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STATE-OF-THE-ART

The determinants of startup valuation in the venture capital context: a systematic review and avenues for future research

Andreas Köhn[1]

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Abstract Startup valuation in the venture capital (VC) context is often said to be more art than science. In view of this, it is particularly important to be aware of and understand the different underlying determinants that affect the valuation of startups. This paper conducts a systematic review of the existing empirical literature to illustrate the determinants of startup valuations in the VC context. Beyond that, the paper seeks to provide an organizing structure to the current literature as well as to detect academic voids and directions for future research. To achieve these goals, it develops an integrative framework for the factors determining startup valuations in the VC environment, which should be of use to both practitioners and researchers. That framework illustrates how startup valuations in the VC context are shaped by a three-sided interplay of factors related to startups, venture capitalists, and the external environment.

Keywords Startups · Valuation · Venture capital · Entrepreneurial finance · Literature review

JEL Classification G24 · G32 · L26 · M13

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✉ Andreas Köhn
andreas_koehn@uni-hohenheim.de

[1] Institute of Marketing and Management, University of Hohenheim, Entrepreneurship (570 C), Wollgrasweg 49, 70599 Stuttgart, Germany

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1 Introduction

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

The Wall Street Journal reports that as of September 2016 there were 150 unicorns, which are private venture-backed firms with a valuation of at least one billion US dollars. Compared to the 45 unicorns reported in January 2014 this implies a staggering growth of over 200% in less than 3 years (Austin et al. 2016). In light of this unicorn craze, it is unsurprising that the US Securities and Exchange Commission has recently become interested in the valuation practices applied by mutual funds to startups (Grind 2015). Evidently, there is a great need for both regulators and other relevant parties to encourage a comprehensive understanding of the determinants that impact the valuations of startups in the venture capital (VC) context. In addition to its importance to regulators and policymakers, the valuation of startups in the VC context is of utmost importance to venture capitalists (VCs), entrepreneurs, and fund investors alike. While for entrepreneurs the valuation specifies how many shares, and hence control rights, they hold in their venture after an investment round, the VCs' returns, and in turn those of their fund investors, are contingent upon the difference between the valuations they invested in a startup and the final proceeds they can achieve at an exit event such as an IPO or acquisition (Cumming and Dai 2011; Hsu 2004; Zheng et al. 2010).

Notwithstanding the current demand by regulators for improved insight into the valuation of VC-backed startups, in academia—due to the domain's significance—there has been ongoing criticism about the paucity of and explicit calls for further research on the determinants affecting startup valuations (Cumming and Dai 2011; Wright and Robbie 1998; Zheng et al. 2010). Existing literature is not only scarce but also very fragmented, and lacks a conceptual framework integrating the existing empirical research on the determinants that impact the valuation of startups in the VC market. This paper therefore aims to contribute to the literature on the determinants of startup valuations in the VC context in several ways. First, it identifies, collates, and reviews relevant empirical articles. Second, it integrates the selected articles into a conceptual framework to provide an organizing structure to the extant literature. Third, the systematic review and the framework help to detect academic voids and directions for future research.

To achieve these objectives, the paper is organized as follows: Sect. 2 describes the review approach and the state of the literature. Building on this, Sect. 3 outlines a framework providing a systematic structure to the extant literature and presents the review's findings. Section 4, discusses the paper's main findings and illustrates avenues for future research. Section 5 addresses the paper's limitations, and the last section concludes.

2 Review approach

Assigning a valuation to a startup in the VC context is remarkably challenging because startup investments are characterized by high risk, high cash burn rates, and asym-

metric information (Sahlman 1990; Sievers et al. 2013). In view of this, it is all the more important to understand the different determinants that impact startup valuations. Hence, a structured literature review of the determinants of startup valuation in the VC context was performed to ensure the findings are systematic, transparent, and replicable (Tranfield et al. 2003). It should be noted that rigorously conducted structured literature reviews are a powerful means to provide a systematic overview of research on a particular subject (Rousseau and McCarthy 2007). To the best of the author's knowledge, this paper is the first systematic literature review that considers the determinants of startup valuation within the VC environment holistically.

2.1 Article focus

To review the literature on the determinants of startup valuations in the VC context a systematic search was conducted between mid-September and early November 2016. The focus of this literature review is on English-language journal articles because such journal articles are regarded as established knowledge and have the greatest influence on the academic discourse (Keupp et al. 2012; Podsakoff et al. 2005). In addition, this review follows previous literature reviews in focusing on empirical research (e.g., Hueske and Guenther 2015; Klotz et al. 2014; Narayanan et al. 2009) as the paper's overarching goal is to identify and synthesize the knowledge about empirically proven factors determining startup valuations in the VC context.

2.2 Article identification and selection

The identification of articles involved a four-step process (see Fig. 1 for a summary of the systematic search and selection process).

The first step involved searching the Scopus and EBSCO Business Source Premier databases for the words "start-up*", "startup*", "new venture*", "venture capital*", venture-backed" and "venture backed" in combination with the terms "valuation*", "valuing*", "market* value*", "firm* value*", "company* value*", "enterprise* value*" or "business* value*" in an article's title, abstract, or keywords, and in the case of the EBSCO Business Source Premier, also in the subject terms.[1] For Scopus, the search was further focused on the subject areas of "Business, Management and Accounting", "Economics, Econometrics and Finance" and "Decision Sciences". Excluding double counts, the first step produced an initial sample of 301 articles. In the second step, a quality cut-off was applied to guarantee journal quality as in previous literature reviews (e.g., Bouncken et al. 2015; Falkner and Hiebl 2015). For journals included in Scopus, that quality cut-off was based on the SCImago Journal Rank (SJR) 2015, and the lowest quartile of the identified journals (SJR $\leq$0.337) was excluded.[2]

[1] The latter group of search strings was derived based on Zheng et al. (2010) considering a startup's valuation as the estimate of its market value.

[2] For discontinued journals the latest available score was applied. It must be acknowledged that the applied cut-off criteria is not free of criticism. However, to the best of the author's knowledge there are no systematic literature reviews suggesting a reasonable quality cut-off for the Scopus relevant SJR. Therefore, it was

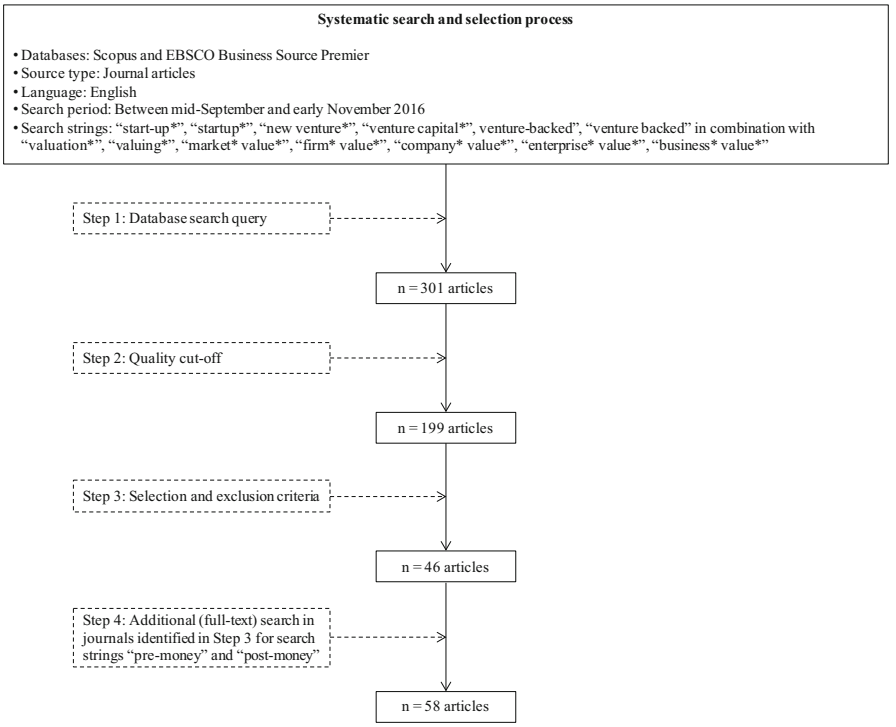

Fig. 1 Systematic search and selection process

For journals that were not assigned an SJR score, the cut-off criteria of Bouncken et al. (2015) based on Thomson Reuters Journal Citation Reports (JCR) 2015 (i.e., a JCR impact factor <0.7) were applied. Journals that had neither an SJR nor a JCR score were excluded. This narrowed the sample to 199 articles. In the third step, all papers were diligently reviewed and only empirical articles examining a startup's financial valuation or a variation of it (e.g., average share price or change in valuation over successive financing rounds) and papers that scrutinized the valuation methodologies relevant to VCs were retained. The exclusion criteria encompassed non-empirical papers, and articles that neither focused on the financial valuation of startups nor on relevant valuation methodologies. To give an example, articles that employed the financial valuation of a startup merely as a control variable for a startup's quality were excluded. Similarly, articles solely referring to public, angel-backed, social, or family firms were excluded because startups in the VC context are typically considered to be private young growth-oriented ventures (Kollmann and Kuckertz 2010; Morris et al. 2005). Articles exclusively considering the valuation of startups at an exit event (e.g.,

Footnote 2 continued
considered appropriate to cut off the journals within the lowest quartile based on the SJR metric. Additionally, to benchmark the cut-off criteria, they were compared with journals that are assigned a JCR Impact Factor as this allowed the author to rely on the threshold suggested by Bouncken et al. (2015) (JCR impact factor <0.7). The comparison indicated that the derived Scopus specific threshold is reasonable.

