "space billionaires": this term is used in referring to people with huge financial power, gained through their activities in other sectors.²¹⁸ Among them one can find Jeff Bezos (Blue Origin), Richard Branson (OneWeb, Virgin Galactic) and Elon Musk (SpaceX). Just to give an idea of their financial effort in space, Bezos has recently announced that he will sell US\$1 billion in shares of Amazon each year in order to finance Blue Origin.²¹⁹ His goal is to become a leader in the tourist space sector and it could be reached through the development of the new space suborbital system, New Shepard, which has been recently presented and will be used for equipping the rocket New Glenn (estimated cost US\$2.5 billion).²²⁰ Bezos talked about a "golden era for space exploration", predicting for the next years the same dynamism that has characterized the Internet sector in the last 20 years.²²¹ Every year, Forbes draws up the list of world's billionaires and 21 of them have a connection to a space enterprise (approximately one percent of all the billionaires).²²²

Angels are primarily based in the United States (71 percent), and in particular in California (32 percent).²²³ The other 39 percent is located elsewhere in the US, including WashingtonDC and New

²¹⁵ 'Dylan Taylor is an American executive and super angel investor best known for being the Global President of Colliers International.' Source: [https://en.wikipedia.org/wiki/Dylan_Taylor_\(executive\)](https://en.wikipedia.org/wiki/Dylan_Taylor_(executive))

²¹⁶ 'Esther Dyson is a Swiss-born American journalist, author, businesswoman, investor, commentator and philanthropist. She is a leading angel investor focused on breakthrough efficacy in healthcare, government transparency, digital technology, biotechnology, and space.' Source: https://en.wikipedia.org/wiki/Esther_Dyson

²¹⁷ The Tauri Group, 'Start-Up Space', p. 19.

²¹⁸ Ibid, p. 19.

²¹⁹ ANSA, 'Bezos vende azioni Amazon per corsa allo spazio', ANSA: *Hi-tech*, [website], 6 April 2017, http://www.ansa.it/sito/notizie/tecnologia/hitech/2017/04/06/bezos-vende-azioni-amazon-per-lo-spazio_d0e79194-dd16-42db-8b0e-7ba6c04e9311.html (accessed April 2017).

²²⁰ Ibid.

²²¹ Ibid.

²²² The Tauri Group, 'Start-Up Space', p. 19.

²²³ Ibid, p. 20.

York.²²⁴ Among the non-US angels, Japan hosts 1/3 of them and Russia and U.K are home to other angel investors.²²⁵

Together with VCs, they are the other primary source (by number) for new space ventures. An article by Fortune²²⁶ calls them “advocacy investors”, i.e. people who do not look only for the economic return, but are moved by a sincere interest in the space sector. In short, the success of the investment is not the *prima ratio*.

According to the Tauri Group’s report, the reason why Angels invest in space is two-fold: an interest in space or financial motivations.²²⁷ The Tauri Group’s interviews show that usually these motives go together and each investor puts more emphasis on one of them according to his preferences.²²⁸ But another aspect that comes out is that sometimes investors are only financially motivated.²²⁹ In other words, they do not care about space.²³⁰ Space is viewed in this case as ‘*another type of IT platform with unique capabilities, that is undergoing the same transformation that combines dropping hardware costs with massive growth in applications and demand*’.²³¹ Finally, investors who would be suitable candidates for space investment – since they are technologically-oriented and even space affiliated – do not invest because of limited deal flow and troubles linked to risks and return.²³²

²²⁴ The Tauri Group, ‘Start-Up Space’, p. 20.

²²⁵ Ibid, p. 20.

²²⁶ Dillow, ‘VCs Invested More in Space Startups Last Year Than in the Previous 15 Years Combine’.

²²⁷ The Tauri Group, ‘Start-up Space’, p. 37.

²²⁸ Ibid, pag. 37.

²²⁹ Ibid, pag. 37.

²³⁰ Ibid, pag. 37.

²³¹ Ibid, pag. 37.

²³² Ibid, pag. 37.

3 REGIONAL VENTURE CAPITAL

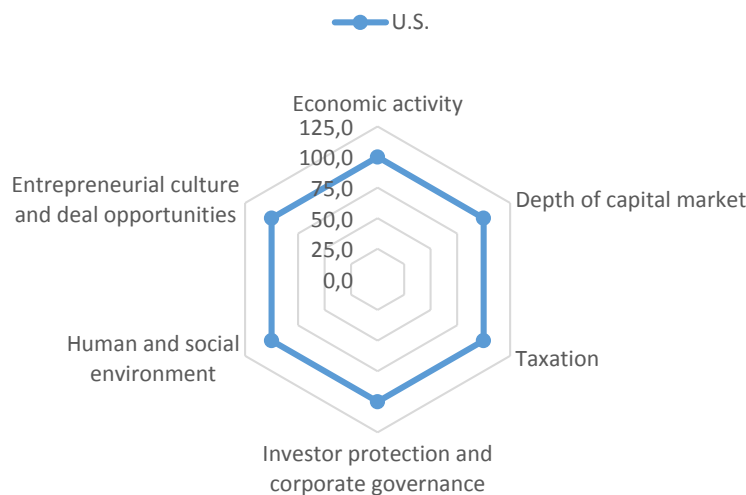
After having presented the general trends that characterize VC investments in the NewSpace economy, in the following paragraphs a further analysis will be carried out for different regions across the world. The analysis will be structured in two parts: the first one will present a general overview of the VC market in the region taken into account; the second one will focus on space investments.

3.1 United States

The United States are characterized by the most vibrant VC market across the globe. Within the country, there are five regions that stand out for the overwhelming VC activity: Silicon Valley, New York, District of Columbia, New England and LA/Orange County.²³³ At the state-level, California and New York are surely at the top for the VC funding supply, since they host the majority of US VC firms.²³⁴ Consequently, a very big number of VCs investing in space are based in the two aforementioned states (see previous chapter, Table 5).

Although the US market has experienced some setbacks, such as the one during the period 2009-2012 (just after the global economic crisis, which had increased the market uncertainty and had enlarged the risk perception of investors)²³⁵ and also during 2016 (a 20 percent drop-off of investments with respect to 2015)²³⁶, it remains the most active in the world. For this reason, it is used as a comparative benchmark for Venture Capital and the Private Equity Country Attractiveness Index: for the sake of simplicity, the US VC market has a score of 100 for each criterion and it ranks first over 125 countries taken into account (Figure 13).

Figure 13 – VCPE Country Attractiveness Index 2016: US.



Source: Groh, A.P. et al., 'United States VCPE Country Attractiveness Index', *IESE Blog Network*, 2016, <http://blog.iese.edu/vcpeindex/unitedstates/> (accessed April 2017).

²³³ PwC and CB Insights, 'MoneyTree™ Report', p. 2.

²³⁴ Ibid, p. 2.

²³⁵ Ernst & Young, 'Turning the corner', p. 2.

²³⁶ PwC and CB Insights, 'MoneyTree™ Report', p. 4.

Historically, in the US VCs have preferred early-stage and expansion-stage investments. Then, starting from 2000 there was a turnaround: VCs moved from early-stage to later-stage investments, which were less risky.²³⁷ Accordingly, consistent with this trend, Limited Partners (LPs) tended to prefer the “brand name” funds, which gave more certainty.²³⁸ After 2012, the trend turned another time and VCs restarted to put more money in the early phases of companies’ lifecycle.²³⁹ During the same period (2000-2015) expansion-stage investments always recorded a greater amount of money than both early- and later-stage rounds.²⁴⁰

The most preferred industry by US VCs is Internet, followed by the Mobile and Telecommunications sector, which have recorded respectively US\$4.6 billion and US\$2.5 billion during the last quarter of 2016.²⁴¹ Both the sectors are also space-related, since they guarantee a broad application for space technology such as satellites. Not surprisingly, at the end of 2016 a mega-round was recorded in the communication industry: OneWeb secured funding for US\$1.2 billion from SoftBank, a deal much higher in value than any others in the last quarter of 2016 (the second highest agreement was US\$500 million investment for Yixia, another Mobile and Telecom company).²⁴²

Two VCs involved in the space sector are also two of the best VCs in the US. The first one is Khosla Ventures (based in San Francisco) that has stakes in 13 firms and is the fifth most active VC firm in the US, preceded only by New Enterprise Associates and 500 Startup in the number of supported companies.²⁴³ The other one is Bessemer Venture Partners, which is among the seven best VCs in the world with stakes in 14 companies (see Box 3.1).²⁴⁴ However, six out of these seven global VC

Box 3.1 – Most active venture capital firms worldwide in 2016

Rank	Investor	Location	# of backed companies
1	500 Startups	California, US	45
2	New Enterprise Associates	California, US	20
3	Intel Capital	California, US	16
4	Index Ventures	London, UK	14
5	General Catalyst Partners	Massachusetts, US	14
6	Accel Partners	California, US	14
7	Bessemer Venture Partners	New York, US	14

Source: PwC and CB Insights, ‘MoneyTree™ Report’, p. 40.

²³⁷ Ernst & Young, ‘Turning the corner’, p. 12.

²³⁸ Ibid, p. 12.

²³⁹ Thomson Reuters, ‘2016 Yearbook’, p. 34-35, Figure 3.12: a-g.

²⁴⁰ Ibid, p. 34-35, Figure 3.12: a-g.

²⁴¹ PwC and CB Insights, ‘MoneyTree™ Report’, p. 12.

²⁴² Ibid, p. 39.

²⁴³ Ibid, p. 31.

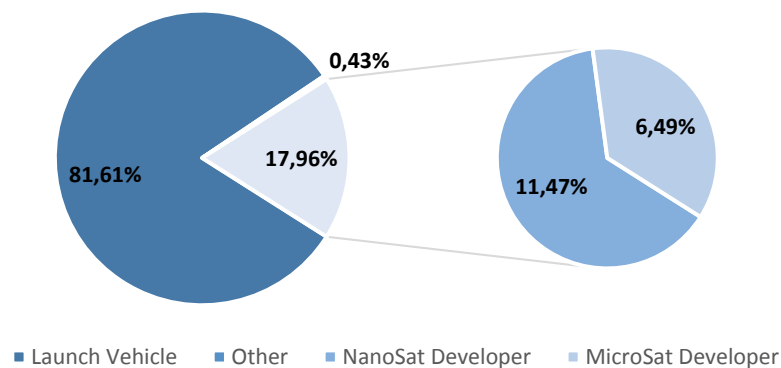
²⁴⁴ Ibid, p. 40.

companies are all American and this fact shows how important US VCs are, since they often fill the void created by the shortcomings of foreign markets.

With the rise of NewSpace economy, space becomes a catalyst for VCs investments. In particular, they are investing heavily in the LEO industry. In 2015 the US LEO sector recorded US\$1.64 billion investments (just the disclosed ones): this is a huge amount, considering that from 2000 to 2015 the global VC investments in space amounted to almost US\$2.86 billion (see § 2.3, Table 3).²⁴⁵ However, it has to be underlined that this extraordinary number includes the US\$1 billion investment in SpaceX by Google and Fidelity. Leaving out the 2015 investments, the LEO sector has still recorded an increase in investments in each five-year period starting from 2000: US\$89 million from 2000-2004, US\$184 million from 2005-2009, US\$284 million from 2010-2014.²⁴⁶ Concerning the number of deals, starting from 1983 18 US LEO-related companies have been supported (37 transactions in total).²⁴⁷ These investments are mostly concentrated in the last eight years (24 transactions).²⁴⁸

In particular, VCs are mostly interested in launch vehicles and in satellite development. Commercial space services, scientific experimentation, propulsion and asteroid mining represent just a small share of the total amount of invested money.²⁴⁹ Although the number of deals registered in 2008-2015 for launch vehicles is equal to satellite-related ones (8), the value for the former is far higher: US\$1,145 million (82 percent) for launch vehicles against the US\$252 million (18 percent) collected for satellite development.²⁵⁰ Figure 14 gives a graphic representation of the difference between the two subsectors, splitting also the satellite branch into nano- and micro-technology. But, once again, if we drop out the 2015 investment in SpaceX, proportions change in favour of satellite (satellite, from 18 percent to 63 percent; launch vehicles, from 82 percent to 36 percent).

Figure 14 – Comparison among LEO subsectors in investment values (2008-2015).



Source: Lerner, Leamon and Speen, 'Venture Capital Activity in the Low-Earth Orbit Sector', in *Economic Development of Low Earth Orbit*, p. 91.

²⁴⁵ Lerner, Leamon and Speen, 'Venture Capital Activity in the Low-Earth Orbit Sector', in *Economic Development of Low Earth Orbit*, p. 90.

²⁴⁶ Ibid, p. 90.

²⁴⁷ Ibid, p. 89.

²⁴⁸ These figures do not take into account the rounds conducted solely by angels/angel networks and investments in non-US LEO companies.

²⁴⁹ Lerner, Leamon and Speen, 'Venture Capital Activity in the Low-Earth Orbit Sector', in *Economic Development of Low Earth Orbit*, pp. 90-91.

²⁵⁰ Ibid, p. 91. Note that figures comprehend only 17 on 37 investments, the others are undisclosed.

Venture Capital in the NewSpace Economy

Another interesting aspect is that the US LEO sector is dominated by Internet- and software- focused VCs, as opposed to “space specialists”.²⁵¹ On average, 32 percent of the VCs that have an interest in LEO have invested in Internet and 23 percent in software.²⁵² It seems that within these VC firms there is just one partner who has interest in space.²⁵³ Table 8 shows the main VC groups that dominate the US LEO industry.

Table 8 – Major VC Groups in US LEO Sector.

Name (Year Founded)	Leo Sector Investments	Partner serving (or who served) on board of portfolio company	Top three industry preferences of VC firm (2007-Jan 2015)
Bessemer Venture Partners (1911)	Skybox	David Cowan	Total Deals: 428 Internet (27%)
		Ethan Kurzweil (Board Observer on Skybox)	Software & Related (23%) Telecoms (11%)
Draper Fisher Juvetson (1985)	SpaceX	Steve Jurvetson	Total Deals: 548 Internet (27%)
	Planet Labs	Steve Jurvetson	Software & Related (18%) Telecoms (16%)
Khosla Ventures (2004)	Skybox	Pierre Lamond	Total Deals: 382 Internet (21%)
	Rocket Lab	-	Software & Related (16%) Telecoms (15%)
Founders Fund (2005)	SpaceX	Luke Nosek	Total Deals: 122 Internet (48%)
	Planet Labs	-	Software & Related (21%)
	Accion Systems	-	Telecoms (12%)
E-Merge (1998)	Spire	N/A	Total Deals: 122 Internet (42%)
	NanoRacks	N/A	Software & Related (33%) Telecoms (17%)
RRE Ventures (1994)	Spire	N/A	Total Deals: 243 Internet (38%)
	Accion Systems	N/A	Software & Related (23%) Telecoms (14%)

Source: Lerner, Leamon and Speen, ‘Venture Capital Activity in the Low-Earth Orbit Sector’, in *Economic Development of Low Earth Orbit*, p. 93.

Support from private institutions is not the only source of funding available in the United States. For example, NASA sponsored two programs (SBIR and STTR, see Box 3.2) that help new businesses to develop innovative technologies. Another strategy consists of searching for a R&D partnership with a research university: in exchange for some concessions (e.g. scholarships/fellowships to university

²⁵¹ Lerner, Leamon and Speen, ‘Venture Capital Activity in the Low-Earth Orbit Sector’, in *Economic Development of Low Earth Orbit*, p. 88.

²⁵² Ibid, p. 92.

