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Early-Stage Startup Valuation

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ABSTRACT

Startups play a critical role within the economy, as they contribute to creating economic value, technological innovativeness and to the creation of jobs. The determination of the value of startup companies is currently a 'black-box' process, mainly because of the private nature of startups and because of the issues in applying traditional valuation methods to young companies, especially in the early stages. Since financing through private equity is the primary source of financing for startups, determining their value is crucial as it impacts the valuation process for both the investor and the founder-entrepreneur. There is no consensus in literature on a method to consistently apply for startups within their early stages, where financial information is absent or scarce and most of all, hard to infer from; the assumptions which rely on historical data must use few years of financial information, during which the company is experiencing factors which will almost certainly be changing drastically in the future. This paper will try to face this issue of early-stage startup valuation through the means of a literature review on traditional valuation methods, non-traditional valuation methods and empirical tools used by business angels and venture capitalists to evaluate young companies. The main conclusions of this paper are that no single valuation tool can be clearly identified as more suitable, as there is no method which bridges all identifies issues in evaluating an early-stage company. Additionally, an investigation over value-determinants and value-tied variables is conducted with the scope of identifying effects which are more prominent in the early-stage. In the process of the review, interesting gaps in literature and current limitations towards research are identified, with the nature of startup-related data being the main obstacle of researchers.

1. Introduction

1.1 – Startup Valuation and the Entrepreneur – Investor Relationship

"There are fewer topics more cloaked in mystery, black magic and aspiration than start-up valuation. People regularly speak of inflated valuations - or insane valuations - but it is difficult to know what anchors the numbers" (Vetter, 2016).

How should the founder of a company determine its value when he's dealing with an investment negotiation? On the other hand, how does the investor determine the value of the company which he's acquiring part of? Traditional corporate finance has found good enough answers to these questions in the form of valuation models and techniques, which are based on the estimation of future cash-flows generated by the asset object of valuation; these estimations are mainly based on historical accounting data of both the asset and other comparable assets. The assumptions rely on the notion that there is enough information to make meaningful inference for the future development of the assets' cash-flows (Miloud et al., 2012). How to proceed however, when the historical information is scarce, both in terms of years and in completeness, uninformative on future developments, and when the notion of 'comparable' is put to test? This is the case of the startup, which often lacks financial data, has different legal requirements in the disclosure of said data, and by its' nature is hardly comparable. The issues of startup evaluation become even more pronounced during their earlier stage, when the interpretation of financial information, when available, becomes murkier. While these problems are central in the negotiation process, there doesn't seem to be a clear answer, at least not one which is agreed upon amongst researchers and practitioners. Not only there is an abundance of different methods without clear winners, there also seems to be a great mispricing problem, with Corea et al. (2021: p.2) stating that "most of the investments done by VCs are completely detached from any fundamental, and often can be overvalued up to 100% of their real value. This is mainly due to a lack of quantitative robust valuation methods that can help to assign the right price to an early-stage company." To assess startup valuation, another key player must be taken into account: the investor. The valuation at the investment round is not just the result of applied

valuation tools and methods, but also the result of a negotiation process; to properly understand it, we must therefore also take this notion into account.

1.2 – Goal of the paper

The goal of this paper will be to showcase the current state of research regarding the valuation of startups, with a focus on the specific issues which affect valuation during the early stages of startup companies. The state of current literature on the subject is fragmented, with a lack of a comprehensive framework on the matter of startup valuation. This paper aims at improving the current state of research, while identifying core issues on the subject, limitations and gaps within literature research on this subject. Section 2 of this paper will be dedicated to the literature on startup and startup environment, with the goal of fleshing out the characteristics of early-stage startups, and the venture capital environment. Section 3 will be revolving around startup value-determinants identified in literature; while evaluation methods and techniques select determinants based on theoretical research, this section will be dedicated to the discussion over factors which have been identified mostly through regressions as impactful in valuation. Section 4 of the paper will be dedicated to the listing and explanation of valuation methods which have been identified in literature as suitable for early-stage valuation; the goal will be to showcase the techniques and their respective flaws and advantages. While it is unlikely that this paper will demystify the issue of early-stage startup valuation, by reviewing the content this paper will try to single out limitations on valuation approaches and eventual gaps in literature. The last section will be dedicated to discussing the conclusions, limitations of this paper as well as some remarks towards future research.

1.3 – Research Question and Methodology

To the purposes of the aim of this paper, the research question was developed as such:

- How to value an early-stage startup?

The paper will attempt to address the question through the conduction of a literature review on the subject. As Gall, Borg and Gall (1996) state, the scope of a literature review includes:

- Identifying the research problem

- Looking for further researching venues
- Establishing research limitations and what can be done
- Identifying variables relevant to the subject

The following research will aim at understanding the issue of early-startup valuation with the above objectives in mind.

As suggested in Fink (2019) and Montani et al. (2020) this research follows four steps to conduct the review of literature. The first step was to define a research question, adequate research keywords and literature databases to access. As stated before, the research question "How to value an early-stage startup?" was developed to reach the scope of the paper. The keywords used for the research were:

"startup", "early-stage", "valuation", "value", "valuation methods", "enterprise value", "value determinants", "venture capital", "new venture", "venture-backed", "business angel". JSTOR and Google Scholar were the main databases from which paper were accessed in this literature review. The following step was to screen through the available research through the definition of screening criteria. English-written academic and working papers, books, reports and articles of professional journals were selected, without applying a date restriction. The next step was to apply the screening criteria and to assess the quality of the selected papers, the characteristics of the research within the papers, with the goal of including papers with theoretical/conceptual, empirical or practical oriented backgrounds in the review, and to screen papers by the relevance in the contents compared to the aim of the review. The papers without JCR or SJR scores were excluded to maintain a standard of quality in the selection. The final step in the review is to the state the content of the analysis on the selected papers. It should be noted that given the nature of the research question, most of the cited papers are relatively recent, signaling the current relevance of the subject.

2 - Startup – Definition and Environment Characteristics

2.1 – Startup Definition and Environment

There are many definitions to be found in literature for the startup company. Moroni et al. (2015) defines the startup as "a company or a human institution that is built on different branches and that spontaneously arises the condition of extreme uncertainty, has at its core innovation to create products and services which they wish

revolutionize the market"; some have defined startups through their impact on the economy, stating that startups provide innovativeness to the market through the development of new products, practices and business models, either on existing markets or through the development of entirely new markets and demand (Eisenmann et al., 2012); startups can be defined by the quality of their growth, mainly defined by very high growth-rates, tied to the often pursued objectives of scalability, and by the high variance and risk in their venture (Blank, 2012). Other authors tried to use 'benchmarks' or 'checklists' to define startups, such as it being a company younger than 10 years old, being characterized by a disruptive/innovative technology or business model, and it being a fast-growing firm with high riskiness (Granlund et al., 2005).

In general, the literature seems to agree on some specific features of the startups, mainly the high-risk/high-reward nature of their business, the innovative/disruptive characteristics of their business and the private nature of their financing, as startups very rarely choose or have access to debt as a form of financing. Financing choices are crucial, as they are often characterized by the lack of fund necessary to reach a sustainable phase. To solve this problem, initially founders rely on what they have but eventually must resolve to access funds through external investors, such as business angel investors and venture capital (VC) funds. As they operate within a complex ecosystem of players, startups are affected by many different factors within their environment; the institutions, policies, legal system and human capital all play roles in the success or failure of startups. Startups share a tendency towards high-risk/high-reward approach to business, exchanging a higher risk and lower survivorship probability with the opportunity for above-average returns (Oviatt et al, 1995). This seems to have an overall beneficial effect on the economy, as startups growth has been linked to overall growth in countries by the research of Oviatt et al. (1995); even with high company mortality, Kane (2010) reports in his study an astounding positive effect of startups on job creation and on employment. Cashman (2012) explains this effect by the notion that startups, due to their limited resources, must resort to local labor, offering jobs to workers which are new on the employment market and are without experience.

2.2 - Startup Development Stages

Startups are placed at the beginning of the traditional business life-cycle, but it is important to understand the different stages of the startup, from beginning to exit (successful or not), to better comprehend the implications that the characteristics of each stage has on valuation. There is no clear-cut way to divide the different stages of the startup company; in absence of a framework, authors have used different terms to define the development stages of startups. Still, literature tends to refer to the same characteristics when making distinction among stages; this paper will try in the following paragraphs to summarize the development stages of startups in a comprehensive way. The figure below summarizes the stages, while linking each stage to the financing employed at each stage (Damodaran, 2009):

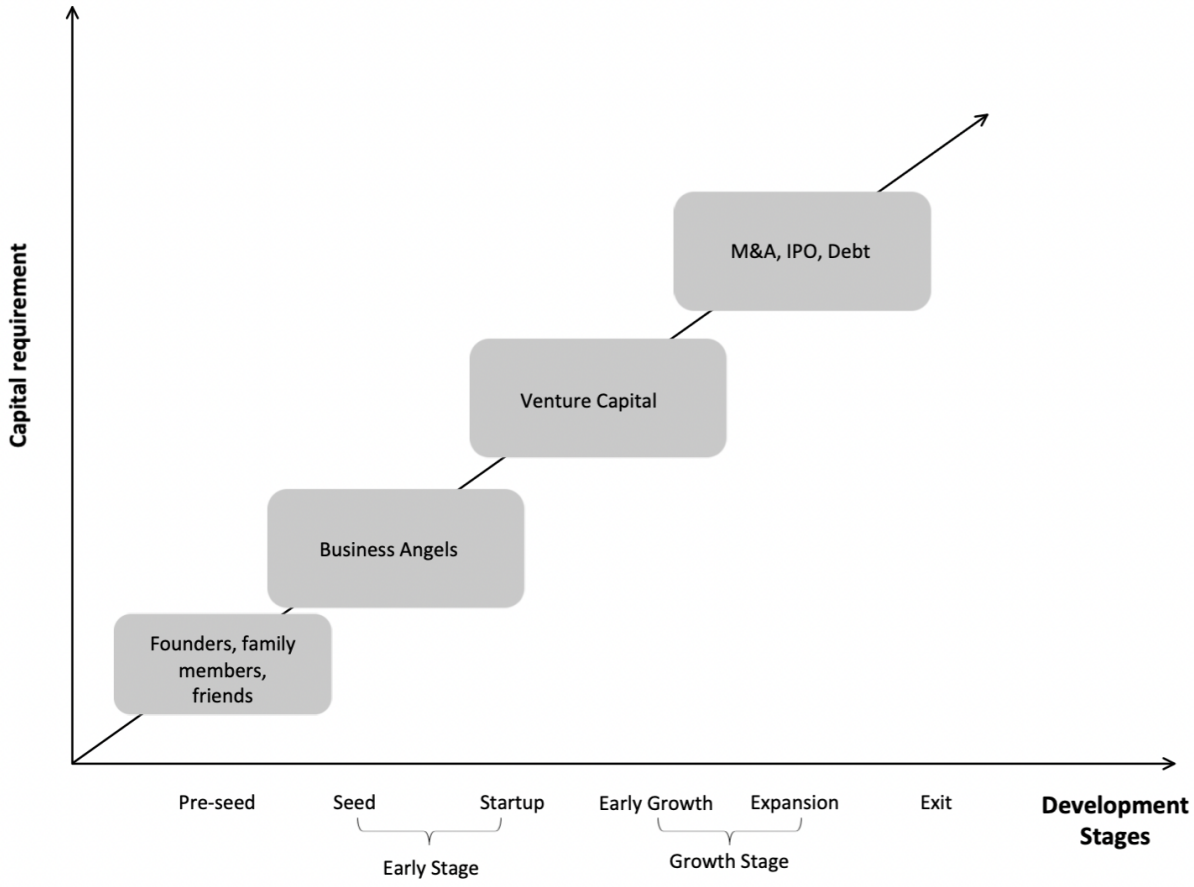

Figure 1 – Startup Financing Life-cycle

Source: Own elaboration, based on Damodaran, 2009

- Pre-Seed
- The earliest stage of the startup begins at the inception of the idea, where the main investors are funders, with in some cases other close individuals contributing such as friends and family. While not formally founded yet, the main team of management is established at this time, with founders often occupying key roles, and the securing of patents of the product or idea can be done at this stage, with benefits both in legal protection and in positive signaling effects to future investors.

- Early stage

  This stage encompasses the timeframe starting with the formal founding of the company, occurring with an initial equity mainly raised by the founders and their close contacts. From the perspective of fundraising, this is often identified as "Series A" founding stage, where funds raised are below $5M.

  This stage can be further divided in the "Seed" and "Startup" stages. Seed stage: The seed stage begins with the first official equity funding stage, with founders looking for individuals to invest in their idea in exchange for equity. At this time, the business idea has developed into a product or business model, albeit still often subject to changes and pivots, with the working team usually kept as small as possible to contain expenses. Business angel investors target companies at this time to obtain a favorable pricing on the early equity stake. The motivation of investors is not only driven by the equity stake, but also by the establishment of a relationship with founders, which might help reaching a favorable stake in future rounds of investment.

  Financial information is scarcely informative, with an absence of an insightful operative structure, as most of the expenses are set-up costs and there are no revenues yet. Negotiations at this time can mainly be based on qualitative factors, such as the quality of the idea or the experience of the founders. Business angels have to therefore rely on empirical tools for negotiating their stakes, such as Berkus, Scorecard method or Rule of Thirds method (Montani et al. 2020).

  Startup stage: Early-stage specialized VCs become available as investors and negotiations can now be based on quantitative data. While there is some financial information available privately to VCs who intend to invest in the company, it is not necessarily meaningful for the purposes of valuation, in the sense that it is hard to

draw insightful estimates on the future from the available information. Earnings are usually negative, with revenues being the most informative measure; growth rates are at the same time quite high and cannot be expected to be sustainable over the following years.

- Growth Stage

  The growth-stage is mainly tied to the presence of positive earnings and to a first round of financing from Venture Capital and Corporate Venture Capital funds that do not target earlier stage startups, typically called "Series B" funding stage, with funds raised between €3 to €10M. This stage can be further divided in “Early Growth” and “Expansion” or Sustained Growth stage.

  Early Growth: While the product has been launched, there is a lot of uncertainty as at this stage the failure rates tend to increase again after decreasing at the early-stage. While more refined than in the previous stage, the product or business model can still be subject to changes at this stage and the uncertainty must be accounted for the sake of valuation.

  Expansion: This stage is characterized by the focus on scalability and expansion into new businesses, products, industries or areas. Usually this is when the company reached break-even point. The team grows to increase the capacity of the company to achieve its full potential and the innovative product or business model is now quite consolidated and will be very close to the one offered at a more mature stage. Towards the end of this stage, the startup resembles more closely a mature company and valuation approaches used by venture capitalists can rely on financial data. Adjustments still have to be made, as the company still hasn't gone public and it might not use debt yet, and valuation has to account for the still quite high uncertainty of the future of the company.