IPO or acquisition) were also excluded. The reason for this is that an exit event is regarded as the financial harvesting based on previous valuations of a startup representing a separate and special event in the entrepreneurial process (e.g., Petty et al. 1994). In this regard, the choice of the exit mechanism and therewith the ultimate valuation at which a startup can be financially harvested is likely driven by different factors (Bayar and Chemmanur 2011). Indeed, the valuation at an IPO marks the first time when a startup is valued by public market investors (Aggarwal et al. 2009) who might rely on different valuation determinants than potential acquirers (Bayar and Chemmanur 2011) and the VCs in the previous private financing rounds (Zheng et al. 2010). Consequently, to avert the risk that the determinants underlying the valuation at an exit event differ from the ones in the pre-exit phase, it is avoided that this could bias the paper's analysis. Furthermore, five articles were excluded because they did not provide sufficient information on the underlying data, lacked necessary data,[3] or because their scope was too limited. In sum, the identification process to this point yielded 46 articles. In the fourth step, to ensure the comprehensive identification of relevant papers, an additional search (of the full-text, whenever possible) of the identified journals hosting the 46 selected articles was conducted. The additional search focused on the search strings "pre-money" and "post-money",[4] because these terms are common VC jargon in the context of startup valuations (e.g., Korteweg and Sorensen 2010; Sorensen 2007). The extended inclusion criteria meant 12 articles were added (see Online Resource 1 for an illustrative example).

In total, the final sample consists of 58 papers.[5] The final number of 58 articles appears to be a reasonable sample size, comparing favorably to those used in the research of Klotz et al. (2014), Schroll and Mild (2012), and Thywissen (2015), for example.

2.3 Overview of the selected articles

The empirical literature on the determinants of startup valuations in the VC context grew significantly in volume since the dotcom period (see Online Resource 2). Twenty of the selected articles were published between 2002 and 2008 while only eight appeared in the preceding dotcom period from 1996 to 2001. Intriguingly, 29 articles (50% of the selected papers), stem from the period following the economic crisis in 2008. Although the number of publications fluctuates annually, the overall

[3] One article only provided summary statistics on valuation and stated that owing to the lack of a complete set of variables, valuation was not considered in the subsequent analysis.

[4] It should be mentioned that in the initial search (first step), the terms "pre-money" and "post-money" were covered by the search word "valuation*" because in the VC jargon one speaks of pre-money valuation and post-money valuation. Furthermore, the additional search (fourth step) targeted undetected papers within the identified journals, including whenever possible a full-text search. Consequently, to guarantee a goal-oriented and efficient full-text search through the additional search, it was specifically searched for the search strings "pre-money" and "post-money" because they are inherently linked to startup valuations in the VC context.

[5] A few of the selected papers used pooled samples of private and public valuations. However, it is not expected that the results would be much different on a disaggregated level. For instance, Aggarwal and Hsu (2009) stated that their results were widely consistent on the disaggregated level.

volume of papers dealing with the topic shows a clear growth. This is underpinned by the average number of publications of the selected articles annually, which increased since the dotcom period from 1.3 to 3.6 average publications per year. A possible reason for the publication pattern could be the aftermath of the dotcom bubble triggering scholars' interest in startup valuations, and the subsequent emergence of new forms of startups exemplified by Uber and Airbnb that became unicorns after the economic crisis in 2008 (The Economist 2015).

The analysis of the final selection of 58 papers reveals that all but three of them adopt a quantitative approach, mainly by applying regression based analysis (see Table 1). In addition, research relies heavily on the readily available valuation data provided by commercial VC databases, primarily VentureSource (formerly known as VentureOne) and Thomson One (formerly known as VentureXpert and Venture Economics). Furthermore, 35 articles focus on US samples, while just 13 focus on European samples. Only three studies were conducted on startup valuation in Asian countries, and seven articles adopted an international perspective. The review's findings regarding the articles' heavy reliance on commercial VC databases and the USA as the main geographical focus are in line with the survey of Da Rin et al. (2013) on the VC field in general.

Given the subject's diversity in terms of the determinants of startup valuation scrutinized, the fragmentation of the topic is obvious. Interestingly, startup valuation in the VC context is a research topic dominated by the field of management (see Online Resource 3). This is evidenced in that the articles reviewed are dominated by the Journal of Business Venturing ($n = 7$) and the Strategic Management Journal ($n = 5$), followed by Venture Capital ($n = 4$), the Journal of Financial Economics ($n = 3$), and Entrepreneurship Theory and Practice ($n = 3$). At first glance, this finding might seem surprising; yet, given the aforementioned fact that startup valuation is particularly challenging, the realm of startup valuations in the VC context seems to be better explained by more concrete determinants, which are apparently more relevant to the research field of management.

3 Toward an integrative framework

The preceding overview of the literature on the determinants of startup valuation in the VC environment illustrates the topic's complexity and heterogeneity (see Table 1), thereby highlighting the need for a conceptual framework that furthers the understanding of the determinants and their relationships regarding startup valuations in the VC context. To derive the conceptual framework a two-step approach was undertaken. First, all 58 papers were carefully read to identify the examined levels of the studied startup valuation determinants. In this vein, it became apparent that some articles focus on factors relating to startups (e.g., Block et al. 2014; Lerner 1994; Moghaddam et al. 2016), and others focus on the valuation determinants directly related to VCs (e.g., Cumming and Dai 2011; Heughebaert and Manigart 2012). Moreover, there are also articles investigating external environment factors such as VC fund inflows (e.g., Gompers and Lerner 2000) or the institutional and cultural setting (e.g., Batjargal and Liu 2004; Cum-

Table 1 Selected articles on the determinants of startup valuation in the VC context

Study (Year)	Valuation/VC data source[a]	Country	Sample size	Sample period[b]	Analytical method[c]	Relevant dependent variable	Relevant research focus
Aggarwal et al. (2012)	Thomson One/Survey	US	432 ventures	Post-dotcom	Seemingly unrelated regression	Logarithm of pre-money valuation	Electronic word-of-mouth
Aggarwal and Hsu (2009)	Thomson One	US	91 biotech ventures	Pre-dotcom to post-dotcom	OLS regression	Logarithm of most recent VC valuation or market capitalization	Cooperative mode
Armstrong et al. (2006)	VentureSource	US	502 ventures	Pre-dotcom and dotcom	Rank regression	Pre-money valuation/Interpolated valuation	Financial, non-financial statement information
Baeyens et al. (2006)	Survey	Belgium	16 VCs	Post-dotcom[d]	Qualitative	n/a	Valuation methodologies
Batjargal and Liu (2004)	Survey	China	158 VC decisions	Dotcom	OLS regression	Difference in percentage of initially offered and finally assigned valuation	Strong ties (*guanxi*)
Bengtsson and Hsu (2015)	Thomson One	US	3125 ventures	All	OLS regression	Logarithm of 1 + pre-money valuation	Ethnic ties
Bengtsson and Sensoy (2011)	Thomson One/VCExperts	US	1266 ventures	Post-dotcom[e]	OLS regression	Logarithm of pre-money valuation	VC investor reputation