²⁵³ Ibid, p. 93.

research students), a firm can have access to a wide range of useful tools and know-how, such as government sponsored research facilities, world class researchers and an inside view of multiple emerging technologies with the potential for IP licensing.²⁵⁴

Box 3.2 – SBIR and STTR Programs

They are two federal programs that aim to support new American business entities during the research and development (R&D) phases of new technologies that have potential for commercialization.¹ Results are twofold: on one hand, companies profit from the commercialization of their products; on the other hand, such activities spur economic growth.² Funds for small businesses are made available by federal agencies/departments, which participate to the programs according to specific R&D budget criteria (>US\$100 million for SBIR and > US\$1 billion for STTR), and are assigned through a competitive award-based structure: each federal institution establishes the topics to which small business may apply in their solicitations (within guidelines established by Congress), then receives all the proposals by entrepreneurs and finally chooses projects with the highest attractiveness and potential for success.^{3, 4} Thanks to these funds, small entities have the chance to compete in the marketplace with the big corporations.⁵

Apart from the common goals of stimulating innovation and increasing private-sector commercialization of innovations derived from federal R&D, SBIR and STTR have two specific purposes, respectively to foster and encourage participation in innovation and entrepreneurship by socially and economically disadvantaged persons, and to foster technology transfer through cooperative R&D between small businesses and research institutions.^{6, 7} In fact, STTR is slightly different from SBIR: to be eligible, it requires that each small business must collaborate with a US non-profit research institution during the pre-commercialization phases. Establishing a partnership such this allows synergies to be exploited by combining the entrepreneurial skills (more application-oriented) and the theoretical high-tech know-how of the research centres.⁸

NASA is one of the Federal Agencies to participate in the programs. Its R&D budget exceeds US\$1 billion, so each year NASA is required to reserve 3.2 percent and 4.5 percent (starting from FY 2017) of the budget respectively for SBIR and STTR awards.⁹ The percentages change every year (in 2011, SBIR guarantees 2.5 percent of the agencies' budget).¹⁰

¹ SBIR.gov, 'About SBIR', *SBIR.gov*, [website], <https://www.sbir.gov/about/about-sbir> (accessed April 2017).

² Ibid.

³ Ibid.

⁴ SBIR.gov, 'About STTR', *SBIR.gov*, [website], <https://www.sbir.gov/about/about-sttr> (accessed April 2017).

⁵ SBIR.gov, 'About SBIR'.

⁶ Ibid.

⁷ SBIR.gov, 'About STTR'.

⁸ Ibid.

⁹ SBA Office of Investment and Innovation, *SBIR/STTR Program Overview Presentation*, 2016. Available from: <https://www.sbir.gov/about/about-sbir> (accessed March 2017).

¹⁰ Ibid.

²⁵⁴ M. Wiskerchen, 'The Emerging Organizational Framework for the Space Commerce Enterprise', *International Journal of Innovation Science*, vol. 2 Issue: 4, 2010, p. 137.

SBIR and STTR are divided into three phases:

- **Phase I.** During this phase, the practicability and the commercial potential of the projects are assessed through a competitive selection process, as well as the expected added value that such projects may bring to NASA.¹¹ The brightest projects receive the Phase I awards and become eligible for Phase II awards.¹² SBIR and STTR Phase I awards normally do not exceed US\$150,000 total costs respectively for 6 months and 1 year.^{13, 14}
- **Phase II.** Awards are addressed to the stage that goes from the development to the delivery of the proposed innovation.¹⁵ Funding depends on the results obtained during Phase I.¹⁶ SBIR and STTR Phase II awards normally do not exceed US\$1,000,000 total costs for 2 years.^{17, 18}
- **Phase III.** It focuses on the proposed product/service commercialization, including further development of technologies in order to be incorporated into NASA programs (but also into other Government agencies, or the private sector).¹⁹ SBIR and STTR's Phase III do not provide any funding.^{20, 21} In fact, money comes from other sources and it may be delivered not necessarily on the basis of a further competition process.²²

¹¹ NASA, 'Annual SBIR/STTR Report 2016', *SBIR & STTR Program Publications*, 2016, p. 9, <https://sbir.gsfc.nasa.gov/content/publications> (accessed March 2017).

¹² SBIR.gov, 'About SBIR'.

¹³ Ibid.

¹⁴ SBIR.gov, 'About STTR'.

¹⁵ NASA, 'Annual SBIR/STTR Report 2016', p. 9.

¹⁶ SBIR.gov, 'About SBIR'.

¹⁷ Ibid.

¹⁸ SBIR.gov, 'About STTR'.

¹⁹ NASA, 'Annual SBIR/STTR Report 2016', p. 9.

²⁰ SBIR.gov, 'About SBIR'.

²¹ SBIR.gov, 'About STTR'.

²² NASA, 'Annual SBIR/STTR Report 2016', p. 9.

US VC market have also recorded successful exits from space-related companies, some of which are presented in the next pages. The aim of this detailed analysis is to provide the reader with concrete examples of timing and amounts of VC funding, as well as the applicable opportunities for space-related technologies. The companies considered are The Climate Corporation and deCarta.

3.1.1 Example of US VC-backed companies

(a) The Climate Corporation

The Climate Corporation is a company based in San Francisco, which stands out in the agricultural field providing support to farmers across the globe through detecting technologies and “big data” analysis. In particular, the company’s support results in helping farmers to increase rents on existing land and better tackle adversities that may arise throughout a crop season.²⁵⁵ The risk-management tools comprise an online service that delivers crop planning, monitoring, recommendations, and insurance offerings.²⁵⁶

Climate’s business relies on its Climate FieldView Platform, a technology platform that integrate hyper-local weather monitoring, agronomic data modelling, and high-resolution weather simulations, delivering a full set of monitoring, analytics and risk-management services that covers an entire season.²⁵⁷ Customers have access to the platform through their personal account, in which all gathered real-time data are stored.²⁵⁸ The data collection is carried out mainly through two tools:

- *FieldView Drive*. It is a Bluetooth enabled device that connects to a tractor or combine and gathers machine data during planting and harvest.²⁵⁹ Key planting data includes hybrid and planting population, while yield pertains to key harvest data.²⁶⁰ Thanks to its Bluetooth technology, it can provide seamless data mapping onto an iPad, where farmers can access them in real time.²⁶¹
- *Field Health Advisor*. It portrays crop health through satellite pictures²⁶² and uses two indexes for analysing a farmer’s fields: the vegetation map, which is a standard index that enable users to compare data across time and across fields; and the scouting map, which is a more precise index that uses two-colour picturing for distinguishing between differently performing areas (e.g. red areas are the relatively poorest areas in the field).²⁶³

The Climate Corporation was founded in 2006 as WeatherBill by David Friedberg, previously manager at Google.²⁶⁴ At the time, the company (backed by Nephila Capital, an investment manager

²⁵⁵ Monsanto Company, ‘Monsanto to Acquire The Climate Corporation, Combination to Provide Farmers with Broad Suite of Tools Offering Greater On-Farm Insights’, *Monsanto: Newsroom*, [website], 2 October 2013, <http://news.monsanto.com/press-release/corporate/monsanto-acquire-climate-corporation-combination-provide-farmers-broad-suite> (accessed March 2017).

²⁵⁶ Ibid.

²⁵⁷ Ibid.

²⁵⁸ Monsanto Company, ‘The Climate Corporation Launches New Climate FieldView Drive™ to Simplify Data Collection, Storage and Visualization for Farmers’, *Monsanto Newsroom*, [website], 26 January 2016, <http://news.monsanto.com/press-release/climate/climate-corporation-launches-new-climate-fieldview-drive-simplify-data-collect> (accessed March 2017).

²⁵⁹ Wikipedia, ‘The Climate Corporation’, *Wikipedia*, [website], https://en.wikipedia.org/wiki/The_Climate_Corporation#cite_note-7 (accessed March 2017).

²⁶⁰ Monsanto Company, ‘The Climate Corporation Launches New Climate FieldView Drive™’

²⁶¹ Ibid.

²⁶² Wikipedia, ‘The Climate Corporation’.

²⁶³ The Climate Corporation, *Climate FieldView™ Pro: Field Health Advisor*, [online video], 4 December 2015, <https://vimeo.com/147874695> (accessed March 2017).

²⁶⁴ M. Arrington, ‘Use WeatherBill To Bet On The Weather’, *TechCrunch*, [website], 2 January 2007, <https://techcrunch.com/2007/01/02/use-weatherbill-to-bet-on-the-weather/> (accessed March 2017).

specializing in reinsurance risk and the company's risk capacity partner)²⁶⁵ provided weather insurance policies to both individuals and businesses, using a complex algorithm for forecasting climatic conditions.²⁶⁶ Insurance policies were sold only to accredited investors (having a business was not a requirement for acquirers), then risk was handed in to hedge funds: in such a way, the company guaranteed to itself (almost) secure profits, regardless of the weather conditions.²⁶⁷

WeatherBill raised its seed round in January 2007. US\$4.3 million was provided by two main investors, namely New Enterprise Associates (NEA)²⁶⁸ and Index Ventures²⁶⁹, as well as a substantial number of angels, which includes Joshua Schachter (founder of del.icio.us), Howard Morgan (First Round Capital), Sean Park (Anthemis Group), Niklas Zennstrom (Atomico Investments) and others.²⁷⁰

Nine months later, the company secured another US\$12.5 million during the first (Series A) financing round, led by NEA and Index Ventures.²⁷¹ Allen & Company, Atomico (through Niklas Zennstrom), Joshua Schachter and Howard Morgan also participated.²⁷² Together with the disclosure of the investment, the company communicated that Kittu Kolluti (from NEA) and Neil Rimer (from Index Ventures) would join WeatherBill's Board of Directors, as well as Barney Schauble (partner at Nephila Capital).²⁷³ The funding was intended to support the business in the US and Canada and to boost company's expansion in Europe, particularly in UK, Germany, Netherlands, Spain and Norway.²⁷⁴ On that occasion, Friedberg said: *'This funding allows us to offer our clients more customizable weather protection as we add additional locations to our service, offer newly supported weather conditions, and enhance the ease of purchase. Strong investment support and advice from these market leading investors is invaluable and will result in more accessible and affordable weather protection for businesses worldwide.'*²⁷⁵

In 2010 WeatherBill launched Total Weather Insurance, the first program that granted to US farmers a protection against the adverse weather conditions throughout the entire season.²⁷⁶ The insurance,

²⁶⁵ PR Newswire, 'WeatherBill Closes \$12.5 Million Series A Financing Led by New Enterprise Associates and Index Ventures; Launches Service in Europe', *PR Newswire*, [website], 17 October 2007, <http://www.prnewswire.com/news-releases/weatherbill-closes-125-million-series-a-financing-led-by-new-enterprise-associates-and-index-ventures-launches-service-in-europe-58691147.html> (accessed March 2017).

²⁶⁶ Arrington, 'Use WeatherBill To Bet On The Weather'.

²⁶⁷ Ibid.

²⁶⁸ NEA is a venture capital firm specialised in IT and healthcare sectors. For more details, see <http://www.nea.com>

²⁶⁹ Index Ventures is a European company with a portfolio of leading technology and biotech companies across Europe, Israel and US For more details, see <http://www.indexventures.com>

²⁷⁰ M. Arrington, 'WeatherBill Launches, Announces All Star Investors', *TechCrunch*, [website], 15 January 2007, <https://techcrunch.com/2007/01/15/weatherbill-launches-announces-all-star-investors/> (accessed March 2017).

²⁷¹ N. Deleon, 'Weather Derivatives Provider WeatherBill Takes \$12.5 Million More', *TechCrunch*, [website], 17 October 2007, <https://techcrunch.com/2007/10/17/an-interesting-bet-weatherbill-takes-125-million-series-b/> (accessed March 2017).

²⁷² Ibid.

²⁷³ PR Newswire, 'WeatherBill Closes \$12.5 Million Series A Financing'.

²⁷⁴ Ibid.

²⁷⁵ Ibid.

²⁷⁶ Business Wire, 'WeatherBill Raises \$42 Million to Expand Technology Platform that Helps Farmers Worldwide Adapt to Climate Change', *Business Wire*, [website], 28 February 2011, <http://www.businesswire.com/news/home/20110228006841/en/WeatherBill%C2%AE-Raises-42-Million-Expand-Technology-Platform> (accessed March 2017).

which came up beside the governmental crop insurance, had the advantage of delivering the payment automatically (i.e. without claims) on the basis of climatic conditions.²⁷⁷

A new round (Series B) was carried out in February 2011. Leading investors Khosla Ventures and Google Ventures (GV), as well as NEA, Index Ventures, Allen & Company, First Round Capital, Atomico and CODE Advisors, brought US\$42 million into the company, in order to support its product and sales growth in the US and worldwide.²⁷⁸ GV's rationale for this investment lies in the words of Bill Maris, at the time managing partner of GV: *'Google Ventures' mission is to identify and fund big ideas – and WeatherBill's vision of helping farmers adapt to climate change aligns perfectly with that mission.*²⁷⁹ Khosla Ventures was instead motivated by its long-time involvement with clean technology, agriculture, internet, computing, mobile and semiconductors firms.²⁸⁰

In October 2011, the company changed its name to The Climate Corporation.²⁸¹ At the time, Total Wealth Insurance covered almost 1000 farmers.²⁸²

In June 2012, the US\$50 million third round (Series C) was led by Founders Fund²⁸³, with the participation of Khosla Ventures, Google Ventures, NEA, Index Ventures, Atomico, Glynn Capital, and Western Tech Investment.²⁸⁴

In October 2013, Monsanto announced that it has reached an agreement for the acquisition of Climate Corporation for an approximate price of US\$ 930 million.²⁸⁵ This M&A event aimed to augment both the near- and long-term growth chances for Monsanto's business (in particular, its Integrated Farming Systems platform), and to integrate Climate's know-how in agriculture analytics and risk management with Monsanto's R&D capacity.²⁸⁶ Moreover, the acquisition was in line with Monsanto's vision, since the two firms shared the goal of improving the life of people around the world and conserving Earth's resources by enhancing the efficiency of human activities.²⁸⁷ The acquisition was concluded on November 1, 2013.²⁸⁸ After completion, the value of Monsanto's shares increased from US\$103.64 (value at 04 November 2013) to US\$113.29 (value at 02 December 2013).²⁸⁹ In the same month, the company launched Climate and Climate Basic Pro, then renamed Climate FieldView in 2015.²⁹⁰

²⁷⁷ Business Wire, 'WeatherBill Raises \$42 Million to Expand Technology Platform'.

²⁷⁸ Ibid.

²⁷⁹ Ibid.

²⁸⁰ Ibid.

²⁸¹ Wikipedia, 'The Climate Corporation'.

²⁸² Enhanced Online News, 'The Climate Corporation Raises \$50 Million in Financing Round Led by Founders Fund', *Enhanced Online News*, [website], 14 June 2012, <http://www.enhancedonlinenews.com/news/eon/20120614005316/en> (accessed March 2017).

²⁸³ Founders Fund provides capital to transformational business run by world-class entrepreneurs. The company and its partners have supported some of the most prominent start-ups of the past decade (e.g. Facebook, SpaceX and Spotify).

²⁸⁴ Enhanced Online News, 'The Climate Corporation Raises \$50 Million'.

²⁸⁵ Monsanto Company, 'Monsanto to Acquire The Climate Corporation'.

²⁸⁶ Ibid.

²⁸⁷ Ibid.

²⁸⁸ Monsanto Company, 'Monsanto Completes Acquisition of The Climate Corporation', *Monsanto Newsroom*, [website], 1 November 2013, <http://news.monsanto.com/press-release/corporate/monsanto-completes-acquisition-climate-corporation> (accessed March 2017).