- Exit

  More than a stage, the exit is the event of realization of the investment of the founders and the investors. When positive, it often occurs through the means of IPO and in less frequent fashion through private acquisitions. The exit can be of course be a negative event through bankruptcy and liquidation. Deals for acquisitions are of course of the highest value at this point but the financial information necessary to perform

meaningful valuation is available at this point. While valuation is less complex and can be performed with traditional tools, understanding exit events is necessary for assessing the terminal value of the company at the early-stage with some valuation methods, such as First-Chicago valuation method, which considers different potential exit events in their calculations.

For the purposes of this paper, we can identify "Early-Stage" startups as companies which have been formally/legally established and are in the process of development and have launched, or are in the process of launching, their first product. In the following section, we will go through the characteristics which are shared by early-stage startups and have an impact on valuation.

2.3. Early-stage startup characteristics

While companies in their early stages have very heterogeneous characteristics, there are some characteristics relevant in future discussion which are shared among them; while there may be more factors which they share, the following description will try to capture factors which are relevant when discussing valuation and financing options.

i. Lack of Financial Information

   It is quite easy to state that young, private companies have little to no data available to use, with financial and operative structure information being restricted to few years and at times hard to retrieve, also due to legislation being laxer on provisions on their financial statements. The consequence of this is that using tools of valuation developed for mature companies is often impossible or uninformative. The issue with lack of data is particularly palpable when trying to perform comparative analysis, since the significance of using industry averages is lowered by the relatively low number of companies for which full data is available; a consequence is that outliers are harder to single out and exclude when performing these comparisons.

ii. Uninformative revenue-cost model

   The revenue-cost model, when available, is hardly informative, as revenues tend to be very small to then grow exponentially in cases of success, and operative costs are high and hardly distinguishable from one-time, set-up expenses. The

consequence is that one cannot simply use past growth in revenues for estimating future growth without making adjustments. Another significant consequence is that multiples-based methods of valuation have to deal with null revenues and negative earnings in the first few years, making inference mostly uninformative.

iii. Private equity funding

Almost all startup businesses aim at receiving funding through private investments. In the early stages, the entrepreneur and his close network are the main investors, with later funding coming from private sources (VCs, angels…). Furthermore, the increasing number of 'exotic' private funding options (SAFE, KISS…) might be a complicating factor. This is especially relevant for the derivation of an appropriate discount rate, as we are lacking most requirements to use traditional methods to determine a discount rate.

iv. More risky than traditional companies

While startups are generally involved in innovative businesses, meaning a high potential return, the drawback is that their survivorship is lower than the average company (Sahlman 1987, Damodaran 2009). Knaup and Piazza (2007) published their research showing that survivorship rates are lower than for mature companies and that they are especially low in the first few years. This riskiness is quite relevant in valuation, as it should be factored in, with the main suggestion of practitioners being the increase of the discounting factor. One problem with the estimation of survivorship rates is that often startups endeavor themselves in new industries, making it harder to retrieve a meaningful survivorship rate.

v. Illiquidity

The investment in startups' equity is as illiquid as it gets, with no real secondary market and unstandardized deals for equity. This is especially true for early-stage companies, as companies are further away from becoming public than from more mature startups. The inherent illiquidity of startup businesses adds a dimension of risk and should be accounted for in some way when performing evaluations (Damodaran, 2009).

vi. Many claims on shares – Multiple rounds of investment

Equity deals for private companies have become quite heterogeneous to provide easier funding opportunities; this means however that there are multiple holders of equity with contracts that are far more diverse than for public equity, leading to diverse priorities in claims and increasing complexities. While at the first investments there are not many different claims, the tracking of equity claims only becomes more complex at each investment round.

2.4 - Startup Financing – Venture Capital

One of the most defining characteristics of startups is their relative lack of initial funding, meaning financing choices are crucial in their development. Private investing in startups is the most common financing choice; debt is scarcely used in financing, meaning entrepreneurs usually resort to Equity Financing in its various forms, which usually are venture capital funds (VCs), individual investors ("business angels"), crowdfunding and company incubators/accelerators (Drover, 2017).

The first rounds of financing happen at the early stages, when it is hardest to assign a proper value to the company, as there is little financial information to draw a valuation from (Damodaran, 2009). At the other side of the coin, we have the Venture Capital (VC) market, which constitute the bulk of startups' investors. VCs business model consists in acquiring riskier and more illiquid equity than publicly available, through investment deals with private companies (Tyebjee & Bruno 1986).

Since it is necessary for determining the amount of equity held by the VCs, the valuation process is crucial even in the early rounds of financing.

Appropriate valuation has been identified in literature as key component in the negotiation process between entrepreneur and investor, as it helps with it being fair and leading to more successful investments (De Clerq et al. 2006). Research has shown that this issue affects VCs, with there being a 'mispricing problem' for startups investments, especially in the early stages, with valuations being detached from financial fundamentals and having cases of overvaluation of up to double the estimated amount according to empirical research (Gornall and Strebulaev, 2019).

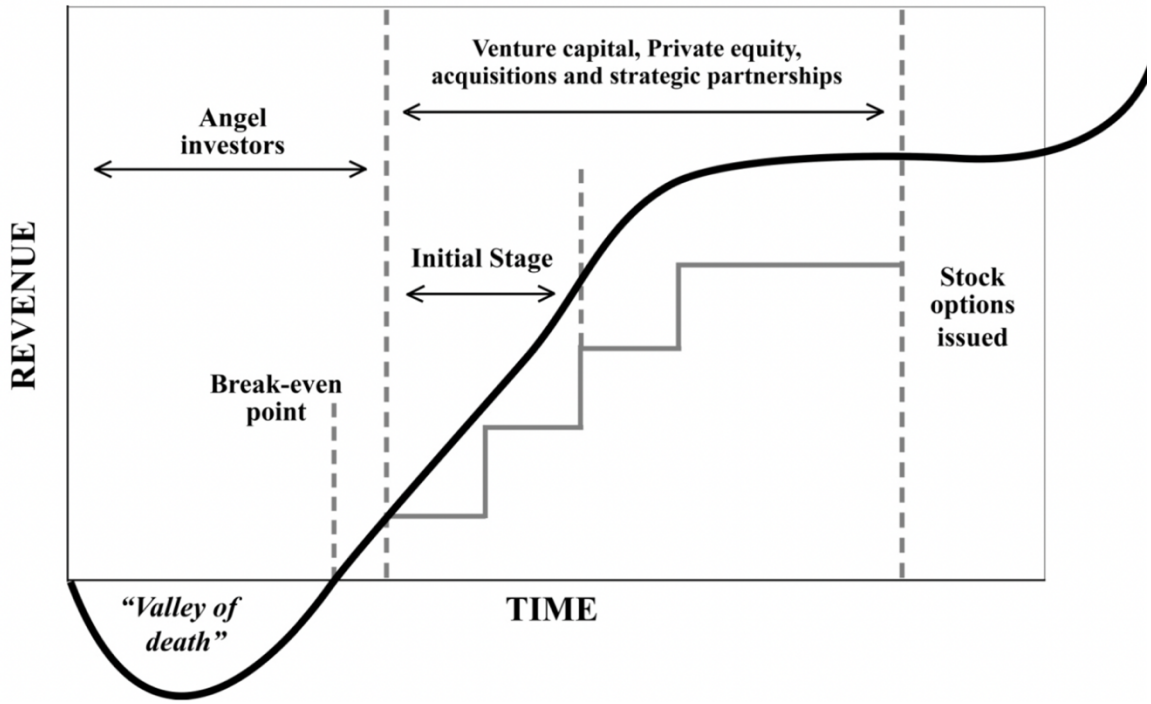

Figure 2: "Valley of Death"

Source: Mason and Harrison, (2015): Startup Financing Cycle

Venture capital (VC) funds are financial intermediaries whose business model revolves around building a portfolio of private equity, often targeting high-risk, high-potential companies. This happens through the acquisition of equity or equity-style contracts (i.e., SAFE, convertible notes) of private companies, which in turn are looking for financing options (Gompers and Lerner, 2001). VC funds can be classified in:

- Independent Venture Capital (IVC)

  The most common venture capital funds, independent venture capital funds pursue the traditional goals of VC funds. The main goal of IVCs is to make a capital gain from the growth of the companies which they gain equity of.

- Corporate Venture Capital (CVC)

  Usually affiliated to a non-financial intermediary, the CVC refers to venture capital funds which acquire equity mainly for strategic reasons. This often occurs through the acquisition of technological startup which have know-how that is synergistic with the parent company of the CVC.

- Government-controlled Venture Capital

  These venture capital funds are often distinguished by having social and political objectives, such as the development of SMEs and increasing the available jobs.

Venture Capital market is fast-growing and as a subject has gathered much theoretical and empirical interest. The global Venture Capital market has been steadily growing the past years, with the global investment value reaching record-setting figures almost each year in the past decade, with it reaching $211.3B in 2021. (imarcgroup.com, "https://www.imarcgroup.com/venture-capital-investment market").

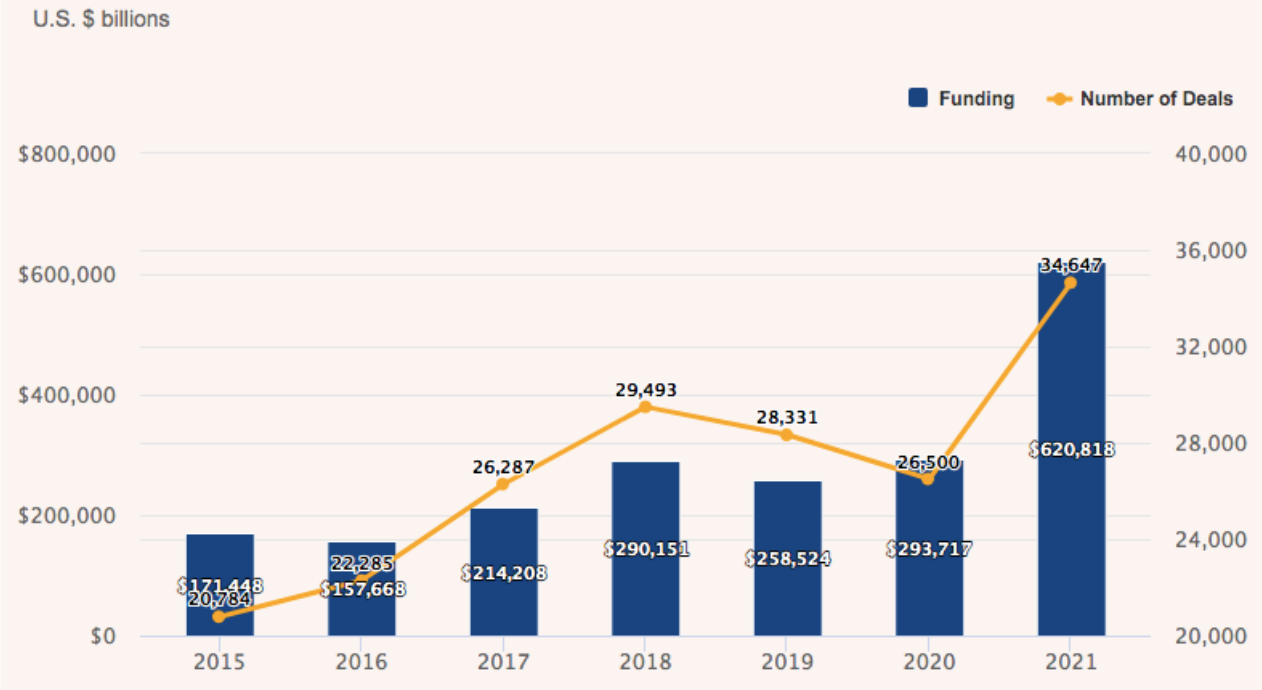

Figure 3: Annual Global Venture Funding and Number of Deals

Source: CBInsights.com

This has been true for early-stage deals as well, with median of early-stage valuation rising 112% YoY on the first quarter of 2021. With such rise in importance in the past decades, especially so in the fast-growing sectors of fintech and deep-tech, many researchers have tried to assess the impact of venture capital market on the economy and on innovation in their publication.

Researchers' results are indicating that VCs might have a positive effect on economic growth through effects on innovativeness of products and business models, and absorptive capacity of knowledge generated by private and public institutions, (Romain, van Pottelsberghe de la Potterie 2004) with empirical findings showing VCs to be up to

four times as significant for spurring innovation as corporate R&D (Lerner and Kortum, 2000). Some authors have gone to argue for VC activity to be responsible for the 'unexplained' part of US's economic growth of the past decades (Baumol 2002). Much of the literature investigated agrees on the notion that VCs are relevant from an economic and social perspective, with links between various proxies of VC activities and economic growth, innovativeness and birth of innovative companies (Romain, van Pottelsberghe de la Potterie 2004, Gornall and Strebulaev, 2021). While there is agreement on the importance of VCs to the economy and innovation, extensively backed up both by theoretical and empirical arguments, there seems to be still a gap in the knowledge on how VCs perform their core activities; that is the valuation and negotiation process of startup investment. This has been mainly attributed to the private nature of the deals which VCs engage with firms; to avoid helping the competition, VC funds tend to keep private the processes behind valuation (Gompers et al., 2016)

2.5 Startup and Venture Capital Activity Data

While it has been subject of scrutiny of researchers, the workings of venture capital funds and the way they operate when performing valuations is a largely unexplained process, with little consensus among researchers. This is not due to lack of effort, as researchers have put extensive work in trying to understand the underlying processes behind valuation (Gompers et al., 2016). One of the ways through which research was performed on the subject is through running regressions to try and find variables which would be explanatory towards valuations; however, of the main issues for researchers in the understanding of valuation processes is the data available on valuations.

Dealing with private transactions, VCs don't have to disclose much information to authorities, contributing to the lack of knowledge on the subject of valuation; the same happens on the opposite site of the coin, with companies being private in their startup phase and not having to disclose financial information and information regarding the negotiation process. This means that the main available data to researchers is that which is reported by venture capital databases, which are private entities who collect data though self-reports of entrepreneurs and investors.

Furthering the problem, the available and most used datasets with the longest history of data collection, VentureSource, VentureXpert (formerly known as VentureOne and Venture Economics, they respectively are units of Dow Jones and Thomson Reuters)

present some issues. The way they collect data is through self-reporting of venture capitalists of by the entrepreneurs which received the investment, with the first inclusion in the database occurring with the first occurrence venture-backed financing of the firm. Kaplan et al. (2002) performed an extensive review on the quality of the data in the databases, the result of which is that there are many occurrences of biased data and inaccurate valuation reports.