Table 1 continued

Study (Year)	Valuation/VC data source[a]	Country	Sample size	Sample period[b]	Analytical method[c]	Relevant dependent variable	Relevant research focus
Block et al. (2014)	Thomson One	US	2341 ventures	Dotcom and post-dotcom	OLS regression	Logarithm of post-money valuation	Trademarks
Broughman and Fried (2012)	Hand-collected data	US	45 ventures	Dotcom and post-dotcom	OLS regression	Logarithm of ratio of last VC round valuation to sale price	Inside rounds
Chatterji (2009)	Thomson One/VentureSource	US	191 medical device ventures	n/a	OLS regression	Logarithm of pre-money valuation	Entrepreneurs with experience at prominent firms
Cochrane (2005)	VentureSource	US	7765 ventures	Pre-dotcom and dotcom	Maximum likelihood estimate	n/a	Risk-return profile
Cumming and Dai (2011)	Thomson One	US	9266 VC financing rounds	Pre-dotcom to post-dotcom	OLS regression	Logarithm of pre-money valuation	VC investor reputation, fund size, limited attention
Cumming and Dai (2013)	Thomson One	US	3034 ventures	Pre-dotcom to post-dotcom	Heckman regression	Logarithm of pre-money valuation	Switching lead VCs
Cumming and Walz (2010)	Center of Private Equity Research (CEPRES)	International	5038 ventures	Pre-dotcom to post-dotcom	OLS regression	Difference between logarithm of 1 + unrealized IRR and logarithm of 1 + predicted IRR	Reporting biases based on accounting and legal environment

Table 1 continued

Study (Year)	Valuation/VC data source[a]	Country	Sample size	Sample period[b]	Analytical method[c]	Relevant dependent variable	Relevant research focus
Davila and Foster (2005)	VentureSource/ Survey	US[f]	78 ventures	Pre-dotcom to post-dotcom	Descriptive analysis and mean difference test	n/a	Management accounting systems
Davila et al. (2003)	Thomson One/VentureSource	US	494 ventures	Pre-dotcom and dotcom	OLS regression	Absolute magnitude of change in valuation over subsequent rounds	Headcount growth
Davila et al. (2015)	Survey	International	66 ventures	Pre-dotcom to post-dotcom[g]	OLS regression	Logarithm of pre-money valuation/Interpolated valuation	Management control systems
Dittmann et al. (2004)	Survey	Germany	53 VCs	Dotcom[d]	Descriptive analysis and OLS regression	Write-off rate of investments	Valuation methodologies
Falik et al. (2016)	Survey	Israel	144 entrepreneurs	New era	Ordered logit regression	Importance entrepreneurs attach to valuation measured on five-point Likert scale	Importance entrepreneurs attach to valuation

Table 1 continued

Study (Year)	Valuation/VC data source[a]	Country	Sample size	Sample period[b]	Analytical method[c]	Relevant dependent variable	Relevant research focus
Fitza et al. (2009)	Thomson One	US	3756 ventures	Pre-dotcom to post-dotcom	Variance decomposition analysis	Change in valuation over subsequent rounds per month	Value-add of VCs
Gompers et al. (2010)	VentureSource	US	3796 ventures	Pre-dotcom and dotcom	OLS regression	Logarithm of pre-money valuation	Successful serial entrepreneurs
Gompers and Lerner (2000)	VentureSource	US	4069 VC financing rounds	Pre-dotcom	OLS regression	Logarithm of pre-money valuation	VC fund inflows, public market valuations
Greenberg (2013)	Israeli Venture Capital (IVC) database	Israel	317 ventures	All	OLS regression	Logarithm of pre-money valuation	Patent applications and grants
Hand (2005)	Recap	US	204 biotech ventures	Pre-dotcom and dotcom	GMM regression	Logarithm of pre-money valuation	Financial, non-financial statement information
Hand (2007)	Recap	US	203 biotech ventures	Pre-dotcom and dotcom	GMM regression	Logarithm of 1 + round-to-round excess return	Risk-return profile
Heughebaert and Manigart (2012)	Hand-collected data	Belgium	180 ventures	All	OLS regression	Logarithm of pre-money valuation	VC firm type

Table 1 continued

Study (Year)	Valuation/VC data source[a]	Country	Sample size	Sample period[b]	Analytical method[c]	Relevant dependent variable	Relevant research focus
Houlihan Valuation Advisors/VentureOne (1998)	VentureSource	US	479 ventures	Pre-dotcom and dotcom	Descriptive analysis and OLS regression	Logarithm of pre-money valuation/Logarithm of change in valuation over subsequent rounds	Startup characteristics
Hsu (2004)	Survey	US[h]	149 ventures	Pre-dotcom and dotcom[i]	OLS regression	Assigned pre-money valuation relative to highest offered valuation	VC investor reputation
Hsu (2007)	Survey	US[h]	149 ventures	Pre-dotcom and dotcom[i]	OLS regression	Logarithm of pre-money valuation	Startup founding experience, academic training, social capital
Hsu and Ziedonis (2013)	Thomson One/VentureSource	US	370 semiconductor ventures	Pre-dotcom to post-dotcom	OLS regression	Logarithm of pre-money valuation	Patent applications
Hwang et al. (2005)	VentureSource	US	9092 ventures	Pre-dotcom to post-dotcom	Heckman selection correction using an ordered probit	n/a	Risk-return profile

Table 1 continued

Study (Year)	Valuation/VC data source[a]	Country	Sample size	Sample period[b]	Analytical method[c]	Relevant dependent variable	Relevant research focus
Kaplan et al. (2007)	Hand-collected data	International	107 ventures	Pre-dotcom and dotcom	Descriptive analysis and OLS regression	Logarithm of pre-money valuation	Legal regime
Karsai et al. (1998)	Survey	Hungary, Poland, Slovakia	18 VCs	Dotcom[d]	Descriptive analysis and mean difference test	n/a	Valuation methodologies
Karsai et al. (1997)	Survey	Hungary	9 VCs	Dotcom[d]	Descriptive analysis	n/a	Valuation methodologies
Korteweg and Sorensen (2010)	VentureSource	US[j]	1934 ventures	Pre-dotcom to post-dotcom	Bayesian estimate	n/a	Risk-return profile
Lerner (1994)	Recap/Hand-collected data	US	173 biotech ventures	Pre-dotcom	OLS regression	Logarithm of pre-money valuation	Patent scope
Lockett et al. (2002)	Survey	Hong Kong, India, Singapore, US	154 VCs	Dotcom[d]	Mean difference test and OLS regression	Valuation methodology employed	Valuation methodologies
Manigart et al. (2000)	Survey	Belgium, France, Holland, UK, US	209 VCs	Pre-dotcom and dotcom[d]	Descriptive analysis and mean difference test	n/a	Valuation methodologies

Table 1 continued

Study (Year)	Valuation/VC data source[a]	Country	Sample size	Sample period[b]	Analytical method[c]	Relevant dependent variable	Relevant research focus
Manigart et al. (1997)	Survey	Belgium, France, Holland, UK	136 VCs	Pre-dotcom and dotcom[d]	Descriptive analysis and mean difference test	n/a	Valuation methodologies
Masulis and Nahata (2009)	Thomson One/IPO prospectus	US	177 ventures	Pre-dotcom and dotcom	OLS regression	Ratio of CVC's average purchase price to IPO offer price	Corporate VCs
Miloud et al. (2012)	Thomson One	France	102 ventures	Dotcom and post-dotcom	GLS regression	Logarithm of pre-money valuation	Industry organization, entrepreneurial resources, external ties
Moghaddam et al. (2016)	Thomson One	US	151 software ventures	All	OLS regression	Logarithm of post-money valuation	Strategic alliances
Nicholson et al. (2005)	Recap	US	566 biotech ventures	Pre-dotcom and dotcom	OLS regression	Logarithm of post-money valuation or enterprise value	Strategic alliances
Pintado et al. (2007)	Survey	Spain	51 VCs	Dotcom[d]	Descriptive analysis and mean difference test	n/a	Valuation methodologies