²⁸⁹ Data on share value are retrieved from Zephyr, <https://zephyr.bvdinfo.com/>.

²⁹⁰ Wikipedia, 'The Climate Corporation'.

Following the acquisition by Monsanto, the Climate Corporation was involved in some M&A operations that have increased its technological capabilities:

- *Solum's soil science business* (February 2014). Solum is a Californian company that operates as a soil analysis service provider.²⁹¹ With this acquisition, Climate obtained the Solum brand, soil testing intellectual property, the soil test lab in Ames, Iowa, and Solum's No-Wait Nitrate platform, while Solum has been rebranded in Granular, Inc., remaining in any case independent from Climate.²⁹² Friedberg comments were: *'The technology The Climate Corporation is gaining in this acquisition, as well as the research and development we currently have underway, will continue to improve our ability to deliver better insights and recommendations to farmers.'*²⁹³
- *640 Labs* (December 2014). It is a company based in Chicago whose mission is to help farmers in gathering and stocking in-field data by the means of analytics, mobile technologies and cloud computing.²⁹⁴
- *WeatherMe OÜ/VitalFields* (November 2016). It is a European farm management software company based in Tallinn and it offers a user-friendly tool for organizing, handling and examining field activities, such as simplified tracking and reporting of all crop inputs that help farmers to meet European Union environmental standards.²⁹⁵

²⁹¹ Monsanto Company, 'The Climate Corporation Announces Acquisition of Soil Analysis Business Line of Solum, Inc.', *Monsanto Newsroom*, [website], 20 February 2014, <http://news.monsanto.com/press-release/corporate/climate-corporation-announces-acquisition-soil-analysis-business-line-solum-> (accessed March 2017).

²⁹² Ibid.

²⁹³ Ibid.

²⁹⁴ Monsanto Company, 'The Climate Corporation Acquires 640 Labs, Team to Bolster Industry-Leading Data Science Capabilities', *Monsanto Newsroom*, [website], 8 December 2014, <http://news.monsanto.com/press-release/climate/climate-corporation-acquires-640-labs-team-bolster-industry-leading-data-scien> (accessed March 2017).

²⁹⁵ Monsanto Company, 'The Climate Corporation Acquires VitalFields to Expand Digital Agriculture Innovation for European Farmers', *Monsanto Newsroom*, [website], 21 November 2016, <http://news.monsanto.com/press-release/climate/climate-corporation-acquires-vitalfields-expand-digital-agriculture-innovation> (accessed March 2017).

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Table 9 - The Climate Corporation: financing rounds.²⁹⁶

Date	Funding Type	Round	Amount	Investors	Partner(s)	Investor Type
15-Jan-07	Seed	-	US\$4.30	Atomico David J. La Placa Eytan Elbaz Howard Morgan Index Ventures Joshua Schachter New Enterprise Associated Salman Ullah Sean Park	Niklas Zennstrom - - - - - - - -	Angel Investor Angel Investor Angel Investor Angel Investor Venture Capital Angel Investor Venture Capital Angel Investor Angel Investor
17-Oct-07	Venture	Series A	US\$12.50	Allen & Company Atomico Index Ventures (Lead) New Enterprise Associates (Lead) Sean Park	- Niklas Zennstrom Neil Rimer Kittu Kolluri -	Investment Bank Venture Capital Venture Capital Venture Capital Angel Investor
28-Feb-11	Venture	Series B	US\$42.00	Allen & Company Atomico CODE Advisors First Round Capital GV (Lead) Index Ventures Khosla Ventures (Lead) New Enterprise Associates	- Niklas Zennstrom - Howard Morgan Bill Maris Neil Rimer Mike Kourey Kittu Kolluri	Investment Bank Venture Capital Investment Bank Venture Capital Venture Capital Venture Capital Venture Capital Venture Capital
14-Jun-12	Venture	Series C	US\$50.00	Atomico Founders Fund (Lead) Glynn Capital Management GV Index Ventures Khosla Ventures New Enterprise Associates Western Technology Investment	Niklas Zennstrom Brian Singerman - Bill Maris Neil Rimer Mike Kourey Kittu Kolluri -	Venture Capital Venture Capital Venture Capital/ Hedge Fund Venture Capital Venture Capital Venture Capital Venture Capital Venture Capital/ Debt Provider
01-Nov-13	Acquisition	Exit	US\$930	Monsanto	-	Corporation

²⁹⁶ Data are retrieved from CrunchBase, <https://www.crunchbase.com>, and Zephyr, <https://zephyr.bvdinfo.com/>.

(b) deCarta

deCarta offers to its client geolocation services to be integrated in mobile devices or in browsing, in order to customize contents and apps and to provide location-based advertising, for example. Nowadays, applications that incorporate local search and maps are crucial in order to make the internet experience more valuable for users, and deCarta leverages on this aspect.²⁹⁷ Considering also that the development of geospatial technology is difficult to realize, deCarta has an incredibly valuable asset to commercialize and sell to corporations.²⁹⁸ The service is attractive not only because it allows clients to customize it according to their needs, but also because they no longer need the “generic” consumer mapping services provided by Internet Service Provider (ISP) like Google and Bing²⁹⁹: corporations now can offer their own branded suite of local search and location services, avoiding the need to include ISPs in the monetization opportunities linked to such services.³⁰⁰

DeCarta offers a wide range of products and services:

- *Geospatial Platform*. It gives to customers the chance of improving app location services through APIs and the ability of working with a lot of geo-data from different datasets and/or different regions.³⁰¹
- *L2 Geosearch Engine*. L2 provides two types of research: an advanced one that can be personalized for each user across over 122 countries; a standard one, useful for a mere address or Point of Interest³⁰² (POI) search.³⁰³ Both the searches rely on a user-friendly interface, characterized by a single line input.³⁰⁴
- *REST APIs and SDKs*. deCarta’s REST API is an easy-to-use interface designed for Location-Based Services (LBSs), while the Software Development Kits (SDKs) are tools that allow easy development of location services for applications supporting maps, routing, geocoding, and other advanced LBS features.³⁰⁵

²⁹⁷ deCarta, ‘deCarta, The LBS Platform Company’, *deCarta: Company Overview*, [website]. Available from: Wayback Machine | Internet Archive, <http://web.archive.org/web/20161019202333/http://decarta.com/company/about.html> (accessed April 2017).

²⁹⁸ Ibid.

²⁹⁹ Ibid.

³⁰⁰ PR Newswire, ‘deCarta Prepares for Expansion with New Funding Round’, *PR Newswire*, [website], 22 December 2010, <http://www.prnewswire.co.uk/news-releases/decarta-prepares-for-expansion-with-new-funding-round-153054645.html> (accessed April 2017).

³⁰¹ deCarta, ‘deCarta Geospatial Platform’, *deCarta: Products*, [website]. Available from: Wayback Machine | Internet Archive, http://web.archive.org/web/20161019200424/http://decarta.com/products/geospatial_platform.html (accessed April 2017).

³⁰² ‘A point of interest, or POI, is a specific point location that someone may find useful or interesting. Most consumers use the term when referring to hotels, campsites, fuel stations or any other categories used in modern (automotive) navigation systems.’ Source: https://en.wikipedia.org/wiki/Point_of_interest

³⁰³ deCarta, ‘deCarta L2 Geosearch Engine’, *deCarta: Products*, [website]. Available from: Wayback Machine | Internet Archive, http://web.archive.org/web/20161019202924/http://decarta.com/products/local_search_engine.html (accessed April 2017).

³⁰⁴ Ibid.

³⁰⁵ deCarta, ‘deCarta REST API and SDKs’, *deCarta: Products*, [website]. Available from: Wayback Machine | Internet Archive,

- *Turn-by-Turn Navigation.* Xplorer V9 is the deCarta's navigation platform, which relies on a cloud-based navigation service for devices such as smartphones and tablets.³⁰⁶ It is equipped with SDKs that allow developers to add the turn-by-turn navigation functionality to their applications.³⁰⁷ In particular, it is possible to combine local search and map display and navigation, in order to create a customized navigation application or to improve other applications with geo-services.³⁰⁸

The company was founded in 1996 as Telcontar and had its headquarter in San Jose (California). The core business consisted of providing their corporate customers with geospatial and LBS (Local-Based Service) services, as well as the possibility to integrate digital maps with traditional databases, in order to customize users' browsing.³⁰⁹ In particular, thanks to Telcontar's effort, companies like Yahoo! and Hutchinson 3G was able to make available for their customers complete, real-time, highly scalable solutions for navigation, mobile safety, security and convenience.³¹⁰

Such a wide range of services was the result of two M&A operations. In the first place, on March 2002 Telcontar acquired Gravitare, a company which developed wireless application software.³¹¹ The deal allowed synergies between Telcontar's capabilities and Gravitare's to be exploited, improving consequently the services offered by Telcontar.³¹² Eric Carlson, at the time Telcontar's CEO, said: *'Gravitare's ability to extract data points from moving through its database technology compliments our map-focused approach extremely well. Applications can use the technology to LBS Gravitare included real time traffic monitoring, asset management tracking, push advertising, emergency response and vehicle software platform for location-based services currently available. The combined result is Telcontar can offer its customers the most comprehensive software platform for location-based services currently available.'*³¹³ Secondly, on February 2005 there was the merger with Televoke, previously announced in 2003.³¹⁴ Televoke guaranteed security telematics services via GPS and its customers were notified by email, phone or pager if their assets were at risk.³¹⁵

During the two-year period 2004-2005, Telcontar raised two rounds of funding:

http://web.archive.org/web/20160925102735/http://www.decarta.com/products/client_apis.html (accessed April 2017).

³⁰⁶ deCarta, 'Xplorer — deCarta's Turn-by-Turn Navigation solution', *deCarta: Products*, [website]. Available from: Wayback Machine | Internet Archive,

http://web.archive.org/web/20161019194709/http://decarta.com/products/tbt_navigation.html (accessed April 2017).

³⁰⁷ Ibid.

³⁰⁸ Ibid.

³⁰⁹ Telcontar, 'About Telcontar', *Telcontar: Company Overview*, [website]. Available from: Wayback Machine | Internet Archive,

<http://web.archive.org/web/20050308020633/http://www.telcontar.com/company/index.html> (accessed April 2017).

³¹⁰ Ibid.

³¹¹ Retrieved from Zephyr, <https://zephyr.bvdinfo.com/> (accessed April 2017).

³¹² Ibid.

³¹³ Ibid.

³¹⁴ Ibid.

³¹⁵ Ibid.

- A Series A financing round on January 2004, to which Mobius Venture Capital participated as a leading investor together with the other existing investors, as well as members of the management team.³¹⁶ The investment was intended to expand existing product lines.³¹⁷
- A Series B financing round on March 2005. Mobius Venture Capital, Cardinal Venture Capital and Venture Capital Ford joined the leading investor Norwest Venture Partners (NVP), collecting US\$10.68 million³¹⁸ addressed to increase sales and marketing operations, international expansion and new product development³¹⁹.

With the name of deCarta, the company received a third financing round (Series C) on July 2007, still led by Norwest Venture Partners with the participation of Mobius and Cardinal.³²⁰ The raised US\$15 million was used for growth purposes and international expansion.³²¹ Using the words of Kim Fennel (CEO): *'[deCarta is] thrilled to have the ongoing support of [its] initial investors in this expansion round, and [it plans] to use the funds to fully leverage [its] unique LBS technology to more broadly serve the marketplace.'*³²²

On June 2008, T-Mobile Venture Fund, T-Mobile's venture arm (which is part of Deutsche Telekom), invested US\$6 million in the company.³²³ It was the first tranche of a bigger round, which was completed on July 2008 with an additional US\$20 million investment provided by Hotung Group, TransLink Capital and NVP.³²⁴ The investment of Hotung was strategic for deCarta's expansion in Asia.³²⁵ On August 2010 six unknown investors completed a new venture financing of US\$6.17 million.³²⁶ Initially, the amount was US\$10.24 million, but the company did not manage to pick them up.³²⁷ In December a US\$9.4 million fourth round (Series D) was led by the major existing investors (Capital, Mobius, NVP, TransLink and T-Mobile).³²⁸ Money was directed to investments in sales, marketing and engineering.³²⁹ The last round was in July 2012: US\$ 3.96 million from unrevealed investors.³³⁰

³¹⁶ Telcontar, 'Telcontar Secures A1 Funding Round of 6.6 Million', *Telcontar: Press Release*, [website], 9 January 2004. Available from: Wayback Machine | Internet Archive, <http://web.archive.org/web/20050309072123/http://telcontar.vnewscenter.com/press.jsp?id=1099598016145> (accessed April 2017).

³¹⁷ Retrieved from Zephyr, <https://zephyr.bvdinfo.com/> (accessed April 2017).

³¹⁸ PE Hub, 'PE Week Wire – Friday, March 18', *PE Hub*, [website], 18 March 2005, <https://www.pehub.com/2005/03/pe-week-wire-friday-march-18/> (accessed April 2017).

³¹⁹ Retrieved from Zephyr, <https://zephyr.bvdinfo.com/> (accessed April 2017).

³²⁰ PR Newswire, 'deCarta Raises \$15 Million in Expansion Round of Funding', *PR Newswire*, [website], 24 July 2007, <http://www.prnewswire.com/news-releases/decarta-raises-15-million-in-expansion-round-of-funding-52763032.html> (accessed April 2017).

³²¹ Ibid.

³²² Ibid.

³²³ Gigaom, 'DT's T-Venture Puts \$6 Million In LBS Firm deCarta', *Gigaom*, [website], 10 June 2008, <https://gigaom.com/2008/06/10/419-dts-t-venture-puts-6-million-in-lbs-firm-decarta/> (accessed April 2017).

³²⁴ Gigaom, 'LBS Provider deCarta Raises \$20 Million Third Round', *Gigaom*, [website], 28 July 2008, <https://gigaom.com/2008/07/28/419-lbs-provider-decarta-puts-third-round-to-20-million/> (accessed April 2017).

³²⁵ Ibid.

³²⁶ Retrieved from Zephyr, <https://zephyr.bvdinfo.com/> (accessed April 2017).

³²⁷ Ibid.

³²⁸ PR Newswire, 'deCarta Prepares for Expansion with New Funding Round'.

³²⁹ Retrieved from Zephyr, <https://zephyr.bvdinfo.com/> (accessed April 2017).

³³⁰ Ibid.

In March 2015, the company was acquired by Uber for an undisclosed amount.³³¹ Uber is the start-up that has based its success on car-sharing service, through its app that uses mapping technologies. This acquisition is very important for Uber, as one can glean from the words of Uber's spokesperson: *'[Uber] will continue to fine-tune [its] products and services that rely on maps and make the Uber experience even better for [its] users.'*³³² DeCarta continues to operate as a wholly-owned subsidiary of Uber, but still using its own name.³³³

³³¹ Mashable, 'Uber acquires mapping startup deCarta', *Mashable*, [website], 4 March 2015, http://mashable.com/2015/03/03/uber-acquires-mapping-decarta/#BoLFaeX5_aqh (accessed April 2017).

³³² Ibid.

³³³ Ibid.