Overall, we can single out some issues in the data available which are relevant in the discussion on research on valuation practices and determinants:

- Incomplete Data

  Overall, theie study finds roughly 20% of financing rounds and of money committed to be absent, making studies based on these estimates underrepresent the actual amounts of funding committed to ventures. The valuations are theinformation which is most incomplete, with 30% and 70% of valuations being missing from financing reports in VentureSource and VentureXpert. The main bias reported is in VentureXpert, which has a bias towards reporting California-based companies, which appear to be relatively larger in number than in truth (Kaplan et al., 2002).

- Inaccurate Data

  When available, studies have shown data on valuation to be inaccurate. The information on valuation which is available is also reported to be noisy in a non-trivial way, albeit in a non-biased way (Kaplan et al., 2002).

  Maats et al. (2011) report a bias towards defunct investments, with the actual number being twice as large. Another aspect which should be noted is the absence of terms of agreement from the valuations, with the reports on both databases being on post- and/or pre-money valuation. In the study of Metrick and Yasuda (2009) some valuations have been found to change by up to three-fourth of their value when assessing the actual terms of agreement between entrepreneur and venture capitalist.

- Deterioration of data quality

  Both in Kaplan and Lerner (2016) and in Maats et al. (2011), a decrease in the quality of data of VentureXpert and VentureSource has been reported, with data

completeness decreasing in the more recent years, especially regarding valuation. While some new databases and alternatives are being developed, such as Pitchbook and Crunchbase, their potential in being reliable data sources has yet to go under as much rigor and testing as VentureSource and VentureXpert have had from researchers (Kaplan and Lerner, 2016).

- Early-Stage valuation data issues

  While past data is often accessible from other sources other than databases for firms that went public, this is not as easy for firms that are still in the early financing rounds. This, coupled with a bias in databases towards not including firms that go bankrupt, means that valuation data likely presents a bias towards companies which reached a mature stage (Kaplan and Lerner, 2016). The consequence is that researchers who perform empirical studies on this data will a data bias which excludes valuations of early-stage companies which have an unsuccessful exit. This also affects survivorship data, which is relevant for some valuation approaches.

- Private access

  The private nature of these databases affects researchers by limiting experiment replication. Since datasets are not easily accessible, the researchers have limitations in trying to compare studies to past publications; another consequence is that publications might go uncontested for many years (Kaplan and Lerner, 2016).

Overall, the data from which researchers have been performing studies on within the field of startup valuation has been lackluster. This is mainly because of the private nature of the data and of datasets; furthering the problem is a tendency in the past 10 years in the degeneration of the quality of the data available. The problem becomes more intense for the case of data on startups within their early stage, with most data being of companies which have reached a mature stage.

3 – Determinants of startup valuation

This section will focus on the factors which have been found by researchers to be relevant when discussing startup valuation. While not all of these factors are possible to include within a valuation model, it is necessary to cite them in this analysis to get a full picture on what are the determinants for higher or lower startup valuation; although fewer researchers have focused on early-stage companies, the goal of this section will be to try and single out the factors which have been found or discussed in research to be relevant for startups' value. To bridge some of the issues which come up when looking at the valuation methods, qualitative and quantitative research has been done to try and understand which factors should be included in valuation models.

I decided to determinants between startup, venture capital, and external environment determinants. It should be noted that not all effects can be easily singled out, as some of these determinants have been found to have interrelations; for example, Wright et al. (2004) report a correlation between valuation methods of venture capitalists, and institutional settings in the country where the VC is based. Furthermore it should be kept in consideration that all studies rely on the same datasets, VentureSource and VentureXpert, which have been shown to have data biases and incompleteness (Kaplan and Lerner, 2016).

3.1 – Startup-side determinants

Determinants tied to generic startup characteristics

Many researchers have worked towards finding empirical evidence of startup characteristics which impact their future valuation.

In Houlihan Valuation Advisors/VentureOne (1998)'s article, the market in which the company is involved and the country/state where the startup is founded, are identified as determinants for valuation. Miloud et al. (2012) reach similar conclusions, while adding growth rate of industry of the company and differentiation of service/product offered by the startup as objects of their research, coming to the conclusion that both factors have significant correlation with higher valuation. Startups which employ management control systems and tools are also tied to higher valuations, especially so in the case of high-competition markets, high growth and earlier financing rounds (Davila et al., 2015). Davila and Foster (2005) also reach a similar finding in their earlier

empirical work, with the adoption of management accounting systems in the early stage being tied to higher first round valuations. Armstrong et al. (2006) reach the interesting conclusion in their work that startup age in inversely correlated to valuation, with the effect being more significant in the early rounds; the intuition of the authors being that waiting too long before reaching the first round of financing might be a negative signal of company quality to venture capitalists.

Determinants tied to founder & team characteristics

Founder/entrepreneur characteristics are among the first determinants identified in research as relevant in the context of valuation of new ventures (MacMillan, Siegel, & Narasimha, 1985). In Hsu (2007) and Miloud et al. (2012), specific characteristics have been identified as signals which are read by investors as positive, such as having a complete management team, having multiple founders, having prior experience both in the form of prior startup founding and prior experience within the same industry as the startup. In Chatterji (2009), empirical evidence shows significant correlation between prior experience of the founder in young, high-growth companies and higher-than-average valuation.

In contrast, the work of Gompers et al. (2010) shows the opposite, as their study showed an absence of correlation found between experienced entrepreneurs and higher valuation; Falik et al. (2016) study the specific case of Israeli entrepreneurs and find that higher valuation is instead correlated with inexperienced entrepreneurs.

This is perhaps result of multiple factors, as the effect which the experience of entrepreneurs has on valuation seems to be different across studies that use startups based in different countries as their samples.

Another interesting relevant characteristic regarding founders is that their willingness to surrender control of the company over later rounds is correlated with higher valuation (Wasserman, 2017),

In general, founder and team characteristics seem to vary in their impact on valuation according to different cultures, industries and overall environment. While seemingly impactful, factoring in these factors in valuation models would likely have to take into account the specifics of the environment of the startup.

Determinants tied to patents and network

The control over intangible assets in the form of patents has been identified among researchers as a quality signal to investors. Hsu (2007) reaches the conclusion in his empirical study on semiconductor companies, that the presence of patents has a positive effect on the perception of startup value for the investors. The presence of patents for technology should improve valuation, as they signal to VCs a higher stage of development of the business plan, which should reduce risk for the company (Greenberg 2013).

Different authors have found that the effectiveness of this signaling effect on valuation might be decreasing as the startup progresses through its life-cycle; specifically, Hsu and Ziedonis (2013) report that the effect of trademarks and/or patents on valuation is stronger in the early financing rounds, especially so for founders with little or absent prior experience. Understandably, the signaling effect would have a higher impact on companies lead by founders without prior entrepreneurial experience. In his study on Israeli companies, Greenberg (2013) has found this effect to be significant and to be varying across industries and maturity stages, with pre-revenue high-tech startups receiving the highest benefit in valuation from the presence of patents, and the effect lowering when looking at later financing rounds and less tech-intensive industries. Similar results are found among authors regarding the effects on valuation from the presence of a strong network of partners.

This effect is shown in in the early study of Stuart, Hoang and Hybels (1999) and in the later work of Miloud et al. (2012), where strong correlation is found between valuation of companies at their IPO and the strength of their network and partnerships. Interestingly, Moghaddam et al. (2016) have found strong networking to be positively correlated with software startups' valuation up to a limit, with networks of 'too many' partners being negatively correlated; the authors argue that this might be a result of VCs not trusting young companies to be able to effectively handle a too vast network. Zheng et al. (2010) found the positive effect of alliances to be decreasing over time, being most relevant in the first stage of valuation.

Overall, both the presence of patents and of a strong network seem to have proof in literature to be a positive signal for VCs, with the effect being most significant for early-stage valuation. This would be coherent with the characteristics of early-stage companies, as with a lack of financial information the relative importance of positive, concrete signals of quality would be higher.

Financial characteristics

While the information contained in financial statements might be less informative for startups than for mature companies, it is still important to assess the impact on valuation where complete or partial financial information is available.

The work of Hand (2005) has been among the first investigations of the effects of financial information on valuation with varied meaningful results; cash, non-cash assets and the expenses in R&D have positive correlation with higher pre-money valuation, with the relationship being also confirmed by Miloud et al. (2012), where the intuition behind this effect is that R&D expenses have a signaling effect on the stance of management on future reinvestments. Hand (2005) also finds that financial information is most impactful when companies are in a mature stage, with the opposite being true for non-financial information, which is consistent with the literature on non-financial value determinants for startups in the early stage. Smith and Cordina (2014) find similar results in a qualitative study, showing again that financial information less impactful on valuation done in early financing rounds and most impactful for mature startups.

While intuitively relevant for valuation and certainly impactful for the valuation of mature startups, financial characteristics seem to be of lesser importance in the valuation of early-stage startups. This is coherent with the notions regarding the characteristics of financial information for early-stage startups, as financial data is less informative in the early-stage, VCs would give less importance to the information when assessing the value of the company. An interesting result is reported in the study on early-stage valuation of Davila and Foster (2005), where they find strong positive correlation between variations in sales and valuation and between variations in headcount and valuation, with the effect being non-significant for the variations in profits and valuation; the intuition of the authors behind this is that in the early-stage financial information which gives insights on growth is more important, as profitability might be less relevant than growth to VCs when assessing early-stage companies.

3.2 – VC-side determinants

Venture Capital investor type

The impact which the type of venture capital fund has on valuation has been investigated in literature. In the empirical work of Heughebaert and Manigart (2012) on Belgian startups, VCs are treated as heterogeneous investors, with the argument that different kind of VC companies would have varied degree of bargaining power which would therefore impact the valuation assigned to their investments. They find that when VCs have lower competition among other investors (such as the case of university VC firms and government VC firms), they tend to assign lower valuation than compared to independent venture capital (IVC) funds. They also do not find any difference in effects on valuation between corporate venture capital (CVC) funds and IVCs. Overall, the kind of investor seems to have an effect on valuation. While this is an element which would be hard to incorporate in a model, it should be considered as a relevant variable when performing regressions on valuation data of startups.

Venture Capital firm reputation and value-added

Both in Hsu (2004) and in Bengtsson and Sensoy (2011) empirical works on USA startups, VCs with high reputation tend to assign lower valuations, with the intuition behind this effect being that entrepreneurs might be inclined to pay for the premium of dealing with an established VC company, in the form of accepting a lower valuation. Focusing on the opposite effect, Falik et al. (2016) reach the conclusion in their study of Israeli startups, that entrepreneurs have a higher bargaining power and put more focus on valuation when dealing with inexperienced VCs. Cumming and Dai (2011) also study the effects of reputation on valuation, while adding the independent variable of fund size to assess the effects on valuation; indeed, they confirm the finding that high-reputation VCs are able to reach agreements of lower-than-average valuation, and that bigger VCs are able to reach an even lower valuation in their negotiations. They also report that founders who gain access to high-reputation VCs tend to offer them favorable deals by accepting a lower valuation.

The reputation, experience and therefore capacity of a VC to add value to a startup seem to have an impact on the negotiation process and therefore on valuation.

Valuation Methods

The number and type of methods employed by venture capitalists intuitively have an impact on the valuation of startups. Bayens, Vanacker and Manigart (2006) explain in

their work how disagreement on the application of valuation methods is the primary source of conflicts between entrepreneurs and investors in the negotiation process. While past research has shown venture capitalists to be relying mostly on one or few valuation methods (Wright and Robbie 1996), it has been shown that, at least for the case of German venture capitalists, the application of multiple valuation approaches leads to a higher rate of success in negotiations (Dittmann, Maug and Kemper 2004). In various works, the intrinsic risk of startups and its assessment is found to be critical in the determination of an appropriate valuation method and that the riskiness of startups is decreasing in their progression through more mature stages (Manigart et al. 1997, Cochrane 2005). Both in Manigart et al. 1997 and Wright et al. 2004 there is evidence of a link between country-specific factors and valuation methods employed; for example, valuation based on multiples seems to be mostly used in the UK, while in Germany DCF-based approaches are most popular. The estimation of required return is also heterogeneous amongst countries, with the UK-based VCs requiring higher return ceteris paribus than Dutch- and French-based VCs.

Expectedly, the number and type of valuation methods used by VCs seem to be have an effect on valuation.

3.3 – External environment characteristics

VC and Equity Market characteristics

The amount of VCs and in general of funds in the private equity investment industry seems to have a direct, positive impact on startup valuation (Gomper & Lerner, 2000b). This is quite intuitive as having more available investors should give entrepreneurs higher bargaining power. Various researchers have found similar evidence of public transactions and valuations to be of impact to startups within the same industry (Gomper & Lerner, 2000b, Hand 2005); this most likely is the result of a signaling effect of the success potential of startups within an industry.

What is a relatively recent finding is that electronic media coverage, in the form of startup blogs, VC forums and other forms, has a positive effect on startup valuation. This is a result of two effects, the first being the obvious signaling effect of internet-popular startups being perceived as of higher quality, the second being that an increase in users and popularity in VC forums is tied to an increase of VCs in the environment, leading to

higher bargaining power for entrepreneurs (Aggarwal et al. 2012). Overall, VC market characteristics have an impact on startup valuations.

Institutions and cultural characteristics

The role of institutions and local culture in startup valuation has been investigated in literature. Within the study of Kaplan, Martel and Stromberg (2007) there is statistical relevance of difference in pre-money valuation across 23 countries being tied to the legal regime of the country. VCs have been also reported to give higher valuations in countries where legislation and accounting are less regulated (Cumming & Walz, 2010). There is also evidence of culture having an impact on valuation, specifically on the value assigned to entrepreneur-given information.

In Wright's et al.(2004) empirical study, Asian VCs seem to give lower importance in valuation to the information which the entrepreneur gives on his and on his and team's quality and experience than US-based VCs do; interestingly Chinese VCs tend to give more favorable deals to entrepreneurs with which they have dealt in the past (Batjargal & Liu, 2004). Within the study of Bengtsson and Hsu's (2015) on Asian startups, a positive effect on valuation is seen when entrepreneur and VCs share the same nationality.
It is likely that the degree of trust between VCs and entrepreneurs is heterogeneous across countries and should play a role in the negotiation process; Zhang, Wong and Ho (2016) find in a related study that Asian VCs tend to give higher valuation to Silicon Valley based, non-Asian companies than non-Asians VCs do.

While hard to single out effects, it is evident that institutions and culture play a role within the negotiating process of startups' investments.