Table 1 continued

Study (Year)	Valuation/VC data source[a]	Country	Sample size	Sample period[b]	Analytical method[c]	Relevant dependent variable	Relevant research focus
Reber (2014)	Thomson One	US	1360 ventures	Pre-dotcom to post-dotcom	Cascade neural networks	Risk-neutral success probability	Risk-return profile
Sander and Kõomägi (2007)	Survey	Estonia	5 VC firms	Post-dotcom[d]	Qualitative	n/a	Valuation methodologies
Seppä and Laamanen (2001)	Thomson One	US	176 ventures	Pre-dotcom and dotcom	OLS regression	Logarithm of risk-neutral success probability	Risk-return profile
Sievers et al. (2013)	Hand-collected data	Germany	127 ventures	Dotcom and post-dotcom	OLS regression	Logarithm of pre-money valuation	Financial, non-financial statement information
Smith and Cordina (2014)	Survey	UK, Belgium[k]	7 interviews	New era[d]	Qualitative	n/a	Financial statement information
Sorensen (2007)	Thomson One	US	1666 ventures	Pre-dotcom	Bayesian estimate of structural model	Latent valuation	VC investor experience

Table 1 continued

Study (Year)	Valuation/VC data source[a]	Country	Sample size	Sample period[b]	Analytical method[c]	Relevant dependent variable	Relevant research focus
Valliere and Peterson (2007)	Survey	Canada, UK, US	59 entrepreneurs	Post-dotcom[d]	Conjoint analysis	Likelihood of accepting an offer measured on seven-point Likert scale	Valuation as selection criterion
Wasserman (2016)	Survey (CompStudy)	US	6130 ventures	Dotcom to new era[l]	OLS regression	Logarithm of pre-money valuation	Founder control
Welpe et al. (2010)	Survey	Austria, Germany, Liechtenstein, Luxembourg, Switzerland	272 ventures	Post-dotcom[d]	Structural model	Change in valuation over subsequent rounds	VC investor experience and effort
Wright et al. (2004)	Survey	International	357 VCs	Pre-dotcom and dotcom[d]	Mean difference test and OLS regression	Valuation methodology employed	Valuation methodologies
Wright and Robbie (1996)	Survey	UK	66 VCs	Pre-dotcom[d]	Descriptive analysis and mean difference test	n/a	Valuation methodologies
Yang et al. (2009)	Thomson One	US	1626 ventures	Pre-dotcom and dotcom	Panel linear regression[m]	Post-money valuation	Valuation capability of corporate VCs

Table 1 continued

Study (Year)	Valuation/VC data source[a]	Country	Sample size	Sample period[b]	Analytical method[c]	Relevant dependent variable	Relevant research focus
Zhang et al. (2016)	VentureSource	US	2670 ventures	Pre-dotcom to post-dotcom	OLS regression	Pre-money valuation	Ethnic ties, social status
Zheng et al. (2010)	Recap	US	170 biotech ventures	Pre-dotcom and dotcom	GLS regression and minimum distance estimation	Logarithm of post-money valuation	Innovative capability, inter-firm network heterogeneity

[a] For the sake of comparability, the latest names of the respective databases are stated
[b] The classification into the periods pre-dotcom (before 1996), dotcom (1996–2001), post-dotcom (2002–2008), and new era (2009–2016) is based on Online Resource 2
[c] Employed analytical method to examine the scope of interest
[d] Refers to the time when the survey was conducted
[e] Bengtsson and Sensoy (2011) state that only 1% of their sample's financing rounds took place before 2004
[f] A. Davila affirmed that the sample consisted of ventures in California, mainly Silicon Valley (personal communication, 9 December 2016)
[g] Davila et al. (2015) report that the ventures covered in the work's sample were founded between 1990 and 2008
[h] D. H. Hsu acknowledged that Hsu (2004, 2007) rely on US data only (personal communication, 20 November 2016)
[i] Hsu (2004) reports the focal startups' years of incorporation, and also states that over 80% of the sample's startups undertook a Series A round between 1998 and 2000
[j] A. Korteweg and M. Sorensen stated that the paper was based on US data only (personal communication, 17 November 2016)
[k] R. Cordina affirmed that the paper relied on interviews with investors based in the UK and Belgium (personal communication, 21 November 2016)
[l] N. Wasserman mentioned that the vast majority of the ventures in his sample raised VC funding extending from 1997 until right before the last year of the survey (personal communication, 16 November 2016)
[m] Y. Yang mentioned applying panel linear regression (personal communication, 17 November 2016)

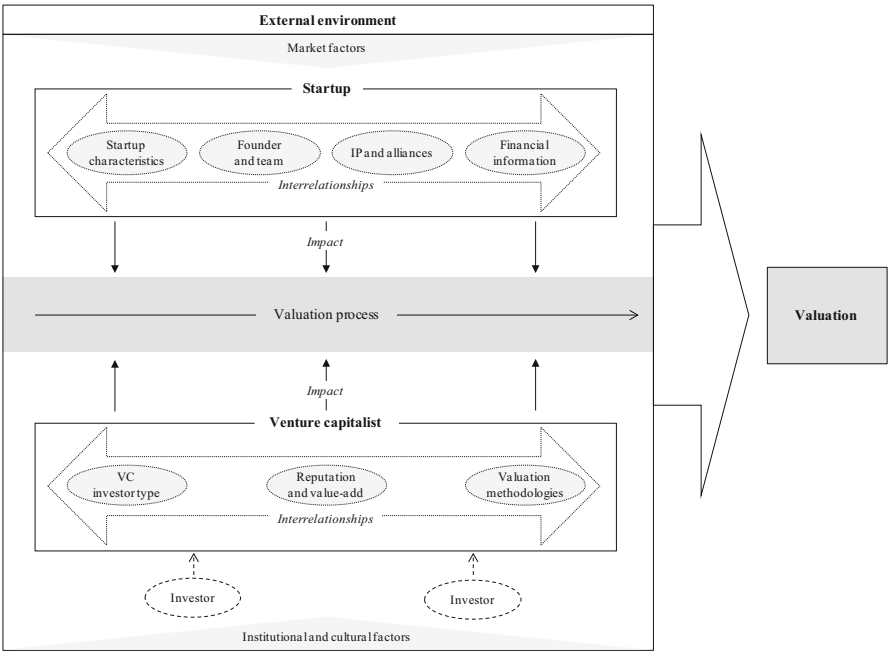

Fig. 2 Derived conceptual framework based on the review process

ming and Walz 2010). Consequently, the integrative framework conceptualizes that startup valuations in the VC context are determined by a three-sided interplay of the determinants related to startups, VCs, and the external environment (see Fig. 2).

To classify the underlying determinants for each of the three levels, all papers were analyzed in a second step to extract each paper's relevant research focus in terms of the examined factors in the realm of startup valuations. Then based on an inductive and iterative process, for each level these factors were classified in superordinate valuation determinants, so that they provide an overarching and consistent classification (see Wood and McKelvie 2015 for a similar approach). Following this procedure, the analysis revealed that the startup determinants can be divided into financial information and non-financial determinants, and that the latter can be further subdivided into startup characteristics (e.g., location, industry, or internal processes), founder and team characteristics, and intellectual property and alliances. The valuation determinants identified on the VCs' side encompass investor type, reputation and value-add, as well as the valuation methodologies relevant for VCs. The value-determining factors of the external environment can be classified into both market factors and institutional and cultural factors. Intriguingly, the respective determinants are to a certain extent interrelated. For instance, Hand (2005) finds evidence that as startups mature, financial information becomes more value-relevant than the non-financial form. On the VCs' side, for example, Wright et al. (2004) show that VCs' use of particular valuation methodologies depends on the institutional setting.

3.1 Determinants related to startups

3.1.1 Startup characteristics

On the startup-level, Houlihan Valuation Advisors/VentureOne (1998) find that industry and location are decisive determinants of startup valuations; in the context of the report that means that more profitable ventures and startups operating in the communications industry and firms located on the east and west coasts of the USA receive higher valuations. Regarding industry relevance, Sievers et al. (2013) apply an OLS regression method to show that German life science and traditional high-tech ventures are valued at a discount, while internet startups are valued at a premium, but that these coefficients are not statistically significant. In the same vein, Miloud et al. (2012) building on established theories in strategic management scrutinize an industry's impact on startup valuations by specifically accounting for its growth rate in terms of the industry's revenue growth and its degree of product differentiation measured by research and development and advertising intensity. Consequently, Miloud et al. (2012) illustrate that in the case of 102 French startups from 18 different industries, VCs assign higher valuations to ventures operating in highly differentiated industries and industries with higher growth rates.

Davila et al. (2015) find that for a cross-sectional sample of 66 startups around the world, VCs assign a premium to startups adopting management control systems, believing that they improve decision-making and execution. Moreover, the effect is apparently more significant for startups operating in high growth and competitive markets and also for the use of strategy-implementing systems. Similarly, Davila and Foster (2005) find a positive association between the early adoption of management accounting systems, which they define as a subset of management control systems, and valuations.