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Table 10 – deCarta: financing rounds.³³⁴

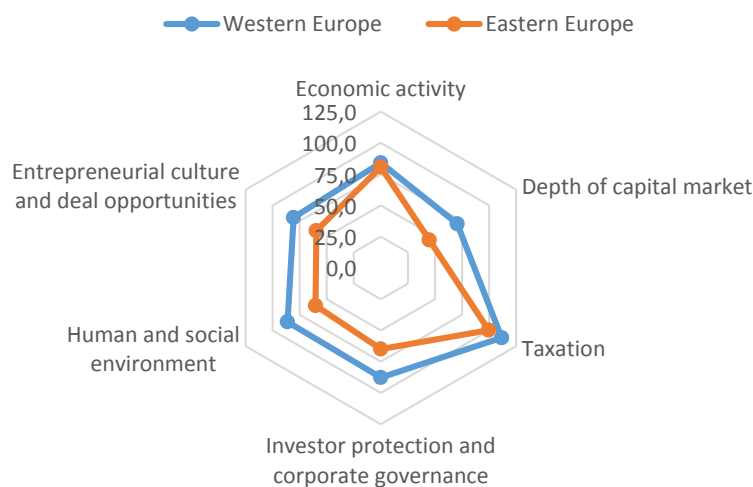
Date	Funding Type	Round	Amount	Investors	Partner(s)	Investor Type
09-Jan-04	Venture	Series A	US\$6.60	Mobius Venture Capital (Lead) Existing investors	- -	- -
21-Mar-05	Venture	Series B	US\$10.68	Cardinal Venture Capital Ford Venture Capital Group Mobius Venture Capital Norwest Venture Partners (Lead)	- - - Jeff Crowe	Private Equity firm Venture Capital Venture Capital Private Equity firm
24-Jul-07	Venture	Series C	US\$15.00	Cardinal Venture Capital Mobius Venture Capital Norwest Venture Partners (Lead)	- - Jeff Crowe	Venture Capital Venture Capital Venture Capital
10-Jun-08	Venture	Undisclosed	US\$6	T-Mobile Venture Fund	-	Corporate VC
28-Jul-08	Private Equity	-	US\$20	Hotung Capital Management Norwest Venture Partners Translink Capital Undisclosed (2)	- Jeff Crowe Toshi Otani -	Venture Capital Venture Capital Private Equity firm -
20-Aug-10	Venture	Series D	US\$6.17	Undisclosed	-	-
22-Dec-10	Venture	Series D	US\$9.40	Cardinal Venture Capital Mobius Venture Capital Norwest Venture Partners T-Mobile Venture Fund Translink Capital (Lead)	- - Jeff Crowe - Toshi Otani	Private Equity firm Venture Capital Venture Capital Corporate VC Venture Capital
17-Jul-12	Venture	Undisclosed	US\$3.96	Undisclosed	-	-
03-Mar-15	Acquisition	Exit	Undisclosed	Uber	-	Corporation

³³⁴ Data are retrieved from CrunchBase, <https://www.crunchbase.com>, and Zephyr, <https://zephyr.bvdinfo.com/>

3.2 Europe

In Europe, the VC market is not as vibrant as in the US. Some factors, including legal framework and liquidity of capital market, impact on the amount of funding that European VCs are able to collect. In addition, Europe is characterized by a very impressive gap between the Western side and the Eastern side of the continent. If we look at VCPE Country Attractiveness Index, West records an overall score of 80.5, while the East totals just 58.8, positioning in the lowest part of regional rank and preceding only Latin America (54.5) and Africa (44.3).³³⁵ Although the economic activity is almost at the same level, the huge gap is mainly due to the difference in the depth of VC market and in entrepreneurial culture/opportunities, as well as investor protection and human and social environment (Figure 15). A unique score for Northern and Southern Europe is not available, but a deductive analysis could be carried out looking at individual country scores. UK, Germany and the Nordic countries (Denmark, Sweden, Norway and Finland) rank within the first 15 positions and their score ranges from 95.5 (UK, #2) to 84.6 (Sweden, #15). Spain (#26), Portugal (#31) and Italy (#34) are not so bad in term of general performance, since they record a score respectively of 73.7, 68.6 and 67.0. Greece instead is positioned in the second half of the ranking table (it is 66th), with a score of just 53.2. It is clear that according to the Index, Northern Europe is a better environment for VC investments than Southern Europe.

Figure 15 – VCPE Country Attractiveness Index 2016: Western Europe vs. Eastern Europe.



Source: Groh et al., 'The Venture Capital and Private Equity Country Attractiveness Index', p. 25.

In Europe, the most impressive example of the VC market is represented by the UK, which outperforms the Western Europe average (see the next paragraph). The Nordic countries are especially strong in entrepreneurial opportunities.³³⁶ The DACH region (i.e. Germany, Austria and Switzerland) stands out thanks to its economic activity, a well-developed capital market, a transparent legal framework, a high innovation capacity and a strong socio-cultural environment.³³⁷ However, it has to be underlined that

³³⁵ Groh et al., 'The Venture Capital and Private Equity Country Attractiveness Index', p. 25.

³³⁶ A.P. Groh, H. Liechtenstein and K. Lieser, 'How European Countries Attract Institutional Investors' Venture Capital and Private Equity Allocations', in *SECA Yearbook 2009*, 2009, p. 39.

³³⁷ A.P. Groh, H. Liechtenstein and K. Lieser, 'The Attractiveness of DACH for Limited Partners', *BAI Newsletter*, April 2010, p. 32.

Austria (overall rank in VC Index #23) performs less than Germany (#9) and Switzerland (#10), since it has a small public capital market.³³⁸ Other distinctive features of the DACH region are a strong and reliable administrative organization, cultural attitude towards performance and diligence with low corruption and crime, which mirror strong legal protection and enforcement and an excellent human capital.³³⁹ Although it does not have a very strong capital market, it shows well-balanced good scores among six key drivers of VCPE Index.³⁴⁰ France has the second largest capital market in Europe, but rigid labour market policies, less capacity for innovation and more difficulties of starting, running and closing business diminish the attractiveness of the country.³⁴¹ However it ranks at 21st position.

Another important factor in determining Europe's attractiveness for VC investors is legislation. In Europe, the main rule of law concerning venture capital is represented by European Union's legislation (UK will not be tied anymore to it if the Brexit process is completed). After the financial crisis, the regulatory framework was made stricter, making it harder to attract investments (compared to the US).³⁴² The current EU regulations rely on two cornerstones:

- The Alternative Investment Fund Managers Directive (AIFMD) provides a standardized framework relating to managing and marketing alternative investment for all member states.³⁴³ It applies to VC fund managers that are settled in the EU and that operate closed-ended, unleveraged funds in the EU with aggregated assets worth €500 million or more, or leveraged funds equal or greater than €100 million.³⁴⁴ The AIFMD provides fund managers with the chance of raising money in all of the EU, without having to ask for authorization by national authority regulators.³⁴⁵ In such a way, fundraising is facilitated and costs and administrative barriers are reduced.³⁴⁶ There are many beneficial aspects, but on the other hand firms have to comply with some commitments, such as respecting a set of requirements, meeting disclosure and valuation standards, reporting regularly to national regulators on their activity and exposure levels to different types of investment, as well as holding certain minimum amounts of capital, appointing a depositary to monitor fund cash flows, and manage custody assets and verify valuations.³⁴⁷ In addition, the Directive also establishes new boundaries on the amount of leverage that can be used at a fund level.³⁴⁸
- The European Venture Capital Fund Regulation (EuVECA) is a voluntary scheme, whose participants can benefit from lighter requirements than AIFMD.³⁴⁹ The Regulation was designed in order to facilitate the funding of innovative, high-growth companies and small and

³³⁸ Groh, Liechtenstein and Lieser, 'The Attractiveness of DACH for Limited Partners', p. 32.

³³⁹ Ibid, p. 33.

³⁴⁰ Ibid, p. 33.

³⁴¹ Ibid, p. 33.

³⁴² Invest Europe, 'Guide to Private Equity and Venture Capital for Pension Fund', p. 31.

³⁴³ Ibid, p. 31.

³⁴⁴ Ibid, p. 31.

³⁴⁵ Ibid, p. 31.

³⁴⁶ Ibid, p. 31.

³⁴⁷ Ibid, p. 31.

³⁴⁸ Ibid, p. 31.

³⁴⁹ Ibid, p. 31.

medium-sized enterprises.³⁵⁰ Eligible fund managers have to hold assets with a total value below €500 million.³⁵¹

Institutional investors have also to comply with their regulatory framework, in particular with the new rules established by Solvency II (for example, European insurance companies are obliged to hold more capital if they want to invest in illiquid asset classes such as venture capital).³⁵² In 2016, EU bodies decided to review legislation on European Venture Capital Funds and European Social Entrepreneurship Funds, in order to boost the chances for young entrepreneurs to access private funds.³⁵³

Despite a relatively favourable VC market, investments in space are not so huge: this is presumably due to conservative approach towards space sector in general and lower risk tolerance among European investors.³⁵⁴ This means that in Europe space activities are mainly funded through public resources, and in particular by the European Space Agency (ESA)³⁵⁵. There are many programs in Europe aiming to support new space start-ups, such as the Competitiveness of Enterprises and Small and Medium-sized Enterprises (COSME) programme and Horizon 2020 R&D programme.³⁵⁶ However, the two programmes that are making a big difference in the space industry are ARTES and BIC.

The **Advanced Research in Telecommunications Systems**³⁵⁷ (ARTES) programme tries to turn R&D efforts into successful commercial products (it is the European version of the NASA's SBIR/STTR).³⁵⁸ ARTES is organised in three segments:

- The downstream segment for Integrated and SatCom Applications and Services *'supports the development and delivery of operational services.'*³⁵⁹ It received almost €67 million funding from ESA, which was applied to 61 projects.³⁶⁰ In 27 projects out of 61, private investors also participated, committing €55.4 million.³⁶¹ Further third-party investment of €112 million (including €100 million from the newly formed private Seraphim Space Fund, see § 3.2.1) are expected.³⁶²
- The Core Competitiveness segment *'supports the development of new products or improvement of existing ones, thus stimulating innovation and strengthening the*

³⁵⁰ Invest Europe, 'Guide to Private Equity and Venture Capital for Pension Fund', p. 31.

³⁵¹ Ibid, p. 31.

³⁵² Ibid, p. 31.

³⁵³ A. González, 'A Snapshot of Commercial Space: An EU Fellowship Report', *CSTPR White Paper*, no. 1, 2017, p. 21.

³⁵⁴ Ibid, p. 21.

³⁵⁵ The European Space Agency (ESA) is an intergovernmental organisation dedicated to the exploration of space. Source: https://en.wikipedia.org/wiki/European_Space_Agency.

³⁵⁶ González, 'A Snapshot of Commercial Space', p. 21.

³⁵⁷ For further details see <https://artes-apps.esa.int/>.

³⁵⁸ European Space Agency, 'ESA: Powering European Growth', *ESA Publications*, 2016, no. 331, p. 1, http://www.esa.int/About_Us/ESA_Publications/ESA_Publications_Brochures/ESA_BR-331_SPACE_ECONOMY (accessed April 2017).

³⁵⁹ Ibid, p. 1.

³⁶⁰ Ibid, p. 1.

³⁶¹ Ibid, p. 1.

³⁶² Ibid, p. 1.

*competitiveness of European companies in the global market.*³⁶³ ESA has allocated €30 million to this part of the programme.³⁶⁴

- The Public-Private Partnerships segment addresses particular bigger activities, with budgets typically in the tens or hundreds of million euros.³⁶⁵ These projects are co-founded both from public and private investors.³⁶⁶

ESA's **Business Incubation Centres** (BICs) instead provide selected entrepreneurs with '*comprehensive commercial and technical assistance to help them start up business that apply space technology to non-space industrial, scientific and commercial fields.*'³⁶⁷ With this programme, ESA support almost 130 companies every year in Europe, reaching a total number of backed projects greater than 400 to date.³⁶⁸

However, the scope and support that the agency can offer to space companies are limited. Since other sources of funding are scarce, start-ups backed by ESA struggle to grow once grant-funding ends. In order to shake this stagnant situation, in the last quarter of 2015 ESA signed an agreement with the Seraphim Space & Special Situations Fund to back new space projects (see the next paragraph).

3.2.1 United Kingdom

As mentioned, the best performing VC market in Europe is in the UK. There is a significant difference between UK and continental Europe. The UK is characterized by a better financial market infrastructure and corporate governance culture, which fosters investors' confidence, trust and security.³⁶⁹ Even the legal framework is more suitable, thanks to common law system.³⁷⁰ However, some changes in the legal framework are expected in the case of a complete exit of the UK from the EU.³⁷¹ The UK has a very high overall score (95.5) and it is the second best VC market in the world after the US. From certain points of view, it performs better, in fact the level of taxation is preferable compared to the US (Figure 16). The UK's real strength is the well-developed financial market (89.2 score against 70.6 of the entire Western Europe).

It is not the case that the Seraphim Fund for space start-ups has been established in UK. The Fund was born from the initiative of David Williams, CEO of Avanti³⁷². On behalf of former UK Minister David Willets, who wanted to address the lack of risk capital in the UK space sector, Williams identified a suitable fund manager in Seraphim Capital, thanks to the collaboration with the whole European

³⁶³ European Space Agency, 'ESA: Powering European Growth', p. 1.

³⁶⁴ Ibid, p. 1.

³⁶⁵ Ibid, p. 2.

³⁶⁶ Ibid, p. 2.

³⁶⁷ Ibid, p. 2.

³⁶⁸ European Space Agency, 'ESA Business Incubation Centres', *ESA: Space Engineering and Technology*, [website], http://www.esa.int/Our_Activities/Space_Engineering_Technology/Business_Incubation/ESA_Business_Incubation_Centres12 (accessed April 2017).

³⁶⁹ Groh, Liechtenstein and Lieser, 'The Attractiveness of DACH for Limited Partners', p. 33.

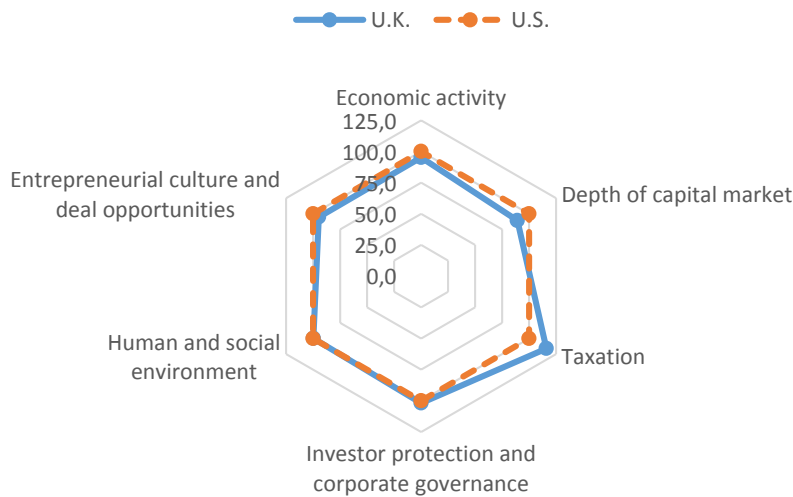
³⁷⁰ Groh, Liechtenstein and Lieser, 'How European Countries Attract Institutional Investors' Venture Capital and Private Equity Allocations', p. 39.

³⁷¹ Invest Europe, 'Guide to Private Equity and Venture Capital for Pension Fund', p. 31.

³⁷² Avanti Communications Group is a leading provider of satellite data communications services in Europe, the Middle East and Africa. Official website: <http://www.avantiplc.com/about-avanti/>.

venture community.³⁷³ This investigation led in 2016 to the creation of the Seraphim Space & Special Situations Fund.

Figure 16 – VCPE Country Attractiveness Index 2016: United Kingdom vs. United States.