3.4 – Critical Reflection

It is clear that there are value-determinants which necessitate being assessed when performing valuation. While some of the aforementioned findings are not relevant when trying to perform valuation (e.g., including 'valuation method used' within a valuation framework would be an absurd notion), they are relevant for qualitative studies which are done to determine the impact of variables on valuation; that said, the following discussion will be targeting the determinants which are possible to include in a valuation framework.

Furthermore, relevant variables for startups in general without any specific effects in the early-stage found in this research were kept, as they should still be used as control variables when performing a statistical analysis of the determinants' effect.

In traditional methods, premiums given by industry and location are reflected by the criteria applied in the selection of comparable companies. With empirical tools, these factors are not always considered. The assessment of the quality of management is done extensively in empirical tools, but never included in traditional methods of valuation. Startup age is also a factor which is largely unaccounted for in valuation tools, both traditional and not.

Overall, there is evidence of VCs looking for specific characteristics in the founders and team which impact valuation. While this is mostly absent from DCF/RO-based approaches, this tendency is reflected in the inclusion of management team/entrepreneur quality in every empirical valuation tool, at least in some form. The Intellectual properties of startup can be assessed through intangible asset valuation; in its own section of this paper, we will go through this in more depth, explaining the issues in the valuation of intangible assets for young startups.

The quality of network is found to be important as an indicator of higher valuation for early-stage companies; while it is accounted for in empirical tools of valuation, this is absent from valuation methods which are supposed to account for the specifics of young companies, such as the First Chicago-Method and the Damodaran Method.

It is interesting to note that empirical studies show a decreasing importance of financial data on valuation when moving towards the earlier financing rounds. This could be a reaction of venture capitalists to the uninformativeness of early-stage financial information.

The table below summarizes the findings regarding determinants:

Factors	Effect	Relevance over life-cycle	Notes
Determinants tied to generic startup characteristics			
Industry CAGR	Positively Correlated	-	
Location	Impactful	-	
Innovativeness of product	Positively correlated	More relevant in early-stage	
Differentiation of product	Positively correlated	More relevant in early-stage	
Presence of management control systems	Positively correlated	More relevant in early-stage	
Startup Age	Negatively correlated	More relevant in early-stage	
Determinants tied to founder & team characteristics			
Founder-tied characteristics	Mixed results, often effect is tied to industry/location	-	(e.g. experience, completeness of management team)
Willingness to surrender control in future	Positively correlated	More relevant in early-stage	
Determinants tied to patents and network			
Number of patents and intellectual propriety	Positively correlated	More relevant in early-stage	Impact is especially relevant when going from none to one patent held.
Number of partners	Positively correlated	More relevant in early-stage	Effect can reach an upper bound of 'too many partners' and become negatively correlated
Financial characteristics			
Cash, non-cash assets, R&D expenses	Positively correlated	Less relevant in early-stage	
Financial information tied to growth	Positively correlated	More relevant in early-stage	e.g., headcount growth, sales growth
Venture Capital-side determinants			

Type of VC	Impactful	-	Traditional VCs assign higher valuation than government/university VC firms
Reputation/Size of VC	Negatively Correlated	-	Entrepreneurs accept lower valuations in exchange for future benefits of being partners with high reputation VCs
Average use of specific valuation methods in a country	Impactful	-	Countries use specific valuation methods and require different returns, impacting valuation; hard to single out from other location-tied effects
Use of more than one valuation methods	Positively correlated to the number of deals	More relevant in early-stage	Second-order positive effect on valuations
VC and Equity Market characteristics			
Number and size of VC firms in a country	Positively Correlated	-	
IPO valuations within same industry	Positively Correlated		
Electronic media coverage	Positively correlated	More relevant in early-stage	e.g., Startup blogs, VC forums
Institutions and cultural characteristics			
Degree of regulation in legislation and accounting systems	Negatively correlated		
Culture	Impactful on perceived value of information		e.g., Asian VCs trust entrepreneur-given information less than US VCs

Table 1 – Startup Determinants

Source – Own development based on literature review

4 – Valuation Methods

4.1 - Traditional Valuation Methods

The following methods are widely used in the valuation of traditional companies and are the standard in common practice; while understandably not designed for startup valuation, they are the basis for most theoretical models developed for startup valuation and are necessary to present to better understand what works and what doesn't within our analysis.

4.1.1 - DCF Method

DCF-based valuation is a staple in valuation techniques; this methodology comes from the intuition of identifying the value of an income-generating asset through and assessment of its future cash-flows, their expected growth, risk and timing and discounting rate. The enterprise value of the company is derived from discounting cash-flows (CF) of the company by its weighted average cost of capital (WACC):

$$Enterprise\ Value = \sum_{t=0}^{\infty} \frac{CF_t}{(1+WACC)^n} \qquad (4.1.1.1)$$

$$WACC = k_e * \frac{V_E}{V_D + V_E} + k_d * \frac{V_D}{V_D + V_E} * (1 - t) \qquad (4.1.1.2)$$

With:

CF = Cash flow

V_E = Equity value

V_D = Debt value

k_e = Cost of Equity

k_d = Cost of Debt

t = tax-rate

The full value of the company is the sum of the tax-deducted cash flows, projected for 'n' year (mostly depending on the company's industry), and the terminal value of the company. The terminal value is either derived from multiples derivation of comparable companies, or from the perpetual growth rate method.

The perpetual growth model explains value as such:

$$Terminal\ Value = \frac{CF_t\ (1+g)}{WACC - g} \qquad (4.1.1.3)$$

With ‘g’ being the expected growth rate.

The terminal value is the largest element of the two for young companies, since most startups and high-growth companies have yet to reach their potential in generating cash flows, meaning that with this method the assumptions on future growth, future cash flows and WACC are of highest importance (Damodaran, 2009).

Here we will try to understand the elements critical for DCF-based valuation and the limitations and issues of trying to apply this for the case of early-stage startups.

- Cash Flows (CFs)

  Since CF projections are determined based on current and past financial information on the company, we must have reliable data to determine them; however, for the case of young companies, financial information is either uninformative on future cash flows (for very early stages) or, when present, is hard to retrieve, as legislation allows for more leeway on public disclosure of financial statements for small, private companies. When both of these circumstances are absent, and we *do* have data, we have the two additional issues; it has too short of a time-span (e.g., 1-3 years of financial statements) to be able to determine future behavior in different market conditions means that it might be uninformative to make predictions on the future. Furthermore, financial statements for early-stage startups are quite often misleading in what would the actual operative revenue-cost structure be; often legal and set-up expenses which would not happen in later stages make for the bulk of operative expenses.

- Cash-Flow Growth Potential

  The expected growth of company assets is also factored in DCF valuation when assessing the terminal value, and is especially relevant for the case of early-stage startups, where most of the value of the company (from an investor perspective) comes from their potential in future growth and scalability. We have two main issues in precisely determining a growth rate; as stated before, we have many problems when trying to use past data for young companies; the assumption of a short span of data on cash flow growth being informative for future growth is quite strong and could lead to misleading valuation. The second issue comes again from lack of history, not just in the form of data but also of behavior; from the tenet of most early-stage

startups of being unable to generate earnings, we can infer that reinvestment behavior is close to impossible to determine (Damodaran 2009). Simply put, since the young companies have no revenues to reinvest in their growth, we cannot always confidently determine how much emphasis the entrepreneurs will put on the growth of the company through investments.

- Discounting Rate changes

  Determining the discount rate for DCF model is perhaps the issue of highest importance, which becomes quite impossible for our case, as we have some issues with determining an appropriate discounting rate for startup-generated cash flows. Usually, one would use CAPM to estimate the cost of equity and use market prices of bonds for cost of debt; however, some major assumptions necessary for applying CAPM are violated here, mainly we have that startups do not yet issue public securities and that their investors are not diversified (we cannot assume market risk as the only component of risk, since in absence of diversification we still have individual risk). That said, the issue of claims of different nature should also play a part here, as the difference in risk for differently ranked claims should lead to different discount factors for each individual claimholder. Additionally, it has been argued in related literature that startups should have different discount rates for different maturity stages, making it necessary to have a valuation method which can take this into account, a feature that the DCF model does not have (Schootbrugge & Wong, 2013).

- Uncertain Scenarios

  While the DCF model is easily applicable for mature, stable companies, the intrinsic uncertainty of startups clashes with the 'one-scenario' approach of the DCF model.
  Startups have a high chance of failure, with approximately 50% of startups going bankrupt within the first three years, and tend to have real optionality events in their business life-cycle, meaning that the development of multiple scenarios is absolutely necessary to have a realistic valuation of the young company (Knaupp & Piazza 2007, Schootbrugge & Wong, 2013).

- Terminal Value

  Terminal value constitutes most of the current value of an early-stage startup, with the work of Mills (1998) identifying the terminal value as between 9/10th and the whole value of the company. The issue is in the two suggested methods applied for determining the terminal value: the multiples method and perpetual growth method. The multiples method suffers from the issue of having to use multiples of comparable companies to derive terminal value; the problem is both in comparable companies being less 'comparable' for young companies than for mature companies and of the past cash-flows being often uninformative, as startups operating profit/losses are usually very different in the first few years than in the future. Similar problems are found in the perpetual growth method, as we can hardly assume future growth to be similar to growth in the first stages of the company; Beneda (2003) calls for the difficulty of making this assumption for young companies' valuation, citing the additional issue of having to further assume the future development and change in time of growth.

There are many arguments in literature both in favor and against the use of DCF for early-stage startup valuation.

Damodaran (2009) Explains how these complexities lead to a vastly more complicated application of DCF Method for early-stage startups. Furthermore, considering that the goal of valuation for startups is to help bridge the negotiation between entrepreneur and investor (Miloud et al. 2012), having the valuation rely on too many subjective assumptions is not likely to be the best approach to follow.

Laitinen (2019) argues for the applicability of this approach regardless of the subjectivity in assumptions; the argument relies on the intuition that cash-flows are the most important aspect for startups in their early-stages, so cash-flows estimations, with the appropriate adjustments for the issues with uncertainty and data, should be the most insightful estimations to base a valuation method on. However, he finds inconsistencies in his own empirical studies, as DCF is shown to be overvaluing startups with a short payback period and slower development, which is contradictory to most notions on innovativeness and high-growth being among the more important value-determinants for startups. In Dittman et al (2004) a study is performed on the impact of fundamentals on startup valuation, trying to gather as much information as possible on the applicability

of the DCF method. While they find more than half of their respondents to use DCF-based approaches, with most using their own estimates for discounting, they do not find DCF-using firms to be outperforming the rest of their sample.

Overall, while it has been one, if not the most used valuation approach for mature companies, the research on literature shows conflicting results on the applicability of a straight DCF approach for startups valuation, with the issues being tied to aspects which are most relevant within the early-stage.

3.1.2 - Multiples method

One approach used by practitioners to value companies is to assess their value by extracting the value of the company from comparing multiples (financial ratios) of the selected company to those of comparable companies.

It is necessary to properly assess which companies are comparable by looking at:

- Location – Macroeconomic factors and institutional conditions would play an important role for business.
- Sector/Market – Companies operating within similar markets share similar risks associated to market characteristics (i.e., technology risk, distribution channels…)
- Financials – Companies' multiples should be compared to companies who share revenues, growth structure, profitability margins etc.

While there are theoretically many numerical value-drivers which could be used for multiples' comparison, researchers have usually focused on two kinds of multiples approaches, with each approach being based on the selected multiples (Liu et al., 2000):

- *Enterprise Multiples*

  These multiples are used to find the Enterprise Value (EV) of a company and the most frequently used are EV to Sales, EV to EBIT or EV to EBITDA ratios.
- *Price Multiples*

  These multiples are used to find the value of equity of a selected company, using mostly Equity Value to Price-to-Earnings ratio and Equity Value to Price-to-Book ratio.

We have argued why the traditional DCF model of valuation is difficult to apply for the case of early-stage startups, now we will try to understand the issues of applying this

alternative traditional method of valuation and the state of research on the applicability of this approach.

- Data Sample

  Having to rely of comparison to similar companies poses an issue for young companies. First of all, since early-stage startups are private companies, data is scarce and hard to obtain, posing an almost insurmountable issue already. When available, datasets are mostly compiled on US companies, making this method, if applicable, only useful for US-based startups (Kaplan et al., 2002). Additionally, startups are by most definitions characterized by a disruptive technology or business model, meaning that the entrepreneurs often aim at building a company which is by design not comparable to current companies.

- Multiple common measure

  Be it for Enterprise Multiples (Sales, EBIT, EBITDA) or for Price Multiples (P/E, P/B) we have it that the common measures for scaling are quite different for startups than for mature companies; specifically, startups often experience small or negative P/E and EBIT or EBITDA in the beginning of their life-cycle (Damodaran, 2009).

- Risk assessment

  While multiples approach can account for risk by scaling with equity standard deviation or equity beta, the same cannot be done with private companies (Damodaran, 2009). Additionally, the far lower survivorship rate of young companies is not considered and would not be part of valuation in this approach (Knaup & Piazza 2007).

- Development in time

  Similarly to the DCF method, as Schootbrugge & Wong (2013) argue, this approach doesn't account for the future changes in startup growth and for having to time the development of the startup. Furthermore, there are no scenarios or optionality considered in the multiples' method.

While presenting similar issues to the DCF approach, the discussion on this valuation approach is mostly one-directional within the context of early-stage companies. On their research on the significance of financial ratios over valuation, Liu et al. (2000) exclude young companies, with the argument that multiples valuation loses significance in this specific case. One silver lining might be found in a multiples' based on different multiples. In the recent study of Barg et al. (2021) a reverse-engineering of which multiples are most value-relevant for young startups is performed, with some positive results. Still, no major empirical studies are present on the applicability of multiples' approach for the case of early-stage companies.

While less complex than DCF valuation method, this approach seems to be to rely on too many assumptions to be a reliable valuation instrument for young startups; since other methods of valuation (such as the aforementioned DCF method) rely in their steps on multiples valuation, the above issues in assumptions become most problematic in these methods (Damodaran, 2020).

4.1.3 – Comparable Transaction Method

Intuitively, this method assesses the company's value by comparing it to the transaction value of previous companies; while there will be similar issues for this method than for the multiples method, there is an advantage of using transaction values as it includes the control premium over startup equity, which in turn is likely to result in a more realistic valuation.

We'll now go through the problems of applying this method of valuation to startups:

- Data Sample

  With the transaction method the value of the company is to be derived from data of previous transactions, with Damodaran (2009) explaining that to obtain a realistic valuation of startups, private transactions must be considered, as well as private companies' multiples. This poses the issue however of obtaining a large enough data sample for early-stage private companies, with the additional restriction similar location and industry to reach a meaningful comparison. The data on early funding is often only available to the parties within the private transaction, with entrepreneurs and VCs not making this information public for competitive reasons. Furthermore, there is a lack of available database

information, making estimations costly and often incomplete (Kaplan et al., 2016).