Furthermore, Houlihan Valuation Advisors/VentureOne (1998) show that, on average, valuations rise from round-to-round. Likewise, Davila et al. (2003) also report that headcount growth positively correlates with changes in valuation over successive financing rounds. Interestingly, as financing round generally covaries with firm age, Sievers et al. (2013) find that in Germany firm age is insignificant in explaining startup valuations, implying that conducting a new financing round is more informative than a startup's age. However, the finding stands in contrast to that of Armstrong et al. (2006) who, while also controlling for funding series, find that age is significant and negatively related to valuation among US startups. Armstrong et al. (2006) speculate that this might be rooted in VCs' time-to-exit rationale, as a longer time-to-exit is associated with lower returns.

Overall, it is clear that the general characteristics of startups are decisive factors that determine their valuation in the VC context.

3.1.2 Founder and team characteristics

In general, VCs consciously look for founder and team characteristics that offer clues as to the quality of a startup, knowledge of which can inform the valuation (MacMillan et al. 1985). Factors that can increase startup valuations include having more than

one founder, a complete management team, prior startup, management and relevant industry experience, and also the level of education (Hsu 2007; Miloud et al. 2012; Sievers et al. 2013; Wasserman 2016).

Chatterji (2009) illustrates that within the medical device industry entrepreneurs with prior experience at incumbent enterprises are assigned higher valuations than other entrants in the last private financing round. In addition, Hsu (2007) shows that entrepreneurs with previous experience of founding a startup who achieved high financial returns with their prior ventures (i.e., an internal rate of return of at least 100% on Series A investments at an exit event) attract higher valuations for their new ventures. Wasserman (2016) also establishes the connection between prior founding experience and higher valuations. Conversely, Gompers et al. (2010) report that successful serial entrepreneurs do not receive higher valuations for their new ventures. Notwithstanding this, Falik et al. (2016) find that inexperienced Israeli entrepreneurs attach greater importance to valuation, arguing that their possible inferior bargaining position might cause them to be more concerned with valuation. In contrast, Valliere and Peterson (2007) report that, regardless of their experience, entrepreneurs from the USA, Canada, and the UK consider valuation as the primary criterion for an investment deal. These results are interesting as they imply that cultural differences could explain the different findings regarding the importance entrepreneurs attach to valuation.

The findings of Wasserman (2016) on the subject are particularly interesting as they show that founders might have to surrender control to acquire a higher valuation. That said, Wasserman (2016) also finds that ventures in which the founder is still CEO and/or controlling the board of directors at the time of the most current financing round are assigned lower valuations. Furthermore, Hsu (2007) and Wasserman (2016) report that the personal networks of entrepreneurs are associated with higher valuations as such networks facilitate entrepreneurs recruiting employees. Hsu (2007) argues that this therefore suggests less effort would be required of VCs, and signals the potential for strong performance.

In sum, founder and team characteristics are decisive determinants of VCs' investment decisions, and in turn of startup valuations owing to their perceived risk-reducing attributes and the improved performance expectation they entail (e.g., Hsu 2007).

3.1.3 Intellectual property and alliances

Intellectual property is significant to VCs as it can, among other things, further the reduction of asymmetric information (Block et al. 2014; Greenberg 2013). Lerner (1994) shows that the number and breadth of patents for biotech startups within the US context are positively related to those startups' pre-money valuations. In later studies, Hand (2005) also relating to biotech startups, Armstrong et al. (2006) across industries, and Hsu and Ziedonis (2013) for 370 semiconductor startups, are consistent in finding that the number of patent applications filed is associated with higher startup valuations. Hsu and Ziedonis (2013) show that patent applications are more relevant in early financing rounds and that this effect is even more pronounced when founders lack prior experience in taking a startup public. Notwithstanding this, Hand (2005) reports that on a round-by-round basis patents' value relevance is remarkably low, and in contrast to Lerner (1994), the same study identifies a significant negative relationship

between patent scope and startup valuations, which the author surmises might result from value relevance changing from portfolios of broadly-scoped patents to narrowly-scoped ones over time.

Intriguingly, Greenberg (2013) conducts a fine-grained analysis of 317 Israeli technology startups differentiating between pending and granted patents and finds that patent applications are significant and positively related to venture valuations, but with the significance reducing from the life sciences, to communications through to the semiconductor industry, while they are not relevant to the valuations of software startups. Furthermore, records of patents granted show an additional value-enhancing effect on non-software pre-revenue startups in their early stages, but the patents measure becomes less significant as ventures mature, indicating their uncertainty mitigating effect.

Additionally, Block et al. (2014) scrutinize the relevance of both trademarks and patents to startup valuations on the grounds that trademarks also enable startups to protect their intellectual property and to signal their market and growth orientation. The authors report an inverted U-shaped relationship between both the number and breadth of trademark applications and startups' post-money valuations, implying that the additional costs in terms of, for instance, coordination efforts outweigh the advantages of a more diversified trademark and indicated product portfolio, thus leading to lower startup valuations. Moreover, the authors report a declining valuation impact of trademark applications as startups mature and enter their more sophisticated development stages.

For startups, strategic alliances offer powerful means to gain access to resources and to signal investee quality, thereby reducing information asymmetries (Miloud et al. 2012; Nicholson et al. 2005; Uzzi 1996). Based on signaling theory, Nicholson et al. (2005) show that biotech ventures with strategic alliances with pharmaceutical companies receive higher valuations. Miloud et al. (2012) and Sievers et al. (2013) come to the same conclusion for French and German startups in terms of network size and having a cooperation partnership. In addition, the results of Hand (2005) are consistent in that the number of strategic alliances are, on average, positively associated with the valuations of biotech startups, even though the valuation effect on a round-by-round basis is noticeably low. Expanding on this, Moghaddam et al. (2016) show that for VC-backed software startups in the USA, alliances have a positive impact on valuations, but that too many alliances can deplete valuation, which the authors ascribe to the fact that startups might lack the resources and capability to handle large numbers of alliances.

Furthermore, Aggarwal and Hsu (2009) illustrate that selecting a cooperative mode that makes less use of a venture's previous governance capability is generally accompanied with a valuation discount for biotech ventures, suggesting that investors regard this as a risky undertaking. The accompanying caveat is that this valuation impact is mitigated in hot and, in turn, less risk averse markets. Zheng et al. (2010) show that the valuation effect in terms of a startup's network status (external resource) decreases, while that of its innovative capability (internal resources) increases as the startup matures. Moreover, the authors document an increasing complementary valuation effect of innovative capability and network heterogeneity.

Overall, VCs seem to view intellectual property and alliances as means to reduce information asymmetries and as value-enhancing factors emphasizing their importance for startup valuations in the VC context (Block et al. 2014).

3.1.4 Financial information

In addition to non-financial information, entrepreneurs also provide VCs with exhaustive financial information, so balance sheet and income statement figures should provide investors with sufficient means to appraise a startup's future financial performance (Manigart et al. 1997). In this regard, it is crucial to understand if, and if so to what extent, current accounting information can explain startup valuations in the VC market. Hand (2005) pioneered this strand of research examining the value relevance of financial statement information for a sample of successful private VC-backed biotech startups in the USA. He finds that accounting information is generally value-relevant in the VC context and that cash, non-cash assets, and research and development expenses are positively associated with pre-money valuations, while stock option dilution and long-term debt have a negative relationship to a valuation. Moreover, he shows that the value relevance of financial statement figures increases as startups mature, while the opposite is true for non-financial information, indicating substitutional dynamics between financial and non-financial accounting information. Interestingly enough, Smith and Cordina (2014) provide qualitative support for Hand's (2005) finding that financial statement information tend to become more important as startups mature in a study focusing on the UK and Belgium in a later period. Analogously, Wright and Robbie (1996) find that later-stage VC investors in the UK put significantly more weight on financial information, while Wright et al. (2004) did not find such an effect across a range of institutional environments.

Armstrong et al. (2006) extend the research of Hand (2005) in applying rank regression across industries of successful startups that went public in the USA. The last study aligns with Hand (2005) in concluding that higher revenues lead to higher startup valuations and that the same holds true for cost components (cost of sales, sales, marketing, general, and administrative expenses, research and development expenses). The results confirm that investors view cost components as value-enhancing investments to generate future cash flows (Armstrong et al. 2006).