Source: Groh et al., 'United Kingdom VCPE Country Attractiveness Index', *IESE Blog Network*, 2016
<http://blog.iese.edu/vcpeindex/unitedkingdom/> (accessed April 2017).

The Fund is now worth £50 million³⁷⁴ and is conceived as part of UK's Space Innovation and Growth Strategy, started in 2010³⁷⁵. It works alongside ESA's ARTES programme and is supported by the UK Space Agency collaborating with private companies, such as Thales Alenia Space, Airbus Defence & Space, Telespazio, Com Dev International, Avanti Communications and e2v.³⁷⁶ The aim is to exploit synergies deriving from the partnership between government, industry and academia in order to provide new sources of funding to projects, accelerate business growth and market opportunities for industry.³⁷⁷ Projects include space technologies, emerging products, applications, associated services realized with ESA's help.³⁷⁸

The Fund provides Series A funding plus a network of international space corporates that can bring expertise.³⁷⁹ Invested money flows both to upstream and downstream space technology opportunities

³⁷³ C. Henry, 'European Space Industry to get Venture Capital Boost', *Via Satellite*, [website], 27 August 2015, <http://www.satellitetoday.com/technology/2015/08/27/european-space-industry-to-get-venture-capital-boost/> (accessed April 2017).

³⁷⁴ European Space Agency, 'Venture Capital Available for Space-Based Companies', *ESA: Telecommunications & Integrated Applications*, [website], 22 November 2016, http://www.esa.int/Our_Activities/Telecommunications_Integrated_Applications/Venture_capital_available_for_space-based_companies (accessed April 2017).

³⁷⁵ European Space Agency, 'Venture Capital to Nurture ESA Space Applications', *ESA: Telecommunications & Integrated Applications*, [website], 11 August 2015, http://www.esa.int/Our_Activities/Telecommunications_Integrated_Applications/Venture_capital_to_nurture_ESA_space_applications (accessed April 2017).

³⁷⁶ Ibid.

³⁷⁷ Ibid.

³⁷⁸ European Space Agency, 'Venture Capital Available for Space-Based Companies'.

³⁷⁹ European Space Agency, 'Venture Capital to Nurture ESA Space Applications'.

and targets also a broader “space-enabling” ecosystem: technologies which rely on satellite data such as drones and The Internet of Things, or which have potential space applications such as artificial intelligence, robotics and nanomaterials.³⁸⁰

It backs mainly UK -based companies, but the fund will also help foreign companies that have or plan to have stakes in the country and with a global focus.³⁸¹ The Fund relies only on private fund (ESA makes no financial contributions).³⁸² This is just the first step of a wider project that will involve all Europe if the Fund proves to be effective and efficient in boosting the space industry.³⁸³

Box 3.3 – Seraphim Capital

Seraphim Capital is a UK-based early stage investor, focusing on high growth European tech businesses.¹ They are located in East London and Harwell, the UK space cluster that contains around 150 science research organisations and private companies.²

The VC firm looks for *‘game-changing products and services that are underpinned by proprietary, protectable technology and have already achieved some early customer traction.’*³ Opportunities in which they are interested should have the potential to redefine existing markets or to create new ones.⁴

They specialize in Series A funding and have invested collectively in over 180 companies returning more than £750 million to shareholders.⁵

The Seraphim Space Advisory Board consists of senior representatives from different space-related companies and agencies: David Williams, CEO at Avanti Communications, is Chairman of the Board; Stuart Martin, CEO of the Satellite Applications Catapult (a UK Space Tech innovation centre); Amnon Ginati, ESA’s Head of Integrated and Telecommunications-related Applications; and intellectual property expert Justin Hill, partner at law firm Olswang.⁶

¹ Seraphim Capital Website, [website], <http://seraphimcapital.co.uk/> (accessed April 2017).

² European Space Agency, ‘Venture Capital Available for Space-Based Companies’.

³ Seraphim Capital Website.

⁴ Ibid.

⁵ Ibid.

⁶ European Space Agency, ‘Venture Capital Available for Space-Based Companies’.

3.2.2 Russia

Russia suffers from a very poor VC market. This situation is driven above all by a lack of high-quality educational system (50.6) and a weak legal framework (53.5) (Figure 17). Moreover, labour regulation and legality index show very low levels. The capital market is not very liquid (in particular there is not a high percentage of IPOs). A good aspect is the taxation system, whose individual score is 97.8.

³⁸⁰ Seraphim Capital, ‘Space Fund’, *Seraphim Capital*, [website], <http://seraphimcapital.co.uk/> (accessed April 2017).

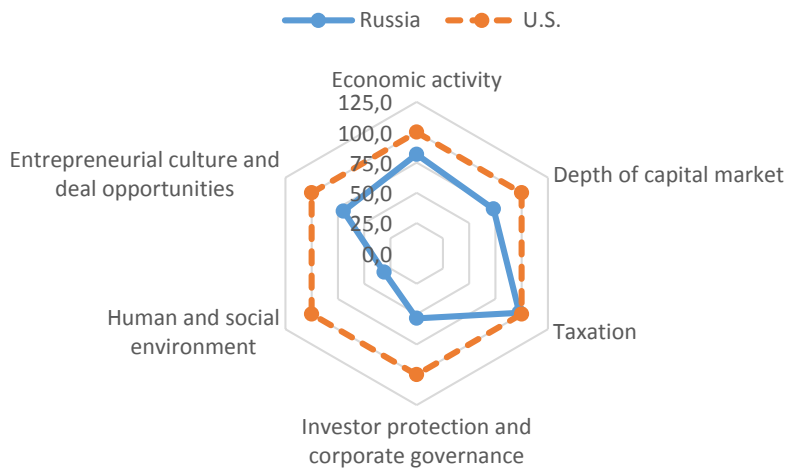
³⁸¹ Henry, ‘European Space Industry to get Venture Capital Boost’.

³⁸² European Space Agency, ‘Venture Capital Available for Space-Based Companies’.

³⁸³ Henry, ‘European Space Industry to get Venture Capital Boost’.

Russia's space sector is suffering from the consequences of Russia's politically isolated position.³⁸⁴ Local start-ups struggle with raising private capital: until 2015, they had raised a total of US\$8.5 million in private capital, nothing compared to the funding that US-based companies are able to secure.³⁸⁵ For example, Skybox Imaging (now called Terra Bella after the acquisition by Google in 2009), have raised US\$91 million from its investors.³⁸⁶

Figure 17 – VCPE Country Attractiveness Index 2016: Russia vs. United States.



Source: Groh et al., 'Russian Federation VCPE Country Attractiveness Index', *IESE Blog Network*, 2016
<http://blog.iese.edu/vcpeindex/russianfederation/> (accessed April 2017).

These difficulties have brought Dauria Aerospace³⁸⁷ to downsize its operations in the US and Europe.³⁸⁸ However, it is probably the most successful Russian company and it is looking for new funding sources. Chinese funds that are increasingly interested in investing in space represent a concrete opportunity for the company. In fact, Dauria Aerospace secured a US\$70 million project from Chinese investment fund Cybernaut in October 2015.³⁸⁹ With this money, Dauria Aerospace will build and launch 10 satellites to monitor life in some of the largest cities in the world.³⁹⁰ Moreover, in April 2015, China's Cybernaut investment group entered into a deal with Russia's Skolkovo Foundation to create a new 1,500m² R&D business incubator, a robotics centre and a US\$200 million venture fund.³⁹¹ Dauria has

³⁸⁴ N. Freischlad, 'How Russia is aiming to re-enter the space race', *Tech in Asia*, [website], 5 December 2015, <https://www.techinasia.com/russia-newspace-next-generation-space-tech-startup> (accessed April 2017).

³⁸⁵ Ibid.

³⁸⁶ Ibid.

³⁸⁷ Dauria Aerospace is a space company based in Moscow. It develops and manufactures the new generation of low cost, small satellites.

³⁸⁸ Freischlad, 'How Russia is aiming to re-enter the space race'.

³⁸⁹ Ibid.

³⁹⁰ Ibid.

³⁹¹ Aerospace Technology, 'China 's Cybernaut to invest \$70m in satellite project to monitor major cities', *Aerospace Technology*, [website], 15 October 2015, <http://www.aerospace-technology.com/news/newschina-s-cybernaut-to-invest-70m-in-satellite-project-to-monitor-major-cities-4694080> (accessed April 2017).

received also US money, principally by the international investment company I2BF Global Ventures, which announced the US\$20 million investment in Dauria Aerospace on October 7, 2013.³⁹²

Dauria has thus diversified the sources of funding for its programs and has demonstrated that state help during the early stage of an aerospace-related project is a good launching pad for companies that want to obtain private investments in the latter stages.³⁹³

Dauria Aerospace has an R&D spinoff, Dauria Satellite Technologies (DST), based in Skolkovo, the Russian space and telecommunications cluster. They have benefitted from two important cash injections:

- The first one in September 2014, when DST received a US\$3.9 million grant³⁹⁴ from the Skolkovo Foundation in order to develop its Earth-observation satellite, called Auriga³⁹⁵. This grant was matched by parent company Dauria Aerospace with a further US\$4.4 million investment. In fact, to receive a Skolkovo grant, residents must raise the same amount or more from an investor.³⁹⁶ In this way they were able to bring the overall cost of the project to 320 million rubles, or US\$8.3 million.³⁹⁷
- The second one in June 2015, was when DST received US\$1.13 million³⁹⁸ from the investment arm of state corporation Vnesheconombank³⁹⁹.

3.3 China

China is one of the Asian countries that are experiencing a stunning economic development. This aspect, together with an enviable tax legislation (at least from investors' point of view), makes China one of the most interesting ecosystem for VC investments (Figure 18). It stands in 24th position in the ranking with a general score of 77.1. Compared to the US, China's weaknesses are represented by a low quality of corporate governance and a low level of legality and workers' protection. However, China has made big steps towards a suitable VC environment, especially with respect to capital market maturity: in 2010 the related score was 37.7, while in 2016 it was 86.7.

³⁹² V. Voronkov, 'Dauria Aerospace receives a 20 million dollar investment', *Skolkovo: News*, [website], 14 October 2013, <http://sk.ru/news/b/articles/archive/2013/10/14/dauria-aerospace-receives-a-20-million-dollar-investment.aspx> (accessed April 2017).

³⁹³ Ibid.

³⁹⁴ D. Nowak, 'Space startup wins \$3.9M Skolkovo grant for Earth-observation satellite', *Skolkovo: News*, [website], 18 September 2014, <http://sk.ru/news/b/news/archive/2014/09/18/space-startup-wins-2400-39m-skolkovo-grant-for-earthobservation-satellite.aspx> (accessed April 2017).

³⁹⁵ Auriga is a next-generation satellite Earth-observation system that provides high-resolution imaging of the planet for natural resource management, precision farming and other industries that require multispectral images.

³⁹⁶ Nowak, 'Space startup wins \$3.9M Skolkovo grant for Earth-observation satellite'.

³⁹⁷ Ibid.

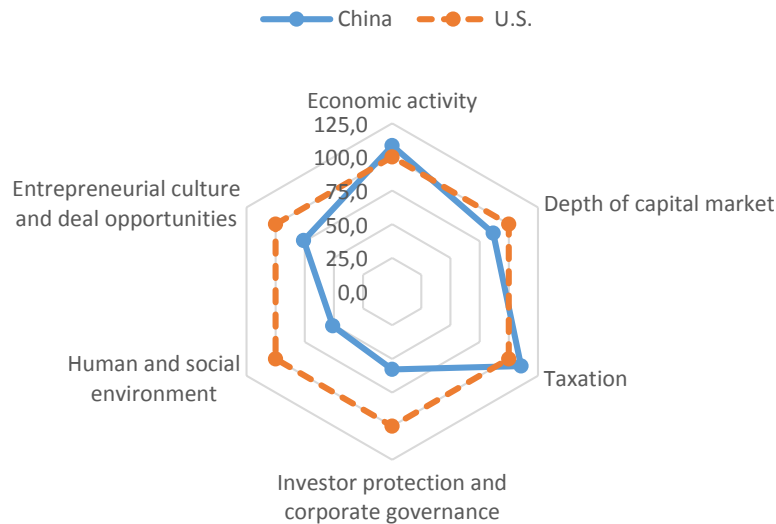
³⁹⁸ D. Nowak, 'VEB plows 60 million rubles into Dauria Satellite Technologies', *Skolkovo: News*, [website], 2 June 2015, <http://sk.ru/news/b/news/archive/2015/06/02/veb-plows-60-million-rubles-into-dauria-satellite-technologies.aspx> (accessed April 2017).

³⁹⁹ VEB Innovations was created by the corporation as a fund for investment in Skolkovo resident start-ups and other innovation-based early-stage companies around the country. The fund has invested more than 600 million rubles in 18 projects to date, making its money back in at least four projects so far.

Venture Capital in the NewSpace Economy

Focusing on the space industry, venture funds based both in China and in the US (but with Chinese ownership) are increasingly investing in space start-ups.⁴⁰⁰ Many recent investments have involved funds like Legend Star, HIT Robot Group, Chun Xiao Capital, Land Stone Capital, and Haiyin Capital, as well as US-based funds like Innospring and Danhua Capital.⁴⁰¹

Figure 18 – VCPE Country Attractiveness Index 2016: China vs. United States.



Source: Groh et al., 'China VCPE Country Attractiveness Index', *IESE Blog Network*, 2016
<http://blog.iese.edu/vcpeindex/china/> (accessed April 2017).

A decisive incentive for VC investments could come from the Chinese government. In fact, China aims to become one of the world's top three aerospace powers by 2030 and is trying for this reason to attract private investment (both local and foreign) to be combined with government funding with a view to implementing a Chinese aerospace program.⁴⁰² Thanks to liberalization on the side of private investments, Government could now better pursue commercial rocket development, satellite research and manufacturing and application of aerospace technologies to public welfare.⁴⁰³ The first objective of China is declared in its 2016 aerospace white paper and consists of commercializing its satellite communications and broadcasting systems, even if targets or time frames for private investment were not disclosed in the document.⁴⁰⁴

China is coming to the surface with the birth of new commercial and tourist space enterprises that would compete with the US.⁴⁰⁵ The most interesting commercial firm is Expace, whose target market is the launch of small satellites for domestic and foreign customers.⁴⁰⁶ Also, a very impressive

⁴⁰⁰ Leininger, 'VCs in Space'.

⁴⁰¹ Ibid.

⁴⁰² Bloomberg, 'China Invites Investors, Including Foreigners, Into Space Effort', *Bloomberg: News*, [website], 27 December 2016, <https://www.bloomberg.com/news/articles/2016-12-27/china-invites-investors-including-foreigners-into-space-effort> (accessed April 2017).

⁴⁰³ Ibid.

⁴⁰⁴ Ibid.

⁴⁰⁵ J. Lin, 'China's Private Space Industry Prepares To Compete With SpaceX And Blue Origin', *Australian Popular Science*, [website], 10 October 2016, <http://www.popsci.com.au/space/space-travel/chinas-private-space-industry-prepares-to-compete-with-spacex-and-blue-origin,439072> (accessed April 2017).