- Multiple common measure

  The same issue found in the multiples' method is found here; while for large and mature companies the EBIT, P/E, EBITDA are informative enough on the company to make derivations of company value meaningful, for young companies these values are often negative and do not reflect properly the nature of startup growth in their business. Furthermore, accounting principles for private young companies are often laxer, meaning that there is further complexity in obtaining financial statements and financial multiples to compare.

While it includes the control premium, the transaction method is scarcely an improvement over the very similar multiples method of valuation. The issued found in the multiples' method are repeated here, with no inclusion of illiquidity, multiples scenarios, high-riskiness/low survivability and further characteristics of startups which are relevant in valuation. The literature research on the topic is even more lacking than for multiples' method; this is most likely the result of both the simplicity of this method and the unavoidability of the issues in applying it. While practitioners and researchers have put much effort in finding suitable ways and adjustments for the DCF to be applicable for younger companies, the comparable transaction method has not received as much attention. The speculation of the author is that if one wanted to use financial information-based approaches, the DCF method and its derivations would be the go-to approach, leading to the higher attention in literature; if one was looking for an easier method to apply, empirical tools developed by business angels and venture capitalists are most likely more suitable than this approach.

4.2- Discount rate puzzle

As this is a leit motif in this paper, the issue of assessing the discounting rate for startups using traditional approaches will be faced in its own section, to avoid unnecessary repetition in other methods for valuation.

We know that for established companies the CAPM can be used to derive the WACC:

$$WACC = k_e * \frac{V_E}{V_D + V_E} + k_d * \frac{V_D}{V_D + V_E} * (1 - t) \quad (4.2.1)$$

$$CAPM: k_e = R_e = \beta_e * (R_m - R_f) + R_f (4.2.2)$$

With R_e being the return of the security, β_e being the beta of the security, R_f the risk-free rate and (R_m – R_f) being the market risk premium.
With the levering and un-levering of Beta we are also able to adjust for changes in the capital structure of the company:

$$\beta_U = \frac{\beta_L}{1+(1-t)\frac{D}{E}}, \ \beta_L = \beta_U[1 + (1 - t)\frac{D}{E}] \quad (4.2.3)$$

While the method aforementioned has had some issues in empirical application (Fama and French, 2004), it is widely regarded as a most effective method to derive expected return of equity, also because of its simplicity.

I will try to explain why the discounting factor for startups has additional issues in being derived from the CAPM and should account for more complexities:

- Deriving cost of equity (R_e)

  While we can derive the equity Beta for publicly traded companies, this is a far harder task for young startups. Furthermore, the diversification assumption of CAPM which allows to make the idiosyncratic risk to be zero is more fragile for the case of young startups, as the equity holders (entrepreneur-founder, business angels and VCs) are all less diversified than the traditional investor portfolio. To complicate the matter further, the stakes on equity are different, with claims not being equal (Damodaran, 2009).

- Deriving cost of debt (k_d)

  Startups are mostly financed by equity in their early stage, so the issue of deriving the cost of debt is of lesser importance, as that part of the equation is often zero regardless. Still, if we were to derive the cost of debt it would pose quite the challenge. This is because there is no way to properly assess the default risk of startups without them having a bond ranking.

- Capital structure (D/E)

  Leverage in startups is mostly absent as the entrepreneurs tend to seek funding in private investors; due to the risky nature of startups in their early stage, debt is issued with unfavorable terms, meaning that entrepreneur have developed other kinds of debt-like contracts (e.g., KISS, SAFE) to obtain funding. This, coupled with the private nature of these agreements making them unavailable to the public, contributes to make the estimation of the capital structure of the young company a hard task.

- Changing required return over business cycle

  From the investor perspective, the discounting rate for a company without debt would be equal to the required rate of return. Sahlman et al. (1987) identified in his work that to the different stages of startups within their business cycle from inception to IPO, there are varying degrees of riskiness with diverse required returns from investors. These rates are consequence of the decreasing risks through the stages of the startup and the additional investment opportunities which become available in the later stages, summed up in the table below:

Stage within business cycle	Required Return
Seed stage (inception)	80%
Valley of Death (negative revenues)	50-70%
1st Early Stage (after Break Even)	40-60%
2nd Early Stage	30-50%
Later Stage – IPO	25-30%

Table 2: Required return during different business cycle

(Sahlman, 1987)

While traditional valuation methods rely on CAPM derivation for the discounting rate for mature companies, it is quite clear how these methods would lead to uninformative valuation for startups, with the issues increasing as one moves towards the earlier stages.

4.3 Non-Traditional Valuation Methods

We have now gone through traditional valuation methods; the main reasons why they are not suitable for startups' valuation are:

- Unrealistic discount rate assumptions
- Lack of flexibility
- Reliance on mostly unavailable data

This result is expected, as there is overwhelming evidence in literature towards this. The methods described in the following paragraphs are approaches which have been developed to bridge the issues presented in the above section on traditional approaches. Most of these approaches try to improve on the DCF approach specifically, with varied results.

4.3.1 - Venture Capital Method

Developed in 1987 by Sahlman & Scherlis (1987), this approach is one of the first attempts at developing an appropriate tool for valuing startups. This approach takes the uncertainty of business into account by changing the way the discount rate is determined when performing the valuation. The following formula shows the calculation for pre-money valuation (Keeley et al., 1996):

$$(pre.money)NPV = \frac{P_{T,VC}}{\prod_{t=1}^{T}(1+R_{t,VC})} - \sum_{t=1}^{T}\frac{I_{T,VC}}{\prod_{t=1}^{T}(1+R_{t,VC})} - I_{0,VC} \quad (4.3.1.1)$$

With:

$P_{T,VC}$ = estimate of company value at 'T' (of the venture capitalist)

$I_{T,VC}$ = estimate of additional investment required in 't'(of the venture capitalist)

$R_{T,VC}$ = one-year discount rate from 't' to 't-1'(of the venture capitalist)

$I_{0,VC}$ = net present value of initial investment

The process of this method follows these steps:

i. The first step to reach the values to compute the above formula would be to determine expected terminal value with a time horizon of 2 to 5 years. The time horizon is chosen to reflect the expected time lapsing before a positive exit event for the company. The future value is estimated through comparable companies, with one single most-likely scenario approach.

ii. After determining a terminal value through financial multiples' comparison discounting can be done. The discount factor is usually quite high to reflect the higher risk of the venture. It also represents the rate of return expected by the venture capitalist (Bhagat, 2014). Practitioners usually discuss 'investment multiples' when talking about the discount rate; the intuition is that they discount at the required investment return (i.e., 10x ROI on a 5-year period would become approximately a 60% discount rate)

iii. The equity share is now computable. Since the post-money valuation is necessary to determine the equity share to give to the venture capitalists/investors, it is computed as the summation of NPV pre-money and the apported capital of the investor.

While quite simple in its application, this approach suffers from many limitations:

- Multiples' computing of Terminal Value

  Using multiples' approach to compute the Terminal Value of the company means having to face the issues which we discussed with the multiples' approach. Van Schootbrugge & Wong (2013) argue against the derivation of terminal value from multiples here, as there is the assumption to be made that the startup will reach the same success as the public company to which it is compared, ignoring the high degree of uncertainty and failure scenarios. What they argue is that there should be additional measures of assessment of risk than only using the sample-based discounting rate.

- One scenario hypothesis

  The Venture Capital Method does not account for multiple scenarios in its valuation, disregarding the possibility of changes in the cash-flow projection, for better or for worse. This is not a structure which can be realistically applied to young companies, as they've been identified in literature by their evolving business model and high degree of difference from early and mature stage in cash flows. This issue is partially solved in one of the following non-traditional methods for valuation, the First Chicago Method (Sahlman et al., 1987)

- Ownership percentage issues

While this method assumes that the ownership percentage at the time of valuation will correspond to the ownership percentage at the time of the exit event of the company, this is largely proven to be unlikely. Woronoff and Rosen (2005) explain in their analysis of the Venture Capital model the effect which different factors, tied to liquidation preference, have on the final value. The assessment of the value of the company should be based on the actual value of ownership at the exit, which only partially depends on NPV, with the percentage of ownership being the other determinant; this means that the Venture Capital method not only looks at a best-case scenario for the company, but also for the venture capitalist, which can't always control the dilution of his shares.

The Venture Capital method is a DCF which has been adapted to suit the situation of startup companies, mainly by the changes in the discounting factor and by adapting the forecasting period for the startup case. The method is easy to apply, hence its popularity among practitioners; the ease in use is however the result of a tradeoff on accuracy.
This approach tries to cope with the discounting factor issues by using the required return on capital instead, which raises the question on if this is an accurate discount for startup uncertainty; it also does not change the way that multiples' comparison is used for terminal value determination, something which we already argued to be necessary. While there is much evidence of the popularity of this approach in literature, there are no studies which advocate for the Venture Capital approach to be better suited than other approaches used for early-stage companies; this comes with no surprise, as it is one of the first solutions developed to face the complicacies of startup valuation.

4.3.2 - First Chicago Method

Designed by the First Chicago Bank, this approach is a widely used valuation method built to improve on the Venture Capital method by considering different scenarios. There are six steps which are performed in this valuation approach:

- Definition of scenarios

  Scenarios have each their own probabilities of realizing, with different financial outcomes, with predictions being done on future cash flow statements and predicted time of exit; this is done to improve on the Venture Capital method by assessing the high variance of startups' outcomes.

Three scenarios are used in the model: Best-, Middle- and Worst- Case scenarios (Achleitner & Lutz 2005). The best case is the best possible outcome for the investor, where an IPO is reached. The valuation in this scenario assumes accrued dividends over the years as well as terminal value times the ownership percentage. The sideways-case is average outcome scenario, where only accrued dividends are collected, with the IPO not being realized; the scenario assumptions are the collected dividends and the eventual recoup on the investment in case of failure to go public, either through liquidation or through re-financing at a higher valuation. The worst case would be the liquidation case, where assumptions have to be made on the potential liquidated and recoupable assets and the period is shortened from 5 to 3 years.

- Terminal Value calculation

  This step usually involves multiples comparison to determine an appropriate Terminal Value for the selected company, following the usual criteria (similar business, location, revenues). There are three Terminal Values estimated (one for each scenario), with the values being tied to negative, average and optimistic predictions of growth in the industry of the selected company.

- Discounting rate calculation

  Sahlman et al., (1987) again proposes the alternative of using a 'required return table' from empirical VC data as discounting rate; he further suggests to use a lower discounting rate than for the Venture Capital method, as we are already assessing failure probability with the multiple scenarios.

- Determination of probabilities

  While there are different ways, more or less cautious, one might approach for this step, the usual distribution of probabilities for practitioners would be a (25% - 50% - 25%) split of probabilities for Best- Middle- and Worst- Case scenarios. Damodaran (2009) proposes three alternative ways of determining probabilities for the scenarios:

i. Determining the failure probability and IPO probability from databases on startups outcomes would be the easiest way to determine probabilities, allowing to screen the data for specific industries in most cases.
ii. Arguing the over-reliance on past data, Damodaran (2009) alternatively proposes to develop models to determine failure and IPO based on various qualitative and quantitative inputs (e.g., patents, quality of management team, cash amounts)
iii. Alternatively, the most complex solution would be building Monte Carlo simulations to assess stages of failure or IPO.

Intuitively, once determined the probabilities of two out of the three probabilities the probability of middle outcome would be derivable.

- Determination of three scenario values and final valuation

$$Valuation_S = \sum_{t=1}^{h} \frac{CF_t^S}{(1+r)^t} + \frac{TV_s}{(1+r)^h} \qquad (4.3.2.1)$$

Where:

$Valuation_S$ = Valuation in scenario S

h = Investment horizon

CF_t = Cash flow in period t, in scenario S

r = Required rate of return

TV_S = Terminal value in scenario S

At this point, with the above calculation, we can find a valuation for each scenario.
To reach the final estimated value for the company one would simply perform the sum of each scenario valuation, weighted by the respective probability:

$$Valuation = \sum_{s=1}^{N} p_s \cdot Valuation_S \qquad (4.3.2.2)$$

Where:

$Valuation_S$ = Valuation in scenario

N = Number of scenarios

p_s = probability of scenario S realizing

(W.Sahlman, D.Scherlis, 1997)

This approach is an improvement on the Venture Capital Method which tries to capture the inherent uncertainty of Startups with the scenario approach. There are however limitations which make this method hardly appliable for early-stage companies:

- No change in time

  The application for this method to young companies might be especially inaccurate, as it does not account for changes over time in the companies' situation, making it most suitable for companies with an already established business model and generating revenues (Demyanova, 2018).

- Scenario Probabilities Estimation

  The additional assumptions on survival probabilities of survivorship need large data to be sound; using Damodaran (2009)'s suggestions on model-building for estimation of probabilities for success/failure might be a viable solution but up to the author's knowledge there have been no applications in research, or evidence of use of these tools by practitioners.

- Reliance on earnings or revenues

  While the discounting rate issue is improved upon from the traditional DCF method, we still have the issue of relying on earnings or revenue estimates. The problem is that for young companies, we have discussed the issue of uninformativeness of revenues and earnings in the early stages for future forecasting. The issue is relevant in the venture capital method, as we are basing the valuation on earnings which are forecasted in the success-case, rather than the expected earnings, which would include alternative scenarios.

More complex than the Venture Capital method, this approach tries to cope with the uncertainty of startups in ways that go beyond simple discounting rate adjustments. It makes the issues tied to discounting rate estimation lighter, and is better suited than the Venture Capital method for the case of early-stage companies.

Still, most of the issues which were present in the Venture Capital method remain unassessed here; the literature on the First Chicago Method is similar to that on the Venture Capital method, with researchers attesting the popularity of this approach, without serious empirical studies to back-up on the accuracy of this method.

4.3.3 - Damodaran's Method (Modified DCF Method)

In his paper on valuation of young and high growth companies, Damodaran (2009) tries to cope with the complexities of applying the DCF method to Early-Stage Startups by making some adjustments. The first step is to determine future cash flows by going beyond estimation based only on the 'bottom lines' (earnings, revenues) and trying to understand the operating expenses in all their component.

To perform this estimation on operating expenses, he proposes two approaches, a top-down approach, which begins industry averages to build the operating expenses, and bottom-up approach, which revolves around estimating the investment capacity of the company.