Sievers et al. (2013) using a hand-collected data set for German VC-backed firms report that financial statement information is also value-relevant for startups in Germany. Specifically, the study states that cash, revenues, and research and development expenses have a positive impact on startup valuations, while selling, general, and administrative expenses have a negative effect, a finding countering that of Armstrong et al. (2006). In the context of the study of Sievers et al. (2013) this latter group of expenses are by VCs thus rather regarded as operational disbursements. In addition, the authors detect that financial and non-financial statement information is equally meaningful in explaining 51% of the variance in pre-money valuations, whereas a combination of both increases the explanatory power to 62%, implying that both components seem to be, on average, complements. Davila and Foster (2005) report a positive and significant correlation between change in valuation and change in both revenues and the number of employees in non-biotech ventures, whereas change in

income is not significant, highlighting that in the early stages valuation is related to growth. For biotech ventures the authors identify a positive correlation between change in valuation and growth in employees and a negative one for change in income.

Overall, financial statement information is important for startup valuations in the VC context.

3.2 Determinants related to VCs

3.2.1 VC investor type

The most easily observable determinant on the VCs' side is the VC investor type. Heughebaert and Manigart (2012) suppose that VC investors are heterogeneous and hence that VC firm type goes along with bargaining power, implying that VCs with relatively stronger bargaining power set lower startup valuations. In linking a VC type's deal sourcing and investment strategy with bargaining power, Heughebaert and Manigart (2012) find that for 180 Belgian VC-backed startups a proprietary deal flow (as in the case of university VC firms) and lower investor competition (as represented by government VCs targeting niche markets) lead to lower startup valuations than those set by independent VCs in line with the bargaining power argumentation mentioned above. Interestingly, the same study finds that corporate VC firms' valuations accord with those of independent VCs. In a similar manner, Sievers et al. (2013) find that corporate lead investors do not significantly influence the valuations of German startups, whereas, for instance, Hand (2005) reports the group having a significantly positive effect for a sample of US biotech startups.

Moreover, Masulis and Nahata (2009) find competitive corporate VCs, which invest in competing startups, assign higher valuations than their complementary counterparts, which invest in startups with complementary relationships. They argue that this is in line with standard bargaining theory, and is connected to the potential for moral hazard issues that startups might face when they have a competitive corporate investor. In addition, Yang et al. (2009) try to explain the startup valuations set by corporate VCs by applying organizational learning theory. The authors consider corporate VCs' valuation capabilities, that is not to overvalue startups, as a learning process that enhances with experience. The authors' sample of 166 US public firms with corporate VC investments in 1626 ventures supports the notion that corporate VCs' valuation capability improves with stage diversity, which is the degree of experience of investing in startups from different development stages.

VC investor type is a critical determinant for startup valuations, illustrating that in this context the heterogeneity of VCs plays an important valuation role.

3.2.2 Reputation and value-add

Hsu (2004) uses a hand-collected sample of 246 professional first-round offers to 149 US startups to show that the entrepreneurs of startups in receipt of several offers tend to prefer the lower valuation offers of highly reputable VCs, indicating that entrepreneurs accept a valuation discount in expectation of better value-adding services delivered by

VCs with a strong reputation. Bengtsson and Sensoy (2011), among others, confirm this finding. Indeed, Welpe et al. (2010) demonstrate that over successive rounds more experienced VCs also add more value, while they do not find a positive effect commensurate with VCs' effort.

Beyond that, Fitza et al. (2009) establish that the capacity of VCs to add value varies considerably, and that some VCs can even have a negative value effect. Intriguingly, this puts into perspective the findings of Falik et al. (2016) that Israeli entrepreneurs in general attach more importance to the valuation when dealing with less reputable VCs. Furthermore, as outlined by Sorensen (2007) there is a positive sorting in the market in that more experienced VCs also invest in startups of higher quality. Gompers et al. (2010) also find evidence that more experienced VC firms assign higher startup valuations. To put their findings into perspective, Gompers et al. (2010) argue that the reason for this finding lays in the fact that their study adopts an *across venture* approach that does not segregate the effect of VC investor quality on startup valuations, whereas Hsu (2004) scrutinizes *within-venture* offers and thus controls for different levels of startup quality. Similarly, Cumming and Dai (2013) study the dynamics of positive sorting in view of asymmetric information and agency cost, and report that startups with better future performance potential are more inclined to switch to VCs with higher reputation, and startups that switch lead VCs generally achieve higher valuations. Moreover, Cumming and Dai (2013) document that entrepreneurs who switch to higher-reputation VCs accept lower valuations.

Alongside VC reputation, Cumming and Dai (2011) examine the effects of fund size and VCs' limited attention on the valuations of startups by studying 9266 financing rounds in the USA. The authors' findings assert that more reputable VCs assign lower valuations, and additionally that fund size is usually negatively related to startup valuations, implying that larger fund size is associated with more bargaining power. In view of this, it should be remarked that fund size can also serve as a measure of VCs' quality, and thus their reputation (Bengtsson and Sensoy 2011; Kaplan and Schoar 2005).[6] However, Cumming and Dai (2011) show that when fund size becomes disproportionately large, meaning that human capital does not grow proportionally to fund size, VCs' outside options are reduced and thus, their relative bargaining power is negatively affected, indicating that VCs' limited attention leads to higher startup valuations.

In summary, VCs' reputation and their value-add capabilities are important factors that shape startup valuations.

3.2.3 Valuation methodologies

Valuation methodologies can be a decisive ingredient in the valuation process, which is because the valuations derived typically provide an important indication of the range within which a final valuation will be negotiated (DeAngelo 1990; Wright and Robbie 1996). Indeed, as Baeyens et al. (2006) point out conflicting views on valuation are the most crucial factor in failed negotiations. The study of Baeyens et al. (2006)

[6] The author is grateful to an anonymous reviewer for pointing this out.

reveals this might be even more so in the realm of biotech ventures, where VCs do not consider the standard valuation methodologies sufficiently reliable, and in turn prefer qualitative measures. It is thus not surprising that VCs usually apply multiple valuation methodologies and then often prioritize one particular method (Wright and Robbie 1996). Intriguingly, Dittmann et al. (2004) reporting on a sample of 53 German VCs empirically establish that VCs relying on a range of valuation methodologies show a significantly reduced rate of failed investments. In addition, the study finds that the use of flow variable valuation multiples, like revenue or free cash flow multiples, do not significantly relate to investment performance. Accordingly, Sievers et al. (2013) show that industry-specific total asset multiples have a higher valuation accuracy than their revenue counterparts in the case of German startups.

Moreover, Manigart et al. (1997) emphasize that the risk-return trade-off plays a crucial role in the realm of startup valuations. In this vein, Manigart et al. (1997) and Pintado et al. (2007) among others, show that in line with finance theory, greater perceived risk prompts VCs to demand higher required returns, which should ceteris paribus lead to a lower valuation. This finding is also in line with those of Houlihan Valuation Advisors/VentureOne (1998) who show that earlier financing rounds are generally associated with lower valuations. In fact, Seppä and Laamanen (2001), working with a sample of US VC investments using a binomial model, provide empirical evidence that startups' risk-neutral success probabilities are lower in their early stages. This might also be traced back to a startup's bankruptcy risk arising from the uncertainty involved, which is likely to be highest in its early stages and which should decrease as the startup reaches the more advanced stages of development (e.g., Engel 2004; Ruhnka and Young 1991).[7]

Generally, to derive the proper risk-adjusted rate of return—typically based on the CAPM (Capital Asset Pricing Model)—finance theory states that investors should only be compensated for systematic risk, because a project's unsystematic risk can be diversified away (Brealey et al. 2011). Cochrane (2005), correcting for sample selection, finds that the systematic risk for startup investments declines on a round-by-round basis (average beta of 0.6), while Korteweg and Sorensen (2010) find an average beta of 2.8. Hwang et al. (2005) point out that Cochrane (2005) relies on a subset of their data and also estimate a beta of less than 1.0. One explanation for these differing results might be that the studies use the data provided by Sand Hill Econometrics (now incorporated into VentureSource), but that Korteweg and Sorensen (2010) use a newer dataset that was corrected for prior data problems (Da Rin et al. 2013). Ang and Sorensen (2012) conclude that the higher average beta seems the more understandable in the startup context.[8]

Interestingly, when comparing the predictive power of risk-neutral and risk-adjusted approaches, Seppä and Laamanen (2001) find that the former better explains future valuations in terms of a binomial model. Reber (2014) extends this research combining the binomial model with cascade neural networks and shows that this approach has greater predictive power than risk-adjusted valuation approaches, regular neural

[7] In this regard, it should be noted that the risk-neutral probability also forms the basis of the seminal work of Merton (1974) on estimating bankruptcy risk.