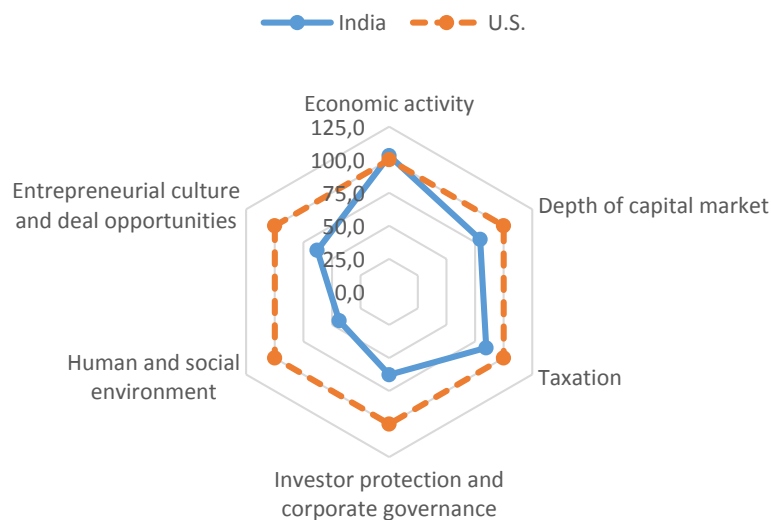
⁴⁰⁶ Ibid.

investment has been made in sci-fi tourism. The Kuang Chi Group has invested US\$1.5 billion for a space theme park.⁴⁰⁷ They will use technologies such as high altitude balloons (the “Cloud”) and an airship (Yuangmeng) to bring people into space.⁴⁰⁸ Those technologies can be used also for serious applications, such as disaster relief and missile defence (sensor coverage), and communications (in place of satellite networks).⁴⁰⁹

3.4 India

India occupies the 29th position in VCPE Country Attractiveness Index rank. Its overall score of 69.9 originates from excellent economic growth (India is one the Asian emerging countries) and a good tax system, which is the result of the liberalization of tax treatment for VC funds in 2000, implemented at the time in order to attract money not only from local investors but also from non-resident Indian investors (for example, Indian firms based in Silicon Valley).⁴¹⁰ The capital market is not very developed and this probably depends on the fact that the Indian VC market is relatively young: the first financing was in 1988, but during the late 1990s the government started to show a serious interest in the issue, carrying out the liberalization of VC regulations.⁴¹¹ The real problem in India is related to its human and social environment: poor labour regulation and a corruption rate among the highest in the world (India ranks 79th over 176 countries according to the Corruption Perceptions Index 2016 by Transparency International)⁴¹² make India a setting in which investors cannot easily trust.

Figure 19 – VCPE Country Attractiveness Index 2016: India vs. United States.



Source: Groh et al., ‘India VCPE Country Attractiveness Index’, *IESE Blog Network*, 2016, <http://blog.iese.edu/vcpeindex/india/> (accessed April 2017).

⁴⁰⁷ Lin, ‘China's Private Space Industry Prepares To Compete With SpaceX And Blue Origin’.

⁴⁰⁸ Ibid.

⁴⁰⁹ Ibid.

⁴¹⁰ V. Chavda, ‘An Overview on “Venture Capital Financing” in India’, *International Multidisciplinary Research Journal*, vol. 1, no. 2, September 2014. Available from: <http://www.rhimrj.com> (accessed April 2017).

⁴¹¹ Ibid.

⁴¹² Transparency International, ‘Corruption Perceptions Index 2016’, *Transparency International*, [website], http://www.transparency.org/news/feature/corruption_perceptions_index_2016 (accessed April 2017).

The Indian space industry continues to rely largely on public funding, thanks to the support of the local Space Agency, which stands among the best Space Agencies in the world.⁴¹³ In fact, the Government is the main actor playing along the space value chain.⁴¹⁴ Due to the lack of deregulation and privatisation, private companies have very little share of the total supply and focus mainly on part, component and subsystem manufacturing.⁴¹⁵ They also rely on government space infrastructure in order to provide services (Table 11).⁴¹⁶ This of course affects the chances of VC investments in space, which remain very poor.

Having a higher amount of private investment would be important for India. Too much government control of the space sector means relying on taxpayers' money for funding, but in order to exploit the enormous potential of the space industry, India needs more money. For this reason India should privatise the main parts of the value chain in order to boost non-public investments.⁴¹⁷

Table 11 – Value chain for the space industry in India.

SATELLITE SERVICES	MANUFACTURING
Consumer Services: <ul style="list-style-type: none"> Satellite TV Satellite Ration Satellite Broadband 	Satellite Manufacturing
Fixed Satellite Services: <ul style="list-style-type: none"> Transponder Agreements Managed Network Services 	
Mobile Satellite Services: <ul style="list-style-type: none"> Mobile Data Mobile Voice 	Parts, Components & Subsystem Manufacturing
Remote Sensing	
Space Flight Management Services	
LAUNCH INDUSTRY	GROUND EQUIPMENT
Launch Services	Network Equipment: <ul style="list-style-type: none"> Gateway Control Stations Very Small Aperture Terminals (VSAT)
Launch Vehicles Services	Consumer Equipment: <ul style="list-style-type: none"> Direct Broadcast Satellite (DBS) Dishes Mobile satellites terminals (including satellite phones) Digital Audio Radio Service (DARS) Equipment Navigation stand-alone Hardware
Private/Commercial Industry	Government/ISRO/DoS
Quasi Government	

Source: Prasad, 'Perspectives on Creating a Space Industry Ecosystem in India'.

⁴¹³ A. Tomar, 'Top 10 Space Agencies in the World in 2017', *Techimos*, [website], December 2016, <http://techimos.com/top-10-space-agencies-in-the-world-2017/> (accessed April 2017).

⁴¹⁴ N. Prasad, 'Perspectives on Creating a Space Industry Ecosystem in India', *The Wire*, [website], 2 April 2016, <https://thewire.in/27049/perspectives-on-creating-a-space-industry-ecosystem-in-india/> (accessed April 2017).

⁴¹⁵ Ibid.

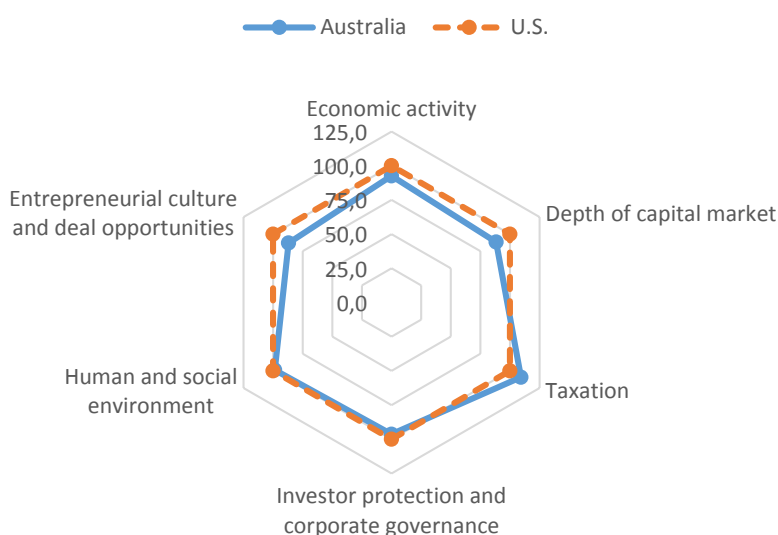
⁴¹⁶ Ibid.

⁴¹⁷ Ibid.

4 AN AUSTRALIAN PERSPECTIVE WITH A FOCUS ON SOUTH AUSTRALIAN ENVIRONMENT

Australia seems to be a tempting target for VCs. In fact, the country occupies the 6th position in the rank drawn up by Groh *et al.* according to their VCPE Country Attractiveness Index.⁴¹⁸ Its total score of 91.9 originates from the favourable economic conditions and the strength of the regulatory framework and law enforcement, as well as a suitable environment for human capital (Figure 20). Taxation system performs even better than the US (score 109.3). Australia's shortcomings are twofold: the liquidity of the market (it is more difficult than in US to realize capital gains over investments) and the level of entrepreneurial opportunities. In short, the conditions exist to create a really important VC ecosystem, but Australia needs to improve in certain areas.

Figure 20 – VCPE Country Attractiveness Index 2016: Australia vs. United States.



Source: Groh *et al.*, 'Australia VCPE Country Attractiveness Index', *IESE Blog Network*, 2016
<http://blog.iese.edu/vcpeindex/australia/> (accessed April 2017).

Although there are favourable conditions for private investment in Australia, there are not many active native VC firms. Seed rounds mainly consist of local capital (not necessarily private firms, but also friends and relatives), but when a company wants to raise more than AU\$10 million the financing round is usually led by a US VC firm.⁴¹⁹ There is support provided during the early stages by international accelerators like Y Combinator, 500 Startups and Techstars.⁴²⁰ In short, looking at these examples it can be seen how global the current VC market is. It does not necessarily matter so much to entrepreneurs where their funding is sourced.⁴²¹

⁴¹⁸ Groh *et al.*, 'The Venture Capital and Private Equity Country Attractiveness Index'.

⁴¹⁹ Niki Scevak, interviewed by Simone Spinelli, [email], 2 March 2017.

⁴²⁰ N. Scevak Interview, 2017.

⁴²¹ Paddy Neumann and Ian Whitchurch, interviewed by Simone Spinelli, [email], 3 April 2017.

However, in South Australia the Government is trying to boost VC investments, through the recently designed South Australian VC Fund, that will operate from 1 July 2017.⁴²² The Fund will be administered by a VC fund manager from the private sector, and will benefit from the collaboration of other VC funds, both Australian and overseas-based.⁴²³ Moreover, it will target local companies, where building a strong relationship with a network of ventures managers is incredibly worthy.⁴²⁴ The value of the fund is AU\$50 million, an amount that includes:

- AU\$10 million for the South Australian Early Commercialisation Fund (see Box 4.1), which aims to help new companies during the very initial stages of their lifecycle, focusing on turning prospective entrepreneurial projects into reality (i.e. reaching product development and early commercialization).⁴²⁵
- AU\$4.65 million for the GigCity Adelaide network, which aims to make the SA capital more attractive for entrepreneurs by offering internet speeds of up to 100-times the national average, and at least 10 times the download speed of the National Broadband Network.⁴²⁶

Box 4.1 – South Australian Early Commercialisation Fund

The South Australian Early Commercialisation Fund (SAECF) is a competitive grant program designed by the South Australian Government, which aims to give support primarily to South Australian early-stage tech start-ups, and then to foreign companies that want to bring their projects in South Australia, as well as university research commercialisation organizations. Along with grants, advice support and expertise is provided thanks to the collaboration of TechInSA (a SA government funded organisation) and the SAECF Panel (made up of independent experts). Grants do not exceed AU\$500,000 per project and funds can be delivered in tranches (unconditioned or also conditioned to the achievement of specific milestones). SAEFC is organised in three phases:

- **Phase 1** concerns the proof-of-concept and grants up to AU\$50,000 on a 3:1 basis (for each AU\$1 privately contributed, SAEFC invests AU\$3).
- **Phase 2** focuses on product development and grants up to AU\$150,000 on a 2:1 basis (for each AU\$1 privately contributed, SAEFC invests AU\$2).
- **Phase 3** deals with the product early commercialisation and grants up to AU\$300,000 on a 1:1 basis (for each AU\$1 privately contributed, SAEFC invests AU\$1).

⁴²² South Australian Government, 'South Australian Venture Capital Fund', *Innovation in SA*, [website], <http://innovation.sa.gov.au/opportunity/south-australian-venture-capital-fund/> (accessed April 2017).

⁴²³ Ibid.

⁴²⁴ Ibid.

⁴²⁵ L. Griffiths, 'South Australia to venture down innovation path with \$50 million for capital fund', *The Advertiser*, [website], 8 July 2016, <http://www.adelaidenow.com.au/business/south-australia-to-venture-down-innovation-path-with-50-million-for-capital-fund/news-story/de7260e677fc6b081013002bf4b96d27> (accessed April 2017).

⁴²⁶ The Advertiser, 'High-speed internet push to make Adelaide a Gig City', *The Advertiser*, [website], 27 June 2016, <http://www.adelaidenow.com.au/business/highspeed-internet-push-to-make-adelaide-a-gig-city/news-story/a81e8ad16cf4046c64227163691c3d65> (accessed April 2017).

To be eligible, applicants must fulfil all the six criteria required (for example, having a South Australian nexus or being strongly innovative). All the eligible applications are evaluated by TechInSA and the SAEFC Panel according to other merit criteria also, such as feasibility and commercial potential of the project.

Source: TechInSA, 'South Australian Early Commercialisation Fund: Guidelines for Applicants', *TechInSA*, [website], 18 November 2016, <http://techinsa.com.au/wp-content/uploads/2016/11/SAECF-Guidelines.pdf> (accessed April 2017).

Thanks also to the latter investment, Adelaide stands out for its impressive ecosystem that fosters the foundation of new start-ups, especially the technology-focused ones.⁴²⁷ It represents an exception within a country that does not register a high score for deal opportunities in the VCPE Index. In particular, Adelaide currently represent an important hub for technological know-how that can be applied in the defence and security sectors: the current value of the major projects related to these fields amounts to almost AU\$100 billion and a recent AU\$230 million investment has been recorded for Defence Industry Capability.⁴²⁸ In addition, Adelaide is the fifth most habitable city worldwide and its laudable effort in sustaining entrepreneurship has been recognised by G20 - these are all the ingredients for a perfect recipe.⁴²⁹ These qualities have not remained unnoticed to Techstars' founders, who have decided to open their first Asia-Pacific based accelerator in Adelaide (see Box 4.2).⁴³⁰

South Australia is trying also to set itself as a leading centre of space industry R&D and entrepreneurship. Australia's share of the global space economy (in terms of annual revenues and estimated workforce) suggests that it has traditionally underperformed.⁴³¹ The country's civil space program has historically received restrained financial support from the Federal Government.⁴³² For example, the Satellite Utilization Policy makes clear that the governmental space strategy is circumscribed to Australian borders and almost ancillary with respect to other services and capabilities, and it '*does not commit Australia to human spaceflight, domestic launch capabilities or to the exploration of other planets*'.⁴³³ According to space policy experts, this approach does not allow Australia to follow the path of growth as in other countries, and for this reason entrepreneurs have started to look for private investments and partnership with universities.⁴³⁴ Government support has

⁴²⁷ Anthill Magazine, 'Techstars heads "down under" launching its first APAC based accelerator in Australia', *Anthill Magazine*, [website], 21 February 2017, <http://anthillonline.com/techstars-heads-first-apac-accelerator/> (accessed April 2017).

⁴²⁸ Ibid.

⁴²⁹ Ibid.

⁴³⁰ Ibid.

⁴³¹ Space Industry Association of Australia, 'SIAA White Paper: Advancing Australia in Space', *SIAA Publications*, March 2017, p. 4, <http://www.spaceindustry.com.au/publications.php> (accessed May 2017).

⁴³² T. Ong, 'Space to grow for Australian satellite industry', *ABC News*, [website], 15 February 2016, <http://www.abc.net.au/news/2016-02-15/space-to-grow-for-australian-satellite-industry/7169224> (accessed April 2017).

⁴³³ Commonwealth of Australia, 'Australia's Satellite Utilization Policy', *Department of Industry, Innovation and Science*, 2013, p. 2, <https://www.industry.gov.au/industry/IndustrySectors/space/Publications/Pages/Australias-Satellite-Utilisation-Policy.aspx> (accessed April 2017).