Top down:

In this approach one begins with assessing figures on the total market for the business of the company and then working out revenues and earnings from there. The first challenge is estimating the potential market for product/services, with complexities arising both in the clear definition of the market targeted by the firm and from the estimation of the market size, as well as estimating the growth of that specific market over time (Mills, 1998). While for the first issue (potential market estimation) it might be difficult to retrieve the appropriate data for young companies, data availability would not be a problem for the subsequent estimations. In literature, there have been suggestions to also include market acceptance of product, competition, risk and financing opportunities in the top-down estimation (Damodaran, 2009).

The first estimation to make is on the market share owned by the company under analysis, with two key dimensions being used for this estimation: the capacity of management to deliver on their set objectives and the resources that the company has available to improve their market share. The operating expenses/margins must also be estimated. One way is to do this is to use comparable mature companies (Mills, 1998). This step would necessitate extensive assumptions so Damodaran (2009) suggests less detail instead of more, especially as the forecasting period progresses since blind assumptions would have to be taken to make more detailed predictions. Growth is estimated then by looking at reinvestments and expenses, especially in R&D which considerable as signals of the intentions of the entrepreneurs to further develop

their company. To estimate future growth, Damodaran (2009) suggests using past reinvestment behavior in the valued company and comparing it to the average revenue/invested capital ratio within the industry. The tax effects should be considered; for early-stage companies there are usually years of negative earnings with forward-carrying positive tax effects, within the forecast of cash-flows, the positive and negative.
To check on the approach validity, the author suggests to do an internal consistency check:

$$Imputed\ ROC: \frac{Expected\ Operating\ aftertax\ income_t}{Invested\ Capital_{t=0} + \sum_{n=t}^{n=t-1} Reinvestment_t} \qquad (4.3.3.1)$$

After computing the imputed return on capital it is to be compared to industry averages, in case it is too far below/above the average value (Damodaran, 2009).

Bottom up:
This approach tries to estimate the cash flows beginning from the expected investments in capacity, which is estimated from human and financial capital available. The following step is to estimate how much can the capacity be saturated (how many revenues can the company hope to achieve); this has to also take the competition, as well as the demand, into account. Operating structure would have to be estimated now to figure out the final profits, including the
administrative and selling costs. Afterwards, similarly to the top-down approach, tax effect must be estimated while trying to include depreciation/amortization effects, to be as precise as possible. Finally, the potential reinvestment of the company must be estimate as it will affect company growth.
Using the bottom-up approach should lead to a lower and more conservative estimate, due to the investment capacity constraints being a factor. This has a particularly strong effect and is suggested by the author of the method for the valuation of young companies within capacity-constrained industries, where scalability cannot be easily achieved and future revenues require capacity building (Damodaran, 2009).

Discount Factor

The discount factor in the form of Weighted Average Cost of Capital (WACC) of the company should now be estimated, with both cost of equity and debt having to be estimated, with many difficulties arising for young companies (Damodaran, 2009).

- Cost of Equity

  Since young companies are usually private, using the CAPM to simply estimate betas from stock prices is not possible. Furthermore, the assumption of idiosyncratic risk of the stock being diversified away is not applicable for companies who are entirely held by mostly non-diversified owners (entrepreneurs and VCs).

- Cost of Debt

  The cost of debt cannot be consistently estimated from bonds outstanding and must depend on unstandardized bank loans, meaning that the cost of debt might not reflect the exact picture of interest payments of the company.

- D/E ratio

  Since early-stage companies are not traded in the public market, the D/E market values are mostly unavailable.

A five-step approach can be used instead to estimate the discounting factor. First one should estimate the industry Beta by running a regression on companies within the same industry to get average Beta to then estimate unlevered Beta, trying to capture the risk involved.

$$Unlevered\ \beta = \frac{Average\ Regression\ \beta\ (public\ firms)}{(1+(1-Tax\ Rate)Average\ Market\frac{D}{E}\ for\ the\ sector} \qquad (4.3.3.2)$$

Adjusting for absence of diversification is the following step. With the same regression as before we can use the R-squared and correlation coefficients to capture the amount of risk in the average firms which comes from the market and which is intrinsic (since it is not diversified by the founder, who is mostly invested in his venture):

$$Total\ \beta = \frac{Market\ \beta_{\ Publicly\ traded\ firms}}{Correlation\ with\ the\ market_{\ Publicly\ traded\ firms}} \qquad (4.3.3.3)$$

As the firm issues investment rounds, some diversified investors (Venture Capital) will take part in the ownership, leading to a smaller Beta though the company life-cycle:

$$Total\ \beta_{VC} = \frac{Market\ \beta_{\ Publicly\ traded\ firms}}{Correlation\ with\ the\ market_{\ VC\ Portfolio}} \qquad (4.3.3.4)$$

Now the cost of debt is estimated Using synthetic bond rating estimation (based on available financial ratios), adding the default spread resulting from the estimation to the risk-free rate. The next step is to find D/E ratio; since management in young companies has a tendency of not disclosing the amount debt in the case of young companies, we must use the D/E ratio of comparable companies to compute the WACC. From the perspective of VCs, this step should be easier as they should have gained access to the debt owned by the entrepreneur in the negotiation process. Taking account of evolution of WACC in time is also necessary; we can expect that the cost of Equity will lower while cost of Debt will increase, since startups usually attract more investors and increase their use of debt over the progression of their life-cycle.

It should be noted that the cost of equity is derived from companies who are already public and have lower risk than a younger company; the cost of equity should therefore be higher than what is reflected by the estimation. This issue is in a way solved with the inclusion on survivorship as an adjustment to the terminal value.

Terminal Value

Estimating the terminal value is a step of high importance for early-stage companies, where it determines most of the company's value.

There are three approaches proposed by Damodaran to estimate the Terminal Value. The first is to use the growth rate model, which would mean to calculate Terminal Value as function of perpetual growth rate and excess returns ($ROI\ -\ cost\ of\ capital$), which is best suited for mature startups who are in the process of receiving an IPO. The second possibility is to change the estimation period; if the perpetual growth is too uncertain, we can estimate a finite number of cash flows which can be reasonably expected to be produced, usually with a span of 2-5 years. Finally the most conservative assumption is the Terminal Value being taken as the liquidation value at the end of the forecast period.

Damodaran makes the case for using the second approach for young companies and the third one for companies with limits in their operating lives, as they are more conservative.

Survival probability

The probability of survival must be assessed to scale down the terminal value of young, high-risk companies.

Damodaran suggests a two-step approach here. First, we should aim at determining the survivorship probability, which can be done in three ways. The first is determining sector survivorship averages from empirical data, such as the tables provided in Knaup and Piazza (2007). The second would be to build a Probit model using determinants of success. The third would be building probability distributions and simulations for operative cost structure, trying to infer bankruptcy rates from the simulation;

Then, we can find the Expected Value of the company as:

$$Expected\ Value\ = Value\ of\ going\ concern\ \big(1 - \ Probability(Failure)\big)\ - \\ Distress\ sale\ value\ (Probabiltiy(Failure)) \tag{4.3.3.5}$$

Illiquidity

The illiquidity issue of startups must be considered in the form of an adjusted discount rate, to account for the illiquidity of private equity investments. According to Damodaran (2009) he two ways we could use to perform this adjustment. Firms have been shown to use 'fixed discounts' derived from empirical studies on the illiquidity discount spread between liquid and comparable illiquid assets, which would be the a solution. Another way is to use the fixed discount approach and then to adjust the discounting factor by the specific characteristics of the company. This would mean giving a lower discounting factor to larger firms with more liquid assets than for smaller firms or firms which are closer to financial distress.

The Damodaran Modified DCF is one of the strongest attempts to solve all of the issues of the DCF when applied to young companies. While very detailed there are still some critiques which can be raised on this approach:

- Data Requirements

  This valuation method is the one which, among the methods looked upon in this paper, requires the largest amount of data to perform, both qualitative and

quantitative. This negative aspect is arguably inconsequential to a VC firm with extensive data access, but it would be an issue for an entrepreneur who wishes to value its own company in preparation for negotiations.

- More adjustments, more assumptions

  Damodaran has tried to solve many of the issues that come up with early-stage startup valuation, by including many adjustments to the discounting rate. The issue is that each of these adjustments require a certain amount of subjectivity in their assumptions, meaning that the mispricing error and variance in valuation across practitioners would multiply for each of these steps. Again, this is an inevitable result of flexibility in the application of the valuation tool which, while good for valuation purposes, could prove to be harmful towards finding a common ground in negotiations.

- Complexity

  This approach is arguably the most complex approach of valuation taken under analysis in this paper and, to the best of the author's knowledge, the most complex tool found to be used for startup valuation. While is assesses many issues brought up in previous paragraphs, such as the discounting rate adjustments, there is an abundance of estimations which have to be performed, and which mainly rely on subjective samples of comparable companies. This increased complexity should not count as a negative on its own; the issue is that the establishing a proper evaluation method is necessary to improve the success of negotiations (Miloud et al., 2012) and that the skills required to perform this evaluation require a great degree of training and knowledge. As VCs and business angels have developed empirical evaluation methods and 'rules-of-thumb' over the years to reduce complexities, it is arguable that they also would be reluctant in adopting a method with such a degree of complexity.

This valuation tool goes to great lengths to bridge the valuation issues of young startups; while we have already discussed the issues it is worth noting that in the development of the modified DCF method, Damodaran (2009) has tried to cope with many different factors which are relevant in this discussion and in the process has fleshed out most of

the issues of applying traditional methods of valuation to early-stage startups. Regardless of the lack of attention from other researchers, as there are no major studies trying to test the efficacy of this approach, it is, up to the author's knowledge, the most detailed attempt at solving the early-stage company valuation puzzle.

4.3.4 - Real Option Valuation

This approach comes from an application of financial theory on options' pricing, which has shown in many papers as applicable to value companies characterized by a certain degree of volatility in their business, especially useful for companies with 'real optionality' in their business model, as shown in the application of Brennan & Schwartz (1985).

Approaching the assessment of a company through using a real options valuation (ROV) is also found to be used for the case of young, high-growth companies, as this approach takes into consideration several of the complexities of startups. Mainly, the volatility, investment timing and management choices, as well as capturing the 'boom-or-bust' nature of outcomes which often occur for the case of early-stage startups, are considered when using this valuation tool (Montani et al., 2020).

The intuition behind the ROV is that within an investment there is a future opportunity to modify the investment, which might happen through the form of optionality to expand, defer, or abandon the investment. Through the application of option pricing theories, we reach a value on the investment which includes the value of the optionality; with this approach, the enterprise value becomes:

$$EV = Current\ value\ of\ existing\ operation + Value\ of\ company\ portfolio\ of\ real\ options \quad (4.3.4.1)$$

The valuation is not an alternative to income or asset-based valuation approaches, as it instead acts as a way to complement them by pricing the investment or disinvestment opportunities- The flexibility of this approach is useful in an uncertain context such as the one of early-stage startups, permitting the assessment of different scenarios which might occur to the company.

There are two main models of option pricing which are used to determine the value through ROA, the binomial model and the Black-Scholes model.

Binomial model (Cox-Rubinstein)

The binomial or Cox-Rubinstein model revolves around the development of iterative binomial trees, so as to assess scenarios though the up and down moves on the decision tree (Cox et al., 1979). The value is assessed through the following illustrations:

$$S \begin{cases} \nearrow & uS \quad \text{with probability } q \\ \searrow & dS \quad \text{with probability } 1-q \end{cases} \tag{4.2.4.2}$$

$$C \begin{cases} \nearrow & C_u \equiv \max[0, uS - X] \text{ with probability } q \\ \searrow & C_d \equiv \max[0, dS - X] \quad \text{with probability } 1-q \end{cases}$$

Where:

S = asset price

C = call option price

X = Strike price

u = upward movement

d = downward movement

q = up-move probability

The way through which the binomial choice model is applied can be described by the following figure:

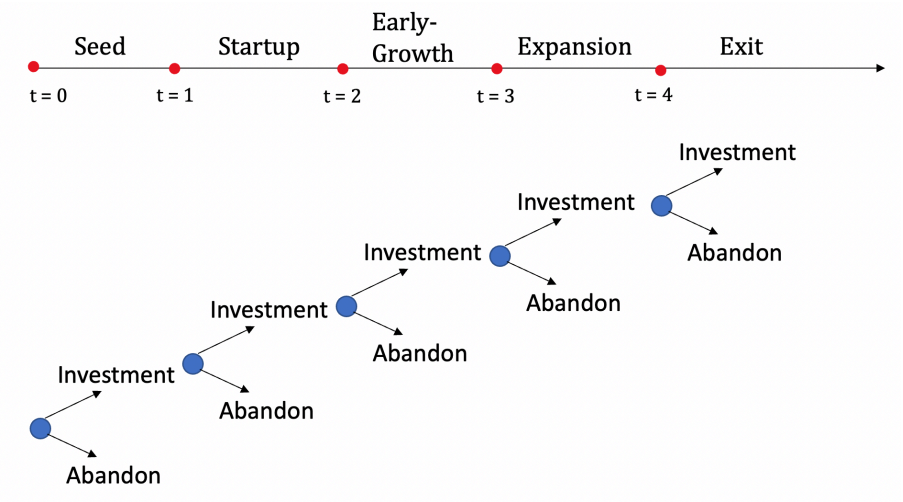

Figure 6: Future investments as optionality

Source: Own development based on Wilson et al., 2022

The real optionality could be interpreted from the perspective of VCs through the option to further invest in a subsequent financing round. While its' technically possible to also disinvest and abandon the stake, the high illiquidity of private equity makes the investment opportunity far more reasonable than the disinvestment opportunity. The outcomes being more or less defined; success comes in the form of IPO or a M&A event, while in the case of failure the salvage value is usually close to zero (Herbst et. Al 2006).

Black-Scholes model

The Black-Scholes option pricing model is based around the notion of geometric Brownian motion of prices and the estimation of option prices through the assessment of the volatility, and price of the underlying asset of the option, as well as its time-to-maturity.

The price of the option is expressed through the following formula:

$$C = S \cdot N(d_1) - X \cdot e^{-rt} \cdot N(d_2) \qquad (4.3.4.4)$$

$$d_1 = \frac{\ln\left(\frac{S}{X}\right) + \left(r + \frac{\sigma^2}{2}\right)t}{\sigma\sqrt{t}} \qquad (4.3.4.5)$$

$$d_2 = d_1 - \sigma\sqrt{t} \qquad (4.3.4.6)$$

The following table describes the variables and their interpretation for startup valuation purposes:

Variable	Meaning	Interpretation for startup
S	Underlying asset price	Present value of cash flows generated by investment
X	Exercise price	Cost of the investment
r	Risk-free rate of return	Time-value of the investment
t	Time to maturity	Deferrable time to make the decision
σ	Standard deviation of underlying asset's returns	Volatility of cash flows generated by investment
N	Normal distribution	-

Table 3: Interpretation of option variables in startup context

Source: Own elaboration

Growth Option Interpretation

Contrary to other researchers Damodaran (2009) argues against using ROV approaches to value startups from the perspective of venture capitalists, as he wards against using this approach when real optionality is not feasible. He instead proposes using ROV to assess companies which might have optionality in their business model. The real-optionality should therefore be a concrete possibility through the use of managerial action; however, he also argues that potentially, we could interpret value growth opportunities as growth options.