[8] It should be noted that the work of Ang and Sorensen (2012) was not part of the selected papers.

networks, and linear regression models, but that the estimation errors remain relatively high. Moreover, Hand (2007) documents that for US biotech ventures, VCs' returns between financing rounds are negatively related to firm size and positively related to book-to-market ratios. It is particularly interesting that Dittmann et al. (2004) demonstrate that VCs who rely on the DCF (Discounted Cash Flow) method in combination with an objectifiable discount rate in line with the CAPM or the WACC (Weighted Average Cost of Capital) approaches have a better investment performance than their peers.

In addition to the above, Lockett et al. (2002), Manigart et al. (2000), and Wright et al. (2004) find that the use of specific valuation methods varies across institutional environments. Wright et al. (2004) document that among VCs the DCF method is more prominent in Germanic legal systems than in English style common law based systems, while the opposite holds for valuation multiples. In view of this, Dittmann et al. (2004) for Germany, Karsai et al. (1997) for Hungary, Karsai et al. (1998) in addition for Poland and Slovakia, Manigart et al. (2000) for Belgium and the Netherlands, Pintado et al. (2007) for Spain and Sander and Kõomägi (2007) for Estonia show that the DCF method is very popular in these countries. One explanation for these results could be that these markets lacked proper benchmark valuations at the time they were studied. Such a lack might prompt VCs to use the forward-looking DCF valuation method (Karsai et al. 1998). Equally interesting is that Manigart et al. (1997) show that VCs' levels of required returns vary across countries. For instance, VCs from the UK require higher returns than their counterparts from France, while Belgian and Dutch VCs demand the lowest required returns of the sample. According to Manigart et al. (1997) this implies that theoretically VCs from the UK should be assigning lower valuations to startups than their counterparts from France, Belgium and Holland.

In essence, the above findings highlight that valuation methodologies are a factor that should not be underestimated in the VC context.

3.3 Determinants related to the external environment

3.3.1 Market factors

Gompers and Lerner (2000) were the first authors to find evidence that fund inflows into the VC industry increase startup valuations and that this effect could, from a financial perspective, neither be traced back to a startup's better risk profile nor to improved cash flow expectations. The authors suggest that increased supply in the VC industry implies higher competition among VCs, thus leading to higher startup valuations. In addition, Gompers and Lerner (2000) show that public market valuations also increase startup valuations. Similarly, Lerner (1994) and Hand (2005, 2007) find that the valuations of private biotech ventures are positively driven by the equity valuations of public biotech firms, indicating that the valuations of publicly listed firms are viewed as an indication of a startup's economic potential.

Moreover, particularly in the USA, blogs on startups and VCs have become an important source of information. Positive blog coverage can serve both as cheap marketing for startups and send a positive signal to VCs (Aggarwal et al. 2012). Aggarwal

et al. (2012) empirically establish that ventures benefiting from positive electronic word-of-mouth from popular blogs receive higher valuations. The authors also conduct a supplementary survey with VCs and entrepreneurs to discern whether the media coverage from popular blogs directly, indirectly, or both indirectly and directly impacts startup valuations. Intriguingly, they find an indirect relation, meaning that media coverage from popular blogs attracts more VCs and the consequent increase in competition among the VCs increases entrepreneurs' negotiation power and, in turn, the valuations of their startups.

3.3.2 Institutional and cultural factors

VCs are likely to have the greatest bargaining power if startups are unable to attract new investors, meaning they could negotiate relatively low valuations. Follow-on investments also illustrate that startup valuations in the VC industry are dynamic, in that they change over time. Interestingly, the findings of Broughman and Fried (2012) who use a hand-collected sample of 45 US startups backed by VCs run counter to the bargaining power argumentation, in that they reveal that inside rounds (i.e., investment rounds that do not involve new VCs) primarily occur with struggling startups, and take place at relatively high valuations. The authors suppose that these relatively high valuations may be connected to litigation risk, meaning that VCs seek to avoid being accused of exploiting entrepreneurs in inside rounds instead of capitalizing on their bargaining position.

Interestingly, Kaplan et al. (2007) studying 145 VC investments in 107 ventures in 23 countries find in their descriptive analysis that pre-money valuations vary across legal regimes. Furthermore, the same work reports that VCs do not trade off more downside protection in the form of US style contractual terms against a higher startup valuation, but that the opposite holds. Similarly, Cumming and Walz (2010) study VC funds from 39 countries and find that VCs tend to assign higher valuations to their unrealized investments in countries with less regulated legal and accounting systems. The authors suggest that the reason might lie in the fact that independent VCs depend on their investors in terms of raising new funds and might thus be tempted to overstate the reported valuations of their portfolio companies.

Wright et al. (2004) report that the cultural context plays an important role in the relative weight of a particular information source. The authors argue and show that Asian VCs, for example—in view of the fact that VCs are not members of entrepreneurs' networks before establishing a relationship—place significantly less importance on the information provided by the entrepreneurs than their counterparts from the USA. In the Asian context, Batjargal and Liu (2004) reviewing 158 investment decisions from VCs based in China ascertain that Chinese VCs with strong ties from previous relationships with entrepreneurs tend to assign higher valuations to the startups of those entrepreneurs. The authors hypothesize that in line with the concept of *guanxi*, strong social ties are important trust-building and, in turn, risk-reducing measures that affect the startup valuations of Chinese VCs.

Similarly, Bengtsson and Hsu (2015) show that ethnic matches between Chinese, Indian, Japanese, Jewish, Korean, Russian, Hispanic and Vietnamese entrepreneurs and VCs in the USA lead to higher startup valuations. The authors reason that this is

in line with the notion of enforced trust and kinship. By the same token, also in the context of the USA, Zhang et al. (2016) analyze first-round VC investments and find that Asian VCs (i.e., VCs with a majority of Asian general partners and Asian limited partners) assign higher valuations to non-Asian-led Silicon Valley-based ventures than do non-Asian VCs. The authors argue that Asian VCs suffer from lower social status when dealing with non-Asian startups and are thus forced to assign higher valuations. To corroborate their findings of the lower status argumentation, Zhang et al. (2016) test for the reverse effect and show that non-Asian VCs do not assign higher valuations to Asian-led Silicon Valley-based ventures.

In sum, startup valuations in the VC industry are also shaped by the external environment, emphasizing that valuations are not only contingent on factors related to the startup and VC investor level.

4 Discussion

This paper conducted a systematic review of the current literature on the determinants of startup valuations in the VC context. It compiled empirically relevant research and developed an integrative framework to organize the extant literature. Additionally, the systematic review revealed weaknesses and academic voids that pave the way for future research. These findings emphasize the need for future research to shed further light on startup valuations by simultaneously taking the determinants and motivations of startups or their entrepreneurs and VCs into account (see Fig. 3).

First, a significant shortcoming of the existing empirical research on the determinants of startup valuation in the VC industry stems from the excessive reliance on commercial VC databases, which only state the final valuations, meaning the valuation process itself remains a black box. Indeed, while some of the identified papers