⁴³⁴ Ong, 'Space to grow for Australian satellite industry'.

become secondary and it consists in some general industry assistance programmes, such as the R&D Tax Concession scheme.⁴³⁵

Moreover, looking at private investments, Australian funds are very poorly engaged in space. Australian investors that are focused on technological sectors seem to prefer software-related companies and appear to have less interest in space (basically they do not understand it).⁴³⁶ For space start-ups is very difficult to gather first round investment and they have to be strong enough (i.e. they have built up 'a good story') before searching for VC support.⁴³⁷ Moreover, very few firms in Australia are able to invest in risky markets such as space.⁴³⁸ Another shortcoming originates from the low maturity of the Australian space market: in fact, there is not a '*pool of veterans of successful companies who can either be or advise VCs or stockbroking firms*'.⁴³⁹ Finally, there has not been a successful exit in the AU\$100 million range: in Australia, there is a functioning stock market for companies worth AU\$5-AU\$15 million and entrepreneurs who face problems raising funding usually prefer to jump from seed round directly to company's sale.⁴⁴⁰ These aspects – in particular the last two ones – may affect the decision of a VC to invest in space.

Recently, the Australian space sector has experienced a new breath of fresh air thanks to the foundation of two South Australian companies, Fleet Space Technologies and Neumann Space. In the

Box 4.2 – Techstars Adelaide

South Australia is a suitable environment for start-ups thanks also to the massive presence of incubators and accelerators, which help new founders to properly start their project and guide them through the first steps of drawing a successful business plan.

Adelaide has recently hosted the first Techstars accelerator in the Asia-Pacific area.¹ Techstars was founded in 2006 in Colorado, by David Cohen and Brad Feld. They are now an international accelerator, which has backed more than 900 start-ups in the last 10 years.² They are attracted by companies that can provide application in IoT, big data, sensors and robotics linked to the defence sector.³ Basically, entrepreneurs selected for the programme benefit from the access to a very wide network of global founders and mentors (more than 5000) and from initial funding from Techstars, in exchange for a little equity in the company.⁴ In particular, they receive US\$120,000 for the first 12 weeks. If the company does not perform as expected, Techstars renounces to its stake.⁵

¹ Anthill Magazine, 'Techstars heads "down under"'.
² B. Willis, 'Global accelerator Techstars picks Adelaide for new start-up program', *The Advertiser*, [website], 31 January 2017, <http://www.adelaidenow.com.au/business/global-accelerator-techstars-picks-adelaide-for-new-startup-program/news-story/e89d1f4f8654316385c1cb4755c4a846> (accessed April 2017).
³ Anthill Magazine, 'Techstars heads "down under"'.
⁴ Willis, 'Global accelerator Techstars picks Adelaide for new start-up program'.
⁵ Ibid.

⁴³⁵ P. Neumann and I. Whitchurch Interview, 2017.

⁴³⁶ P. Neumann and I. Whitchurch Interview.

⁴³⁷ Flavia Tata Nardini, interviewed by Simone Spinelli, [email], 3 April 2017.

⁴³⁸ F.T. Nardini Interview, 2017.

⁴³⁹ P. Neumann and I. Whitchurch Interview, 2017.

⁴⁴⁰ P. Neumann and I. Whitchurch Interview.

next paragraphs, the two companies will be briefly described, as well as one of the main VCs involved in the funding of one of the two companies: Blackbird Ventures, a Sydney-based VC firm. The focus is not only on the core business and general financial information about the firms, but also on the effort they continue to push in order to boost the Australian space sector.

4.1 Fleet Space Technologies

Fleet Space Technologies was founded in 2015 thanks to the joint effort of Flavia Nardini (current Chief Executive Officer), Matthew Tetlow (Chief Operating Officer) and Matt Pearson (Chief Technology Officer).⁴⁴¹ The company is based in Adelaide, with offices also in California and the Netherlands.⁴⁴²

Fleet's mission is to contribute to the realization of the IoT revolution, through the creation of a global satellite communication network in LEO that enables users to track and control devices from any point of the globe by simply using a smartphone or a tablet.⁴⁴³ This remote control system is applicable to a wide range of human activities, such as mining, oil and gas extraction, agriculture, transport and logistic, improving their efficiency.⁴⁴⁴ Fleet is planning to launch almost 100 nanosatellites by 2020,⁴⁴⁵ which allow almost three billion people to reach Internet access for the first time at a very low cost⁴⁴⁶, with a total coverage of 60 billion devices around the world, enabling the 'small data revolution'.⁴⁴⁷ Basically, they will provide a backhaul service for the IoT⁴⁴⁸, which will be called '1F' (F stands for Fleet).⁴⁴⁹

The company is supported by the Government of South Australia and was backed by Delta-V accelerator, a Sydney-based accelerator. In particular, the South Australian Government provided a AU\$50,000 grant through the Premier's Research and Industry Fund (PRIF) in 2015⁴⁵⁰, that matched the AU\$25,000 seed financing from one of the co-founders.⁴⁵¹ Recently they raised AU\$5 million Series A funding⁴⁵² led by Blackbird Ventures (see § 4.3), with which they will launch the first two/three nanosatellites.⁴⁵³ The future plans expect a new funding round (Series B) of AU\$20 million in order to

⁴⁴¹ Fleet Space Technologies, 'Who We Are', *Fleet*, [website], <http://www.fleet.space/about/> (accessed April 2017).

⁴⁴² Ibid.

⁴⁴³ *Fleet*, [website], <http://www.fleet.space/> (accessed April 2017).

⁴⁴⁴ Ibid.

⁴⁴⁵ *ABC News*, [website], 12 April 2017, <http://www.abc.net.au/news/2017-04-12/flavia-tata-nardini-is-ceo-of-fleet/8440456> (accessed April 2017).

⁴⁴⁶ A. Spence, 'How to become a space entrepreneur', *The Lead*, [website], 29 January 2016, <http://www.theleadsouthaustralia.com.au/innovators/how-to-become-a-space-entrepreneur/> (accessed April 2017).

⁴⁴⁷ Fleet Space Technologies, *Fleet 2016*, [online video], 28 July 2016, <https://vimeo.com/161351810?from=outro-embed> (accessed April 2017).

⁴⁴⁸ *Fleet*.

⁴⁴⁹ F. T. Nardini Interview, 2017.

⁴⁵⁰ T. Ong, 'Space to grow for Australian satellite industry', *ABC News*, [website], 15 February 2016, <http://www.abc.net.au/news/2016-02-15/space-to-grow-for-australian-satellite-industry/7169224> (accessed April 2017).

⁴⁵¹ F.T. Nardini Interview, 2017.

⁴⁵² Fleet Space Technologies, 'Who We Are'.

⁴⁵³ F.T. Nardini Interview, 2017.

bring into orbit another 20 satellites.⁴⁵⁴ The Series C round will depend on the financial self-sufficiency of the company: if the cash flows are substantial, they will fund by themselves.⁴⁵⁵

Before founding Fleet, the three entrepreneurs created Launchbox in 2014, a company that aims to make the Australian Space Industry flourish, changing the approach to space of neophytes.

Launchbox was inspired by the low engagement from young students in Science, Technology, Engineering and Mathematics (STEM) activities.⁴⁵⁶ The company delivers, upon application, a kit (priced at almost AU\$900) containing a small satellite for taking pictures of Earth and gathering raw data, equipped with a balloon that can reach 15 km altitude.⁴⁵⁷ Apart from the legal requirements for the “launch” (in order to send this small device in orbit it is necessary to obtain institutional authorization), the experiment can be carried out very easily.⁴⁵⁸ Moreover, it does not create any debris, because after reaching 15 km altitude, the balloon explodes and the device returns to the Earth thanks to a parachute. It can be retrieved thanks to on-board GPS and sensor for tracking its position.⁴⁵⁹

Launchbox won the Innovation Pitch Prize⁴⁶⁰ at The Avalon Airshow in 2015.⁴⁶¹

4.2 Neumann Space

Neumann Space is a company based in South Australia, that became recognised thanks to their innovative project that focuses on rocket drive mechanisms that could change the space travel forever. Currently, space vehicles use chemical-based thrusters, which are very expensive in terms of required fuel.⁴⁶² Neumann’s propulsion technology is based on ion power, which could make transport more efficient (it can even be feed also with recycled space junk)⁴⁶³ and could extend the life of satellites.⁴⁶⁴ Their aim is to ‘*build the planet’s best long duration space thruster*’.⁴⁶⁵ This could result in a reduction in costs, especially for prolonged missions such as exploration and mining.⁴⁶⁶ If the

⁴⁵⁴ F.T. Nardini Interview, 2017.

⁴⁵⁵ F.T. Nardini Interview.

⁴⁵⁶ Launchbox, ‘Beyond the final frontier: Flavia Tata Nardini talks about Australia’s future in space’, *Launchbox: News*, [website], 26 July 2015, <http://www.launchboxspace.com/news/2015/7/26/beyond-the-final-frontier-flavia-tata-nardini-talks-about-australias-future-in-space> (accessed April 2017).

⁴⁵⁷ Flavia Tata Nardini, interviewed by ABC Radio, [personal interview], 27 January 2015. Available from: http://blogs.abc.net.au/sa/2015/01/does-sa-have-a-future-in-space.html?site=adelaide&program=adelaide_mornings (accessed April 2017).

⁴⁵⁸ F.T. Nardini Interview, 2015.

⁴⁵⁹ F.T. Nardini Interview.

⁴⁶⁰ The Prize is assigned during the Innovation Pitchfest. For further details, see <http://www.defencescienceinstitute.com/2015/09/25/defence-science-institute-dst-group-innovation-pitchfest/>

⁴⁶¹ Defence Science Institute, ‘Innovation Pitch Prize – Avalon 2015’, *Defence Science Institute*, [website], 14 April 2015, <http://www.defencescienceinstitute.com/2015/03/05/innovation-pitch-prize-avalon-2015/> (accessed April 2017).

⁴⁶² B. Porter, ‘International Space Station to trial Aussie-designed thrusters that could power journey to Mars’, *ABC News*, [website], 29 September 2016, <http://www.abc.net.au/news/2016-09-29/australians-revolutionising-space-travel/7885998> (accessed April 2017).

⁴⁶³ Ibid.

⁴⁶⁴ Neumann Space, ‘About Neumann Space’, *Neumann Space*, [website], <http://neumannspace.com/> (accessed April 2017).

⁴⁶⁵ P. Neumann and I. Whitchurch Interview, 2017.

⁴⁶⁶ Neumann Space, ‘About Neumann Space’.

experimentations prove the thruster's potential, it will be affordable to go to and come back from Mars with just a single fuel tank.⁴⁶⁷

To date tests have been carried out in a vacuum system, in order to simulate the same conditions that are present in space.⁴⁶⁸ In 2018, the first real experiment is expected to be conducted on the International Space Station (ISS), thanks to the agreement that Neumann Space reached with Airbus Defence.⁴⁶⁹ The experiment will take place on the Bartolomeo platform (managed by Airbus), which will be connected to the European Columbus Module outside the ISS.⁴⁷⁰ The Bartolomeo platform is designed precisely for private and commercial businesses, that range from space mission in LEO to technology testing in orbit.⁴⁷¹ Thanks to the deal, Neumann has obtained more than 50 litres of payload aboard the platform and they will use it in order to perform their Facility for Australian Space Testing (FAST) programme.⁴⁷² This programme allows small companies like Neumann (but also medium enterprises, as well as universities and schools) to demonstrate the potential of a technological project directly in orbit, without resorting to simulation in the lab.⁴⁷³

The company has been recently established (it was founded just in 2015), but to date they have already raised seed money from private investors, as well as friends and family financing support (the amount is undisclosed).⁴⁷⁴ In order to carry on their project, they will probably need a new round financing (around AU\$1.4 million) in the medium term, before being able to rely just on cash flows generated by their own business.⁴⁷⁵

4.3 Blackbird Ventures

Blackbird Ventures is a Sydney-based VC company with a clear mission: investing in Australian start-ups that aim to pursue global strategies.⁴⁷⁶ The company is interested in high-risk, high-reward and revolutionary projects.⁴⁷⁷

Blackbird Ventures was co-founded in 2012 by Niki Scevak (current company's Managing Director), Bill Bartee (Southern Cross Venture Partners Managing Director) and Rick Baker (former MLC Private Equity Portfolio Manager of Venture Capital).⁴⁷⁸

Although there is an atmosphere of scepticism around Australian venture capital that had made it very difficult to raise money from investors, Blackbird's first fundraising brought in US\$30 million in

⁴⁶⁷ Neumann Space, 'The Science behind the technology', *Neumann Space: The Science*, [website], <http://neumannspace.com/science/> (accessed April 2017).

⁴⁶⁸ Porter, 'International Space Station to trial Aussie-designed thrusters'.

⁴⁶⁹ Ibid.

⁴⁷⁰ D. Messier, 'Airbus Signs First Customer for New ISS Hosted Payload Platform', *Parabolic Arc*, [website], 30 September 2016, <http://www.parabolicarc.com/2016/09/30/airbus/> (accessed April 2017).

⁴⁷¹ Ibid.

⁴⁷² Ibid.

⁴⁷³ Ibid.

⁴⁷⁴ P. Neumann and I. Whitchurch Interview, 2017.

⁴⁷⁵ P. Neumann and I. Whitchurch Interview.

⁴⁷⁶ *Blackbird Ventures*, [website], <http://blackbird.vc/> (accessed April 2017).

⁴⁷⁷ M. Bingemann, 'Blackbird Ventures happy to fly close to start-up sun', *The Australian*, [website], 10 October 2015, <http://www.theaustralian.com.au/business/blackbird-ventures-happy-to-fly-close-to-startup-sun/news-story/c083e4467d45a47edbfcc7dc9a9c5fdf> (accessed April 2017).

⁴⁷⁸ Ibid.

investments from 96 technology entrepreneurs,⁴⁷⁹ in order to invest in Australian Internet start-ups.⁴⁸⁰ Partners who have participated in the fund are over 35 Australian tech founders – among which there are the entrepreneurs who have founded successful Australian firms like Atlassian (Mike Cannon-Brookes), Campaign Monitor and Aconex – as well as VCs from Silicon Valley like Bill Tai and Dave McClure, who are very accustomed to Australia's start-up environment.⁴⁸¹ In September 2015 the company closed its second fund (US\$200 million), with participation of a large number of existing investors, as well as two major superannuation funds – First State Super and Hostplus Super.⁴⁸² This fund is seen as the largest VC fund that has been raised in Australia for technology start-ups and allows Blackbird to acquire bigger stakes in the companies they want to back.⁴⁸³

Blackbird has a clear strategy in their investment choices. They look for specific characteristics of the companies to be funded, in particular:

- Start-ups should pursue the goal of becoming **global market players**.⁴⁸⁴
- The related market should be **big** in terms of revenues (at least US\$100 million per year).⁴⁸⁵
- Businesses should rely on **digital marketing and sales** (i.e. not direct sales), which provide a short sales cycle and allow to avoid the additional task to build up sales teams in each market Blackbird pursues.⁴⁸⁶
- Start-ups should guarantee an **efficient use of capital**, i.e. they should be able to manufacture the prototype and to test it using a small amount of funding.⁴⁸⁷
- Companies' core business should be in line with Blackbird's preferences, which range from consumer subscriptions (such as Gmail, to give an indicative example) to direct response advertising (AdWords⁴⁸⁸), social games and mobile apps (Flight Control⁴⁸⁹) to enterprise software (Atlassian⁴⁹⁰).⁴⁹¹

Blackbird usually invest in Seed and Series A rounds, but it also occasionally invests in later stages (Series B and C funding).⁴⁹² In particular, during the seed round Blackbird helps companies to raise US\$500,000-US\$1 million, providing approximately half of the funding and contacting those companies with their acquaintances (such as other investors) in Australia and in Silicon Valley.⁴⁹³ At the Series A stage, enterprises may need an amount that ranges from US\$3 million to US\$5 million; sometimes, it is

⁴⁷⁹ Bingemann, 'Blackbird Ventures happy to fly close to start-up sun'.