In traditional DCF models we do not assess the potential of entering new markets and expanding product portfolio within the valuation model; startups in their early-stage can have a high flexibility in switching markets or products. We could value a company who has yet to achieve a sustainable business model similarly to the value of the expansion investment of a mature company.

According to the Damodaran (2009), there are four steps which have to be followed to reach the option valuation. First one would need to estimate the future expansion, how much would the cost of expansion today be, and also estimate the present value of future cash flows which originate from the investment; The following step is determining the uncertainty in the achievability of the investment, capturing volatility in the form of standard deviation of future cash-flows. While model-based simulations on the outcome

of the investment can be used to derive the volatility of cash-flows, using the standard deviation of similar public companies within the field could be a viable and more attainable proxy. At this point we need to estimate the time length after which the decision to expand or not must be made. This factor is specific of the determinants of the expansion, on whether there are expiration dates on patents, licenses or similar elements. Binomial or Black-Scholes option valuation models can now be used, using the present value of CFs, the cost of expansion, standard deviation of cash flows and expiration date for expansion as proxies for value of the underlying asset, strike price, standard deviation of the underlying asset and time of option expiration.

One limit of the ROV approach, which is specific to Damodaran's interpretation as a growth option, is that exclusivity of the investment is a necessary but very strong assumption to make. Simply put, the opportunity must be in some form protected against being taken by other young companies, in the form of unique know-how or patenting protection. Damodaran (2018) further argues that an excessive premium is given to the upside potential of uncertainty. He also warns on the potential 'double-counting' for the value of growth when using ROV with DCF models.
Overall, there are both advantages and disadvantages found in the application of ROV:

- Flexibility

  Real optionality has been tested and found to be a powerful tool when having assess uncertainty. ROV models can account for changes which other valuation approaches cannot, such as changes in time to investment or volatility of cash-flows.

- Necessity for real optionality

  Damodaran (2009) argues that real-option approaches should not be applied to cases where the real optionality is not well defined or absent. Since optionality gives a premium to uncertainty, this should not be counted for cases where real optionality is not realistically attainable.

- Reliance on financial information

  While complementing to DCF approaches in the assessment of uncertainty, the ROV methods face similar limits of other traditional methods, mainly the reliance

on financial information to make estimates on the valuation. This means that for companies in the early-stage, using this method in conjunction to DCF approaches does not solve the identified issues in valuation.

Real-Option Valuation methods are perhaps the most investigated in literature. Keeley at al. (1996) investigate the applicability of the approach by trying to apply a binomial option pricing model to startups and comparing it to more popular valuation approaches, with results showing the ROV to be comparable in efficacy to other valuation approaches. Herbst at al. (2006) investigate the perceived overpricing of high-growth, high-tech, early-stage companies, by applying the ROV method, with the conclusion that ROV is better at explaining the valuation of companies than DCF/NPV-based methods. Milanesi et al. (2013) developed a binomial ROV method and applied it to technological startups, with their result being that it is a viable complimentary method to value high-uncertainty businesses. They also warn for the underestimation of higher moments in ROV approaches, as they assume normal behavior of stochastic processes.

To conclude, ROV approaches can be useful for valuing in combination with DCF approaches when significant financial information is available. However, the ROV should be used as a specific-case valuation approach, and not be applicable to the generic valuation of young companies, but only for those cases when managerial decisions can actually be taken.

4.3.5 - Intangible Assets Valuation

When not included in the valuation method, the estimation of the value of the company should also include the assessment of intangible assets. It is first necessary to explain how intangible assets have been treated for corporate valuation purposes to understand their role for startup valuation. First of all, we should explore and define intangible assets; Kothari et al. (2013) describe the requisites to be included in the balance and considered 'intangible assets' sheet to be intangibility, proven control over the resource and existence of future benefit.

They further classify intangible assets as internally generated or externally purchased. Intangible assets which would relevant for startups' valuation and which are difficult to identify are technology-based intangibles, such as a software or innovative business models. The issue is that for early-stage companies which aim at producing a disruptive

or innovative product, the requirement of "existence of future benefit" would be hard to prove, but it nevertheless comprises an important part of the young startup's value. While no distinct conclusion or framework on the intangible aspects which impact startup value has been identified, it is quite intuitive to understand that intangible assets should be included in the assessment of the value of a startup.

To try and cope with the absence of a clear framework, in the following paragraph three main approaches to value assets (market-, cost- and income-based approaches) will be looked upon, with a focus on their application for the case of young companies.

i. Market-based valuation

This approach is very straight-forward, as it tries to value an asset through comparison to past transactions involving similar assets. The issue is that transactions on intangible assets happen far less frequently than for tangible assets; the issue is deepened by the fact that intangible assets which characterize early-stage companies are hardly ever sold on their own, with companies usually buying-out the whole startup to access their technology (Kothari et al., 2013). When these transactions do happen, they do so in a private way as we are dealing with early-stage private companies. It is clear to see that using this approach to value startups' intangibles would be quite hard and if attainable have the valuation be dependent on too few transactions to give a meaningful result.

ii. Cost-based valuation

This approach involves assessing the value of an asset by looking at the costs to replicate the assets. The value of the asset would therefore reflect all direct (e.g., R&D expenses) and indirect costs (e.g., marketing expenses), summing up all expenses tied to the intangible asset generated. The issue here is that the value does not reflect two important aspects, which are the know-how necessary to produce the asset and the potential future cash-flows generated by the intangible asset (Kothari et al., 2013, Goldman, 2008). While it is not perfect, it is a more viable option for startups and VCs to assess intangible assets than market-based valuation, as the private information necessary to perform this valuation should be available to both parties in the negotiation.

iii. Income-based valuation

This approach tries to assess the value of the asset by using a Discounted Cash Flow method on the potential cash flows generable by the asset. This reflects more accurately the origin of value of intangible assets, more so in the case of deep-tech companies (Kothari et al, 2013). Market conditions and behavior of comparable intangible assets have to be assessed to perform the cash-flow forecast; the factors relevant in assessing the potential are:

- Customers' loyalty
- Attractiveness of the product
- Market growth and competitiveness
- Entry Barriers
- Competitive advantages
- Resource-based constraints
- Expected profitability
- Timing of revenue stream
- Institutional environment and taxes

(Goldman, 2008)

Many researchers have identified the importance of intangible assets in new ventures and tried to assess the impact of intangible assets on startups' valuation.
In their article on entrepreneurial ventures, Stuart et al. (1999: p. 317) say that "because the quality of young companies often cannot be observed directly, evaluators must appraise the company based on observable attributes that are thought to co-vary with its underlying but unknown quality. Resource holders therefore assess value by estimating the conditional probability that a firm will succeed, given a set of observable characteristics of the organization".
Basing their reasoning on signaling theory, Hsu and Ziedonis (2008) study the impact of intellectual property holding on valuation at the early financing rounds; their results are that patents and networks of partners play a significant role in valuation, with a decreasing significance when progressing through the financing rounds. They also find evidence that higher-quality VC funds consider intellectual properties when performing valuation, as they assign higher than average valuations to startups which have control over intellectual properties. Fukugawa (2012) tests the impact of the control of patents

on biotech startup valuation, with the results showing a positive impact in valuation both in funding rounds and at IPO.

Overall, intangible assets' valuation is an important aspect to consider when evaluating startups, especially in their early stages where their assets are mostly intangible and their value harder to assess. While the above-mentioned methods are not perfect, they should be considered when evaluating a startup, especially so with approaches which do not account for the future cash-flows generable by the intangible assets of the company.

On the other side, it is important to not 'double-count' the cash flows and avoid adding the value of intangible assets to that of the company when using methods that include this in their valuation (i.e., Damodaran's (2009) DCF approach.).

4.4 - Empirical Non-Traditional Methods

The approaches object of analysis until this point have had financial information, and inference on future performance based on said information, at the core of their application. We have discussed how these approaches are not suitable for companies in their earlier stages, when financial information is scarce or uninformative, and the assumptions on which the valuation approaches are based on are largely violated; in response, authors and practitioners have developed methods to overcome the issues found in traditional approaches through different scenario assessment, adjustment of discounting factor and other modifications. Still, some practitioners have preferred to avoid traditional approaches to valuation completely and develop their own tools for valuation; this was mainly the case for business angel investors and early-stage focuses venture capitalists (Montani et al., 2020). In the following paragraphs we will go through the characteristics of these approaches and their relative advantages and disadvantages in application.

4.4.1 - Berkus Method

The Berkus Method, developed by the famous angel investor Dave Berkus in the 1996, is one of some methods studied in this paper which shifts away from traditional and semi-traditional valuation methods, by not making estimations and assumptions based on cash-flows or comparable transactions or companies and instead focusing on risk; risk is segmented in different components and then used to derive an appropriate valuation.

The method tries to reduce complexities, but has some additional limitations, such as being designed for startups identified as with potential to grow reach $20M revenues by year five (Berkus, 2012).

The five risk-related factors identified by Berkus are:

- Soundness of the basic idea: the potential of the company is mainly derived from how good and innovative the business model or technology is;
- Prototype presence: the presence of an already built prototype reduces technology risk;
- Quality Management Team: having an already established, quality management team reduces execution risk;
- Strategic relationships: having an established network of partners and key figures reduces market risk;
- Product Rollout or Sales: by having already established product rollout the production risk is considered as lower;

To each of the factors a value of up to $0.5M is given, leading to a maximum valuation of $2.5M. (Berkus, 2012). In more recent versions, the factors have been modified to be able to reach a value above $0.5M to allow more flexibility in valuation. While this approach is extremely simple in its application, it does present some issues, mainly tied to the subjective nature of this tool. The estimation of the quality of the idea and of the management team, which determine two-fifths of the value of the company, rely completely on subjective measures. While this is done understandably to make the method simpler, it might lead to a different perception of the quality of the company from the perspective of the founders than that of the investor. Since the argument for a simpler method relies mainly on the reduction of subjective assumptions and of an easier negotiation process, using these subjective measures to determine such a large part of the value could be inappropriate. The Berkus' method relies on the idea that the five measures for risk used in the tool are the most indicative measures for risk for the selected startup. Our review of determinants has shown that startups present a heterogeneous exposure to risk factors, which seem to have different effects on startup success across industries. As an example, the presence of patents has a larger effect on biotech startups than for startups operating within other industries (Hsu, 2013) and this difference should be reflected in the valuation tool. Furthermore, compared to the other

empirical approaches analyzed in this paper, the Berkus methods uses the fewest factors; while it makes the approach simpler, the chance of disagreement between the impact of a risk factor between entrepreneur and investor is intuitively higher.

4.4.2 - Scorecard Method

This valuation was developed by the angel investor Bill Payne specifically for pre-revenue, early-stage Startups. The idea is to find the value of comparable young startups to get an average, pre-money average value, to then adjust by using the scorecard. (Payne, 2011a)

Factors	Weight
Strength of Management Team	0 – 30 %
Scalability	0 – 25 %
Product/Technology strength	0 – 15 %
Competitive Environment	0 – 10 %
Marketing/Partnerships/Sales' Channels	0 – 10 %
Need for additional investments	0 – 5 %
Other	0 – 5 %

Table 4: Scorecard weights

(Payne, 2011b)

The factors and their weights are both selected according to Bill Payne's experience, with the author suggesting adjustments done on the base of knowledge of the investor. The valuation is therefore derived by multiplying the factors' sum to the average pre-money valuation of comparable young companies; the key step in this approach is therefore finding the average valuations within the region and industry. This approach is, similarly to the Berkus Method, quite simple in its' application; it is more flexible and allows to adjust for different kinds of young companies than the Berkus method, but suffers from the trade-off of flexibility for subjectivity. On its own, it might be too subjective of an approach, as the weights, the factors and comparable companies' selection all rely on quite subjective assumptions.

The method is also found to be quite popular among practitioners but less so among researchers, since, up to the authors' knowledge, there are no significant studies investigating the effectiveness of the scorecard approach, with it merely being cited as an instrument to use as alternative or in conjunction traditional methods (i.e., Corea et al. 2021, Montani et al. 2020) . This might be the unintended result of having a subjective method; it being so dependent on assumptions means that its assessment through its application can hardly be done in an objective way.

4.4.3 - Risk Factor Summation Method

Developed by OhioTechAngels (Rahardjo & Sugiarto, 2019), this is similar in nature to the Berkus and Scorecard Method as it also tries to assess the value of the company through the assessment of risk determinants; it does however include more risk factors, which are especially relevant in the early stage of the company. Akin to the Scorecard Method, the first step for establishing a base for valuation is to determine the average pre-money valuation of pre-revenue comparable companies (by industry and geography). The Risk Factor Summation Method consists then in the adjustment to the value according to a number of risk factors. These factors are given different weights according to the specifics of the company, since some kinds of risk are more relevant for different industries. (Bratic et al. 2014). A rating is given to the exposure to each risk factor and is used, after applying weights, to reflect the exposure to risk on the pre-money valuation.

Rating	Meaning	Average Pre-money Valuation Adjustment
2	Very positive	+ $500,000
1	Positive	+ $250,000
0	Neutral	+ 0
-1	Negative	- $250,000
-2	Very Negative	- $500,000

Table 5: RFSM Factor adjustment table

Source: Kowlessar, 2016

Payne (2011) suggests assessing 12 specific risk dimensions: risk management, business level risk, legislation / political risk, risk of production, sales and marketing risk; Threat-raising funding / capital risk , market threat, technical hazard, legal danger, global risk, credibility risk, and possible lucrative escape.

This approach tries to improve on the Berkus method by being more inclusive or different kind of risks and adding the flexibility of choosing and weighting risk factors in accordance with the specific industry of the young company. It also suits early-stage startups quite well as it allows to adjust risk weights to reflect the uncertainty and higher risks which define early-stage companies. It however suffers from similar limitations of previous approaches; the pre-money valuation is 'standardized' as result of average comparable companies' valuations, meaning that the subjective selection of which companies to include would significantly alter the valuation. The subjectivity of using comparable companies is especially high for the case of young companies, where financial multiples and data necessary to make such a comparison are mostly absent. Another issue is that for a specific geographical area – industry combination, there might be an absence of comparable companies, making the pre-money valuation (the starting value for this method), highly reliant on few pieces of data.