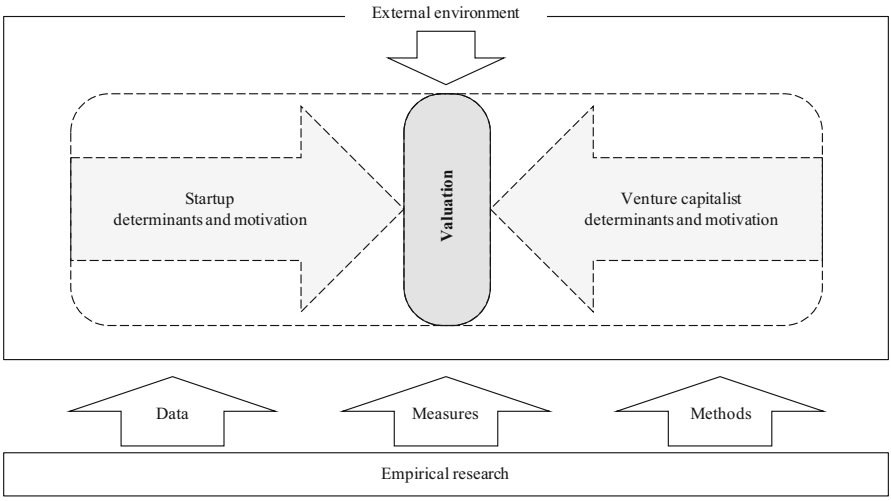

Fig. 3 Avenues for future research on the determinants of startup valuation in the VC context

talk about the valuation or negotiation process (e.g., Heughebaert and Manigart 2012; Moghaddam et al. 2016; Yang et al. 2009), the author has found no empirical study directly examining the valuation process itself. However, as outlined in the derived framework, startup valuation in the VC context is a dynamic process such that valuations change during the negotiations until both VCs and entrepreneurs decide upon a final valuation (Yang et al. 2009). In this vein, entrepreneurs often also receive multiple offers at a specific point in time with (usually) varying valuations (Hsu 2004). Thus, the use of VC databases means that scholars cannot observe and examine the valuation formation process or the dynamic factors and mechanisms shaping it in detail. In that sense, future research must scrutinize the valuation or negotiation process not only from a theoretical perspective (e.g., Kirilenko 2001; Narayanan and Lévesque 2014) but above all from an empirical one. Hsu (2004) is an excellent example of how to overcome this shortcoming and highlights that future research needs to address the dynamics and heterogeneity of startup valuations in greater detail. To do so, researchers could, for instance, capitalize on televised business pitches such as those illustrated in the *Dragons Den* series (e.g., Narayanan and Lévesque 2014; Pollack et al. 2012) where they can directly observe the valuation process and the underlying determinants.

Second, scholars need to put their findings into a clearly understandable context to ensure those findings are a representation of the real world and not merely of methodological relevance (e.g., Ketchen and Shook 1996). Thus, to substantiate and validate the cogency of the findings, future work might capitalize on the approach of Aggarwal et al. (2012) by additionally employing expert feedback. In addition, researchers also need to put their findings into the context of previous work, as for instance Gompers et al. (2010) did when setting their findings against those of Hsu (2004). This is particularly important in light of the respective sample period. Researchers must be wary when generalizing and transferring the effects of the determinants of startup valuations in the VC context from one period to another. That said, the identified determinants and their respective impacts might change over time, and hitherto unknown factors might also become relevant. Consequently, future work should study the determinants of startup valuations by comparing their relevance for the different periods. Similarly, conflicting results might also be explained in view of the underlying datasets. Interestingly, Cochrane (2005) and Korteweg and Sorensen (2010) both rely on the data provided by Sand Hill Econometrics yet report different results. One explanation might be that the latter had a more current version that was corrected for data problems. This effect might be even more pronounced when the findings based on commercial databases are compared to research relying on survey data. Specifically, commercial datasets are naturally limited in terms of the available data, implying that conflicting results might be explained by omitted variable bias.[9] Consequently, regarding the underlying dataset, researchers should address conflicting results in a more comprehensive manner. Moreover, there is a need for consistent measures. Specifically, the reputation of VCs can be measured in several ways such as experience in terms of age, capital under management, IPO frequency, IPO capitalization share (Krishnan et al. 2011), or fund size (Bengtsson and Sensoy 2011; Kaplan and Schoar 2005).

[9] The author is grateful to an anonymous reviewer for highlighting this point.

Accordingly, more research is required on the most suitable measures for the different determinants of startup valuations if the research on the factors determining startup valuations in the VC context is to become more robust and comparable.

Third, researchers prefer the US context for examining the determinants of startup valuations in the VC setting. Nonetheless, this article shows that startup valuations in the VC context are also influenced by the external environment, suggesting that "VC valuation and negotiation processes may hence be different in different parts of the world" (Heughebaert and Manigart 2012, p. 527). Therefore, researchers should not only expand the geographical scope of their analysis but also explicitly consider the characteristics of the institutional and cultural environments the startups are nested in to examine the variability of startup valuations across countries (Wright et al. 2005; Wright and Robbie 1998). Furthermore, the scrutinized work in this domain is dominated by regression analysis providing sufficient leeway for future research to use emerging methods such as qualitative comparative analysis (QCA) (Berger and Kuckertz 2016).

Fourth, Cumming and Dai (2011), Heughebaert and Manigart (2012) and Hsu (2004), among others, state that VCs' characteristics such as reputation, fund size, and investor type influence startup valuations. Interestingly, the findings on the impact of corporate VCs' involvement on startup valuations is mixed. One possible explanation for these mixed results is that these studies regarded corporate VCs as a homogenous group; however, corporate VCs might also differ in their investment motivation to the extent it is determined by their strategic and financial orientation. Although, Masulis and Nahata (2009) differentiate types of investments, they do not focus on the overall investment motivation of corporate VCs. Thus, future research needs to examine the heterogeneity of corporate VCs, for instance by capitalizing on the study of Röhm et al. (forthcoming), to better understand the valuations they assign. In a similar manner, current research has overlooked to study the impact of team heterogeneity on startup valuations, for example, in terms of professional background, education, age or perspective in the sense of prior startup success and failure experience. Along these lines, current research often pools a startup team into dummy variables, such as to measure if any founder or team member had pervious startup, founding, industry or IPO experience (e.g., Hsu and Ziedonis 2013; Miloud et al. 2012; Sievers et al. 2013), therewith disregarding the various levels of team heterogeneity. Consequently, by drawing on the work of Zimmerman (2008), who studies the influence of team heterogeneity on the amount of capital raised through an IPO, a promising path for future research is to apply heterogeneity measures to examine the impact of the different dimensions of team heterogeneity on startup valuations.

Fifth, as outlined by Cumming and MacIntosh (2000) in contrast to public firms, where stock prices represent the heterogeneous opinions of the market participants, startup valuation is significantly riskier because VCs must usually rely on their own valuation capabilities. Therefore, it is not only important to understand which valuation methodologies are applied by VCs, but also in what way they are applied. Hence, future research should address how the use of specific valuation methodologies and the assessment of their underlying assumptions affect startup valuations. Similarly, future researchers might also be able to unravel the determinants leading to over- and undervaluation when comparing the outcome of the valuation methodologies

with the actual valuations assigned. Indeed, Khanna and Mathews (2016) outline theoretically that VCs might rationally assign higher valuations in later funding rounds than necessary, possibly to posture a startup against its competitors and thereby spur its entrepreneurs to increase their efforts. Thus, empirically examining these valuation rationales is of utmost importance to further the understanding of startup valuations in the VC context.

5 Limitations

This paper has shed light on the determinants affecting startup valuations in the VC context, but it has some limitations that must be addressed. First, the paper relies on only two databases, applies a journal quality threshold, and focuses on English-language journal articles meaning that, for instance, working papers were excluded. However, the last two means were necessary to guarantee the identification of high quality impactful research. Moreover, by conducting an additional search—that wherever possible included a full-text query—the taken approach should provide a solid basis to create a holistic view of the state of the empirical literature. Second, the paper might apply too narrow inclusion and exclusion criteria, and the selection of the papers might be subjectively biased. However, in light of the paper's underlying setting the narrowed focus was a necessity, as for instance it permitted the exclusion of articles focusing on young public firms that are irrelevant in the scrutinized VC context. Third, from a financial perspective, business plans including a startup's projected cash flows usually provide the basis for a startup's financial valuation in the VC context (e.g., Douglas et al. 2014; MacMillan et al. 1985; Manigart et al. 1997) and it is therefore surprising that none of the selected articles directly examined the reliability and impact of the business plans provided by entrepreneurs on startup valuations. Admittedly, this review cannot claim to provide a complete picture of the matter, and relevant factors might not have been identified in the course of the review. Nevertheless, the author is confident that this review and the derived framework provide a good starting point from which to deepen the understanding of the determinants influencing startup valuations in the VC environment, and that the article can pave the way for future research.

6 Conclusion

This paper has compiled relevant empirical research on the determinants of startup valuations in the VC context. It illustrates that in the VC market, startup valuations are determined within a complex setting because the interplay and dynamics of the different factors concerning startups, VCs, and the external environment all contribute to the final outcome. Beyond that, as revealed by the underlying review of the literature, it became obvious that current research thus far only scratched the surface of uncovering the determinants of startup valuations. Therefore, this research area will greatly benefit by addressing the identified research gaps. In this regard, the illuminated paths for future research together with more comprehensive datasets and measures, in combination with emerging research methods, will further disentangle the determinants influencing startup valuations in the VC context.

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