⁴⁸⁰ Blackbird Ventures, 'Announcing the Blackbird Ventures Fund', *Blackbird Ventures*, [web blog], 14 March 2013, <http://blackbird.vc/blog-announcing-the-blackbird-ventures-fund> (accessed April 2017).

⁴⁸¹ Ibid.

⁴⁸² Bingemann, 'Blackbird Ventures happy to fly close to start-up sun'.

⁴⁸³ Ibid.

⁴⁸⁴ Blackbird Ventures, 'What Products and Markets are we looking for?', *Blackbird Ventures*, [web blog], 4 February 2013, <http://blackbird.vc/blog-what-products-and-markets-are-we-looking-for> (accessed April 2017).

⁴⁸⁵ Ibid.

⁴⁸⁶ Ibid.

⁴⁸⁷ Ibid.

⁴⁸⁸ See https://adwords.google.com/home/?zd=1#modal_active=none.

⁴⁸⁹ See <https://play.google.com/store/apps/details?id=com.namcowireless.flightcontrol&hl=en>.

⁴⁹⁰ See <https://www.atlassian.com/>.

⁴⁹¹ Blackbird Ventures, 'What Products and Markets are we looking for?'.

⁴⁹² Blackbird Ventures, 'At What Stages Will Blackbird Invest?', *Blackbird Ventures*, [web blog], 4 February 2013, <http://blackbird.vc/blog-at-what-stages-will-blackbird-invest> (accessed April 2017).

⁴⁹³ Ibid.

very difficult for firms to raise that amount of funding, since VCs are not so likely to invest such a quantity of capital at this stage.⁴⁹⁴ Blackbird usually only invest US\$1-1.5 million together with other compatible investors, irrespective of their background.⁴⁹⁵ When they participate in later-stage rounds, they usually raise fund amounting to more than US\$10 million with the collaboration of Silicon Valley VC firms.⁴⁹⁶

Apart from their support to Australian start-ups, Blackbird is involved in two programmes that aim to boost the interest in technology of future generations. In particular, they help in promoting the FIRST Robotics programme and in raising funds that will allow Australian students to go to the US in order to attend international championships focused on technological activities.⁴⁹⁷ Moreover, they have designed WorkEx, a programme that gives to young people the chance to get involved in a working environment and to experience directly how tech start-ups work.⁴⁹⁸ To date, they have placed at least 5 people at start-ups.⁴⁹⁹

Box 4.2 – Blackbird’s portfolio

To date, Blackbird has stakes in a wide range of companies. Here is the list of their investments, as well as some information about the financing round in which Blackbird was involved¹:

- **Accelo** is a professional sales and marketing platform, which manages more easily than other tools emails and appointments with clients thanks to its distinctive Smarter CRM system.² Completed round: Seed (US\$2M in July 2013).
- **Bugcrowd Inc.** focuses on cybersecurity and provides a platform for applications’ security testing.³ Completed rounds: Seed (US\$50k in April 2013), Series A (US\$6M in March 2015) and Series B (US\$15M in April 2016).
- **Canva** is an online design platform. It allows companies and individuals to create designs in the cloud.⁴ Currently, it boasts more than 10 million users.⁵ Completed rounds: Seed (US\$3M in March 2013 and US\$3.6M in July 2014), Venture (US\$6M in May 2015), and Series A (US\$15M in October 2015 and US\$15M in September 2016).
- **CoinJar Pty Ltd.** is a provider of a Bitcoin platform, which enables users to buy, sell, and transact in Bitcoin through services such as Bitcoin exchange and digital wallet.⁶ Completed round: Seed (US\$460k in December 2013).

¹ Data on financing rounds are retrieved from CrunchBase, <https://www.crunchbase.com>, and Zephyr, <https://zephyr.bvdinfo.com/>.

² Accelo, ‘The Smarter CRM’, *Accelo*, [website], <https://www.accelo.com/> (accessed April 2017).

³ Information is retrieved from Factiva, <https://global.factiva.com>.

⁴ Bingemann, ‘Blackbird Ventures happy to fly close to start-up sun’.

⁵ *Canva*, [website], <https://about.canva.com> (accessed April 2017).

⁶ Factiva, <https://global.factiva.com>.

⁴⁹⁴ Bingemann, ‘Blackbird Ventures happy to fly close to start-up sun’.

⁴⁹⁵ ‘At What Stages Will Blackbird Invest?’.

⁴⁹⁶ ‘At What Stages Will Blackbird Invest?’.

⁴⁹⁷ ‘FIRST Robotics’, *Blackbird Ventures*, [website], <http://blackbird.vc/> (accessed April 2017).

⁴⁹⁸ ‘WorkEx’, *Blackbird Ventures*, [website], <http://blackbird.vc/> (accessed April 2017).

⁴⁹⁹ Niki Scevak, interviewed by Simone Spinelli, [email], 2 March 2017.

- **Culture Amp Pty Ltd.** is a provider of survey and analytic software and platform, which can be used also for measuring the happiness of employees at companies.⁷ Completed rounds: Series A (US\$6.3M in March 2015) and Series B (US\$10M in March 2016).
- **DGraph Labs Inc.** is the provider of an open source graph database built for real-time query that requires a high volume of input and a low period of latency.⁸ Completed round: Seed (US\$1.1M in March 2016).
- **Edrolo Inc.** is the provider of online education services and tutors to high school students (currently available in US and Australia), in particular online preparatory courses for SAT (Scholastic Assessment Test).⁹ Completed rounds: Seed (US\$50k in March 2013) and Series A (US\$2.6M in May 2015).
- **LIFX Labs Inc.** is a provider of smart light bulbs, which can be controlled through smartphones.¹⁰ Completed round: Series A (US\$15M in June 2014).
- **Redbubble Ltd.** is an intermediary in online selling of objects and accessories (such as greeting cards and bags) designed by artists.¹¹ Completed round: Venture (US\$8.95M in March 2016).
- **SafetyCulture Pty Ltd.** is a provider of mobile applications related to work safety.¹² Completed rounds: Seed (US\$1.09M in November 2013), Series A (US\$1.75M in September 2014 and US\$6.1M in September 2015) and Series B (US\$23M in October 2016).
- **Skedulo P/L** is a provider of a mobile workforce scheduling and management application, which functions also in absence of an active cell phone connection.¹³ Completed rounds: Seed (US\$2M in October 2014) and Series A (US\$11M in November 2016).
- **Shoes of Prey Pty Ltd.** is a provider of a retail website that enables women to design and purchase their own hand-made shoes.¹⁴ Completed round: Series A (US\$5.5 million, December 2014).
- **Zoox Inc.** is a developer of self-driving cars, which aims to build the new generation of mobility-as-a-service in urban environments (such as driverless taxis by using robotics and machine learning).¹⁵ Completed round: Series A (US\$200M in July 2016).

⁷ Factiva, <https://global.factiva.com>.

⁸ Ibid.

⁹ Ibid.

¹⁰ Ibid.

¹¹ Ibid.

¹² Ibid.

¹³ Ibid.

¹⁴ Ibid.

¹⁵ Ibid.

Scevak's other creation is Startmate, the Blackbird's mentor driven accelerator.⁵⁰⁰ Startmate aims to support newly-established enterprises to successfully launch their business, providing a substantial network of mentors that is made up of companies previously backed by the accelerator and other

⁵⁰⁰ Blackbird Ventures, 'Startmate', *Blackbird Ventures*, [website], <http://blackbird.vc/> (accessed April 2017).

Australian founders.⁵⁰¹ Startmate's mentors give their support in particular to design the early-stage funding operations and to build a solid customer base.⁵⁰²

Startmate's programme lasts five months and is carried out both in Sydney (the first three months) and in San Francisco (the last two months).⁵⁰³ During this period, new founders will get involved in a great number of events, such as lunch meetings, during which they should make new acquaintances and gather as much advice as possible to build their own successful business model.⁵⁰⁴ Startmate will provide also an initial investment of AU\$75,000, in exchange for a 7.5 percent stake in the company.⁵⁰⁵ After these first five months, some enterprises (approximately 20 percent of the total backed companies) search for Series A funding rounds from Silicon Valley VC firms and manage to raise this money.⁵⁰⁶

Being a Blackbird-associated accelerator, Startmate chooses its clients according to similar guiding principles. Regarding team's characteristics, they search for teams that are:⁵⁰⁷

- technology-focused, such as software developers or user experience designers
- able to work with few resources
- made up of three people at maximum
- flexible and can move with ease from Sydney to San Francisco

and that:⁵⁰⁸

- act according to the Lean Start-up Principles⁵⁰⁹.

⁵⁰¹ Startmate, 'Overview', *Startmate*, [website], <http://www.startmate.com.au/program> (accessed April 2017).

⁵⁰² Ibid.

⁵⁰³ Ibid.

⁵⁰⁴ Ibid.

⁵⁰⁵ Ibid.

⁵⁰⁶ Ibid.

⁵⁰⁷ Startmate, 'Teams', *Startmate*, [website], <http://www.startmate.com.au/teams> (accessed April 2017).

⁵⁰⁸ Ibid.

⁵⁰⁹ For further details, see <http://theleanstartup.com/principles>.

5 CONCLUSION

Trends in the space industry, especially the most recent ones, have made it clear that the NewSpace economy is now a solid reality. This means that there has been a shift from a government-led economy to a very suitable setting for private investments. In 2015, 76 percent of space revenues originated from commercial space activities. This is an astonishing turnaround if compared to the 1990s' situation, when the share was about 20 percent of total revenues (at the time, mainly supported by the government).⁵¹⁰ The principal driver of this significant change has been the decreasing costs of access to space. New technologies and materials have led to manufacturing satellites whose size is much smaller than in the past (i.e. nanosatellites), reducing the costs of production dramatically. Thanks to the increasing supply of launch opportunities, the cost of bringing them in orbit is now much lower, and this has made private investments in space very affordable. The decreasing trend of costs has met 'megatrends' that have opened the opportunity to exploit new value from satellites through non-traditional applications. For example, one is 'big data analysis', which has proved to be very useful in fields such as agriculture and geolocation (two successful examples are The Climate Corporation and deCarta). Another is the 'Internet of Things', which is at an early stage and could lead in few years to bridge the digital gap and to connect millions of devices across the world. These trends have opened the door to private enterprises and consequently to investments opportunities for venture capitalists. In this framework, VC space investments have shifted from an annual average of US\$31 million in the six-year period 2000-2005 to US\$460 million in 2011-2015.

Venture capital investments are fundamental for growth opportunities of new companies. They provide invaluable support during the early stages of establishment that is difficult to receive from other private institutions (such as banks) or government. In particular, government grants or benefits alone are not usually sufficient for starting a business (they have to be matched by entrepreneurs' or other private investors' funding) and they are typically only delivered for a short period of time. The principal obstacle to investment for start-ups is generally the elevated risk, which only VCs are able to bear.

However, VC funding is not easy to obtain. The process is demanding not only in terms of entrepreneurial requirements – they must have a very innovative project, pursue a clear vision, show significant management skills – but also in terms of time. The investment path is long and entrepreneurs secure funds just at the end of the due diligence process, that is just after proving to have delivered accurate information of the company's financial health and commercial situation.

Venture Capital is also a highly variable source of investments, since financing can change very rapidly across time. There could be different reasons behind this trend: for example, investors' preferences may change on the basis of the economic situation, as happened in the US during the pre- and post-2008 financial crisis. In particular, after the crisis investors shifted towards later-stage financing, which was less risky than early-stage. In short, it is necessary to take into account macroeconomic and also individual market trends in dealing with VC investments.

In the space economy, this variability originates, among others, from the substantial weight that corporate investments have on the total venture space funding. Corporations used to invest during

⁵¹⁰ Defence SA, *Space Innovation and Growth Strategy (South Australia): Action Plan 2016-2020*, Adelaide, Space Industry and R&D Collaborations, September 2016, p. 8.

later stages, when the investment risk is lower and deals are consequently more highly valued. So, even if corporate deals are less in number than the traditional venture investments, they represent a big share of total funding because of their higher value. This aspect, together with their extraordinary financial power, leads corporations to invest huge amounts of money that can suddenly change market trends. Dynamics observed during the two-year period 2015-2016 are such an example: 2015 big financing rounds had led us to think that there would have been a drop in 2016 investments, at least until December when OneWeb recorded a new huge funding.

Although there is high variability in investments, the perspectives for the future remain strong and one can expect new private investments in space. For example, if the fuel provision for space vehicles will be more efficient thanks to new technologies, new commercial chances would be created, especially for space tourism, and would foster new private investments.

With regards different regions, the US is and will be probably the best market in which to invest money for space. Market maturity is very high and the strong network of entrepreneurs and investors widens the range of opportunities. However, new countries are coming to the surface, especially in Asia. Apart from countries such as Japan, Hong Kong and Singapore, which have already a well-established VC market, China and India are opening to private investments and are trying to close the gap with the US. In Europe, UK is the strongest market. In general, a stricter regulation regime compared to the US restrains investments in Europe.

Finally, South Australia has a very young space industry, but the setting is very promising. An active government and a private sector environment populated by a high number of accelerators and incubators are positive factors for the future growth of a South Australian space industry, widening the support that companies can rely on and consequently leading to new entrepreneurs in space. Recently established companies such as Fleet Space Technologies, Neumann Space, Myriota and Inovor Technologies, together with multinational corporations such as Boeing, Lockheed Martin and Northrop Grumman, provide a great opportunity to point the way for future enterprises.

APPENDIX 1

Annual total values and number of CVC deals in US.⁵¹¹

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Tot. Deal value (tot)*	\$29.15	\$35.51	\$37.23	\$26.54	\$31.89	\$44.17	\$40.75	\$44.94	\$68.59	\$78.82	\$71.72
Deal value (w/CVC)*	\$8.96	\$10.62	\$10.07	\$6.29	\$7.49	\$12.24	\$11.33	\$13.49	\$24.02	\$33.63	\$32.36
% Deal value w/CVC	30.74%	29.91%	27.05%	23.70%	23.49%	27.71%	27.80%	30.02%	35.02%	42.67%	45.12%
# of deals closed (tot)	3,314	4,296	4,722	4,446	5,411	6,780	7,989	9,323	10,563	10,496	8,467
# of deals closed (w/CVC)	533	662	669	455	541	696	803	1,003	1,223	1,304	1,153
% deal closed w/CVC	16.08%	15.41%	14.17%	10.23%	10.00%	10.27%	10.05%	10.76%	11.58%	12.42%	13.62%
<i>*data in US\$billion</i>											

Annual total values and number of CVC deals in Europe.⁵¹²

	2010	2011	2012	2013	2014	2015	2016
Tot. Deal value (tot)*	€ 5.90	€ 6.20	€ 7.20	€ 7.70	€ 9.90	€ 15.50	€ 11.70
Deal value (w/CVC)*	€ 2.00	€ 1.30	€ 3.10	€ 2.90	€ 3.00	€ 4.30	€ 4.40
% Deal value w/CVC	33.90%	20.97%	43.06%	37.66%	30.30%	27.74%	37.61%
# of deals closed (tot)	1,983	2,497	3,016	3,865	4,510	4,227	3,407
# of deals closed (w/CVC)	255	338	389	450	488	492	541
% deal closed w/CVC	12.86%	13.54%	12.90%	11.64%	10.82%	11.64%	15.88%
<i>*data in €billion</i>							

⁵¹¹ PitchBook Data, Inc., 'VC Valuation Report: 2016 Annual', pp. 4; 17.

⁵¹² PitchBook Data, Inc., 'European Venture Report: 2017 1Q', pp. 4; 7.

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