4.4.4 - Rule of Thirds

The 'Rule of Third method is used in the first valuation rounds by venture capitalists as a sort of valuation screening method, trying to anchor negotiations to this rule, especially when dealing with pre-revenue startups. The idea behind this method is that practice has shown startups to have three main parties involved in early ownership:

the party of founders, who developed the idea behind the company and usually contribute to the initial sources of equity, a party of investors who usually contribute to the majority of equity and a third party comprising present and future management team to which a compensation in the form of stock option is planned.

By the 'rule of third', equity should end up split in equal parts among the three parties, the post-money valuation would therefore be derived from the concept that the equity offered by the external investors should convert to one third of the equity, so the valuation depends directly on the capital negotiated between founders and investors (Mothersill et al. 2009).

4.5 - Critical Reflection

What has become evident after going through the valuation methods is that young ventures are indeed quite hard to evaluate.

Traditional approaches are theoretically proven, but rely on assumptions or models which are quite unrealistic for the case of early-stage startups; they also require data which is mostly unavailable or uninformative. To cope with these issues, new valuation tools were developed, with the focus being on adapting assumptions and methodology of valuation to account for the increased uncertainty.

The Venture Capital method, while popular and simple in application, merely adjusts the projection of cash-flows and discount rate, while assessing only one successful scenario; the First Chicago Method adds a mild success and failure scenarios to better assess the uncertainty of company. Damodaran DCF is perhaps the deepest attempt at solving the valuation puzzle, as it assesses all major issues found in early-stage valuation. It proposes different ways to determine the discount rate, acknowledging the impact of illiquidity, lower survivorship and data scarcity in its application; the main critique against this approach is that its complexity has perhaps discouraged application amongst practitioners, as up to the author's knowledge there is no evidence of Damodaran's DCF being tested or adopted by venture capitalists, nor of studies on the efficacy of the approach. The Real Option Valuation is a viable option for ventures which have real optionality events, and is best suited for companies where the value of the company is mainly tied to these events, such as pharmaceutical or deep-tech companies, which don't expect to generate revenues until the realization of real option events; however, this is only a subset of early-stage startups and a common notion among researchers is that this approach should be used only when real optionality is truly possible, as it tends to inflate valuation when this clause is not followed (Damodaran, 2009). We have argued the valuation of intangible assets to be of high relevance within the context of early-stage startup valuation; they should therefore be assessed when adopting an approach which ignores this element.

While for some fringe early-stage companies these are viable valuation methods, they are potentially dangerous to adopt for companies within their first revenue-years, as they are least informative at that stage. Empirical tools and scorecards have been developed specifically for the cases when financial information-based valuation approaches fail. They are quite similar in that they all reach a value for the company after a qualitative

assessment of value-determinants for the company. The decision over which value-determinants are most important is the main difference between these tools. This means that the effectiveness of the approach is entirely tied to the knowledge of the investor on the market and on the selected company's characteristics; it is understandable how these approaches have found little attention among researchers, since to apply them, one usually needs information which only becomes available when engaging in a negotiation. The 'rule-of-thirds' rule is an exception among these tools, as it is basically a negotiation benchmark and not really a valuation tool, in the sense that it assesses characteristics of the company to determine 'fair value'; it however is interesting in its popularity among practitioners, likely tied to its usefulness within the negotiation process.

The main issues for early-stage startups which we had identified prior to this section were:

1) Lack of data for comparable companies
2) Lack/uninformative financial data for the selected company
3) Higher uncertainty than mature companies
4) Multiple claims on equity - multiple rounds
5) High rate of development in time
6) Illiquidity

Issue (1) is the most frequent, as even empirical tools rely on comparable companies' data; Damodaran's DCF attenuates the issue by suggesting building CF projections on capacity potential and by suggesting to build models and simulations as alternatives. While his solutions could be viable, they require further research and the development of models.

The main problem is not that one cannot in principle use comparable companies' multiples, as it is widely accepted as a solution for mature companies. The main issue lies in the state of available data, which we explained in the dedicated section to be lacking; databases are private and when accessible, they have been found to be inaccurate and incomplete.

Issue (2) is relevant for all valuation methods except (partially) for empirical tools; it has become evident that forecasting cash-flows is a difficult task for early-stage companies. The best attempt is shown by Damodaran DCF, as his top-down and bottom-up approaches better reflect the conditions of uncertainty.

Issue (3) manifests when having to face the determination of an appropriate discount rate; this is again best attempted by Damodaran (2009) by directly adapting the discount rate. The First Chicago and Real Option valuation methods also tackle this issue by presenting different scenarios. Empirical tools cope with the uncertainty by basing the valuation on the factors which are identified to be risk-reducing or risk-enhancing.

Issue (4) is largely unassessed, as Damodaran DCF is the only method which tries to include this in valuation; still, he admits to the difficulty in assessing this factor, especially when trying to capture the effect that future rounds of financing would have on current valuation. While there are many arguments which could be moved towards the importance to assess heterogeneous claims which develop over financing rounds, it is understandable that valuation methods have avoided this, as it would over-complicate valuation and require even more assumptions.

Issue (5) is mainly solved by the development of scenarios, so First Chicago and Real Option are the methods which best assess this; empirical tools are mostly meant to be used for the first financing round alone, it is therefore understandable why they do not try to solve issues (4) and (5).

Issue (6) is assessed in Damodaran DCF and the First Chicago method, by the determination of a liquidity premium to then 'sum' to the discount rate.

We can conclude that empirical tools and DCF/RO-based models are best used together, as they complement each other, which is coherent with the work of Dittmann, Maug and Kemper (2004), as they have found the adoption of more than one valuation method for valuation to be positively correlated with successful negotiations between investor and entrepreneur.

	Relative valuation (Multiples/ Transaction)	DCF/NPV	Venture Capital	First Chicago	Damodaran's Modified DCF	Real Option	Empirical Tools (Scorecards)
Principle	- Valuation based on multiples or transaction data of comparable assets	- Valuation based on discounted estimation of future cash-flows and terminal value estimation - Terminal Value estimated on multiples or growth model - Discount rate usually based on CAPM	- Based on multiples comparison for terminal value - Assessment of terminal value for shorter span - Discount rate adjustments based on empirical table	- Similar Venture Capital, but with cash flow projection multiple scenarios for different outcomes - Discount rate includes liquidity premium	- Based on DCF, with adjustments made for FCF estimations, illiquidity, lower survivorship and heterogeneous stakeholders	- Valuation based on Option Pricing theory, allowing to account for managerial flexibility - Usually compare the company and future investments to a growth option	- Valuation based on checklists for risk-reducing factors (Scorecards) - Factors selection based on investor experience - Scorecards give weights which are applied to average comparable company valuation
Limitations	- Lack of comparable companies - Hard to compare with mature companies	- Often uninformative operative structure information - Lack of long financial history - Hard to estimate FCF, CAPM not suitable for discount rate estimation	- Discount rate adjustments lead to high discount rate without clear justification - Optimistic case only	- Similar issues found in DCF for estimations - Probabilities for scenarios are mostly based on 'rule-of-thumb'	- Requires highest number of steps and estimations among methods - Untested by academic research/practictioners	- Volatility can have big impact on final valuation and is hard to assess - Second-most complex in application - Requires for Real-Optionality to be an actual feature of the company	- Selection of weights and factors is entirely subjective - Ease-of-use is exchanged for subjectivity
Advantages	- Would be easy to apply and require less assumptions if a suitable sample was available	- Among the most used valuation methods and recognized as effective by both academia and practictioners	- Easy to apply	- Includes different scenarios in valuation	- Assesses most issues of early-stage ventures' valuation - Gives flexibility in the execution of each step	- Accounts for developments in time and managerial flexibility	- Easiest in application - Takes into account qualitative value-drivers which are mostly ignored by other approaches

Table 6: Valuation method comparison

Source: Own development based on literature review

5. Discussion and future research

This paper has summarized relevant research on the state of valuation of early-stage startup companies. It has portrayed that the in startup and VC environment, several factors are relevant in the context of valuation; valuation methods have been developed for the case of the early-stage company, with no clear winner among them. Furthering the issue, we have seen how empirical research has identified many value-determinants which are mostly unassessed by valuation methods. It can be confidently said that there is still much research to perform on the subjects of both the identification of better valuation methods and the clear identification of value-determinants.

- *The issue of VC/Startup Databases*

We have also seen how the state of databases and VC-related data have limited research on the subject. The empirical studies found within this literature review mostly rely on the VentureSource and VentureXpert databases, which leads to some problems for researchers. Although trivial for institutions which have access to them, the restricted nature of this data makes the public research on the subject scarce, especially when compared to the state of research on publicly available data (e.g., empirical research based on stock prices); this in turn makes the replication of current research far less frequent.

Another issue for researchers is that these databases have only final valuations available, making an empirical study of the negotiation process behind valuation much harder to perform. While the valuation of startups has been object of much research and the negotiation process between entrepreneur-investor has been identified as crucial for the final valuation, the author has found a lack of articles analyzing empirically the negotiation process, perhaps as a result of scarcity of publicly available information on the process. While the fact that VCs and startups do not wish to disclose certain information on the negotiation process, such as the information which is most important for the negotiation or contractual clauses which are most impactful, a solution could be posed by the development of an anonymous database containing such information. Its development would be a hard task, but would certainly contribute to the research on negotiation and valuation.

- *Application of hybrid or new approaches*

We have gone through the valuation approaches with the conclusion that there is no 'clear-cut' winner, as each has its own pitfalls and advantages and; while we can

identify some that are more frequent in use by practitioners, there is no further proof of them being more efficient. On the contrary, researchers seem to indicate that valuations are quite detached from fundamentals and that there could be high frequency of overvaluations of startups, with it found to be detrimental to a future successful exit (Gornall and Strebulaev, 2019).

Two solutions could be available and should be investigated, in the opinion of the author. The first would be to try and combine valuation approaches to help overcome their individual limitations; Damodaran (2009) already expressed the possibility of 'completing' a DCF/NPV approach with Real Option approach, with the clause of applying this only for cases where real optionality is possible. Trying to apply this for startups which require heavy investments to further the project (e.g., pharmaceutical, deep-tech) could prove useful. Another solution which involves the use multiple valuation methods together, could be to perform evaluations with each individual approach and finding an 'average valuation'. While in the work of Dittmann, Maug, and Kemper (2004) the use of multiple methods is reported to increase success rate in negotiations, since there are no significant studies which perform multiple-method based valuation and test its' efficiency, this could be an interesting venue of research.

- *Assessing qualitative factors*

While empirical scorecards include qualitative factors in their valuation, they are quite subjective and untested by the rigor of theoretical research. On the other side, valuation methods based on more traditional financial principles don't include these qualitative factors in their assessment of the company.

Since deriving an appropriate discount rate seems one of the core issues with traditional methods, perhaps the adjustment of the discount rate based on these factors could be a viable way to assess them. Further research on the inclusion of qualitative factors in valuation methods could certainly help with the valuation puzzle. One example of this exploration is found in the work of Corea et al. (2021) which try to use machine learning and artificial intelligence to build a early-stage investment framework, which tests most empirical findings on qualitative factors that impact startup success; while very interesting, the authors themselves report a lack of comparable works among researchers.

6. Limitations

As a literature review, this paper suffers for the limit of not producing empirical testing of the subject of research. Furthermore, while we have fleshed out the issues researchers have with startup and VC-activity data, the empirical studies which we have analyzed mostly rely on the same pool of data. The restricted nature of the data makes also for scarcity in attempts to replicate these findings, making all studies less sound than would otherwise be. During the review, a lack of papers aimed at contesting past evidence was noted, with conflicting findings being the result of studies performed on different data sets, rather than on the same data. This means that, while we have tried to summarize the value-determinants which are of impact for early-stage valuation, the conclusions are as fragile as the sources, which is a main limit of this paper. Another limit of this paper comes from the paper pool, as the papers under review were all of English language and only from two databases; furthermore, it was not always possible to access all papers found in the databases, as some had restricted access. While using the databases was necessary to ensure that the quality of material was sufficient, a more comprehensive pooling could lead to more insightful conclusions. This review cannot claim to have identified all relevant determinants, nor to have clearly identified the best valuation methods, since there might be important factors which have been ignored or missed during the conduction of the review; the author believes this to be still an insightful review of the subject, as it fleshed out some important issues and has been able to identify venues of future research.

7. Conclusions

This paper has summarized relevant research on the state of valuation of early-stage startup companies. We have tried to identify the life-cycle of the startup to point out the differences which occur through it and the impact which early-stage characteristics have on valuation; it has portrayed that in startup and VC environment, several factors are relevant in the context of valuation.

The inherent need of private financing for startups makes the valuation puzzle relevant, and quite the interesting task; we have assessed the options which are used by investors and entrepreneurs to reach a valuation of the young venture, with the goal of fleshing out the limitations and advantages of each approach.

We have gone through valuation methods to understand the issue in valuation; the result of this research is that there doesn't seem to be one 'best' valuation method, but that all have different pitfalls. While DCF/NPV-based valuation tools can provide more objective and theoretically sound valuations, they rely on financial data to make their forecasts which appears to be a relevant obstacle. The first issue is that the current state of startup databases is lacking, perhaps a result of the private nature of the negotiations and of lack of requirements of self-reporting, which makes research on the topic a complicated task. When available, the information which we are drawing estimations from has usually a short time-span, meaning that any inference must account for this. This has been the crux of financial information-based valuation approaches which has spurred the birth of qualitative information-based valuation methods. While these can be useful for early-stage valuation, they rely on very subjective assessment of data. Each method reaches a unique result, and there doesn't appear to be one method which undoubtedly triumphs over the others. The issue of improving the state of valuation is a relevant one, as there are many reports of significant mispricing (Gornall and Strebulaev, 2019; Corea et al. 2021). The reason of the mispricing might be in the negotiation process itself; what is quite relevant in the discussion is the question of what is the 'true value' of the company, with researchers agreeing on the notion that the true value is the result of the negotiation between the bargaining parties, in this case the entrepreneur and the investor (Heughebaert and Manigart, 2012).

We have gone through the state of research over value-determinants within the early-stages of financing with many interesting findings identified in literature. We have also seen how the state of databases and VC-related data have limited research on the subject. While some better approaches were identified in this paper, it can be confidently said that there is still much research to perform on the subjects of both the identification of better valuation methods and the clear identification of value-determinants for the early-stage startup.

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Declaration of oath

I hereby declare in lieu of oath by my own handwritten signature that I have written this thesis independently and have not used any sources or aids other than those indicated. All passages that have been taken verbatim or in terms of content from the stated sources are identified as such.

The present work has not yet been submitted in the same or similar form as a bachelor's, master's, diploma or master's thesis or dissertation.

Pescara, 28/09/2022

(Place and Date)

(Signature of the student)