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Valuation of Start-up Companies

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Valuation of Start-up Companies

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Literature Tracking Index (Journal des Articles et de Suivi des Articles)

In principle each study which composes this dissertation has been to conference multiple times. Additionally, all of this dissertation's component studies have been submitted to peer review, with one having been published and another already under minor revision. Overall, this segment of the dissertation can be considered a living document, as the number of studies on startup valuation grows, as the heretofore unpublished studies make their way through the submission and peer-review process, and as the number of conferences at which these studies are presented continues to grow. These are summarized below in Table 1.

Table 1 : Literature Tracking Index Summary

Number	Title	Author	Status	Publications and Journals
1	What do we know about startup-valuation drivers? A systematic literature review	Max Berre and Benjamin Le Pendeven	Published in Venture Capital (ABS-2) in 2022.	Peer Review Submission: Venture Capital (2021), Journal of Economic Surveys (2020), Small Business Economics (2020)
				Conferences: EURAM (2019, Turin), AFFI (2020, Nantes)
2	Business-cycles and Cash-on-Market: Pre-money Startup Valuation in the Macroeconomic Environment	Max Berre and Benjamin Le Pendeven	Submitted to peer review in 2023	Peer Review Submission: Journal of Financial Intermediation (2023)
				Conferences: AFFI (2020, Nantes), EntFin (2021, Marseille), FEBS (2021, Lille) FEM (2022, Paris), EntFin (2022, Bath)
3	Cross-Border Venture Capital Valuation: Business-Cycle, Institutional Factors, and Distance	Max Berre	Submitted to peer review in 2023	Peer Review Submission: Research in International Business and Finance (2023)
				Conferences DIF (2021, Lyon), FEBS (2022, Portsmouth), World Finance Conference (Turin, 2022)
4	Can Startups Disrupt the Gender Pay Gap? Can they Disrupt Economic Exclusion? A Two-Tiered Approach	Max Berre	Submitted to peer review in 2022. Currently Under Minor Revision at Finance (ABS-3)	Peer Review Submission: Finance (2022)
				Conferences: JIRF (2022, Lyon), WFC (2022, Turin), ICSB (2022, Washington), World Finance Conference (Turin, 2022)

While one of the studies attached to this dissertation has been submitted to an ABS-4 journal, the majority of this dissertation's submissions have concentrated on ABS-3 and ABS-2 journal targets. These include Small Business Economics, Finance, Research in International Business, and the Journal of Economic Surveys.

Concerning conferences meanwhile, conference selection has focused primarily on generalist finance conferences, such as the Financial Engineering and Banking Society (FEBS), Financial Economics Meeting (FEM), French Finance Association (AFFI), and World Finance Conference, but also included Ent-Fin, an entrepreneurship-focused conference.

Understanding of Approaches and Contexts in Startup Valuation[1]

Max Berre[2]

ABSTRACT: Startup valuation is a key research question and matter of ongoing curiosity and debate within the entrepreneurial finance domain. Unfortunately, research on this topic is more diverse and less consistent than overall valuation research. This is due to roles played by microeconomic and macroeconomic valuation drivers, to risks specific to entrepreneurial ecosystems, and to intangibility and unavailability of key valuation-input figures. Therefore, answering this subject's key questions demands a varied and thorough approach. In order to bring clarity to this fragmented field, this dissertation approaches valuation of startups using diverse and rigorous approaches.

Compréhension des Approches et les Contextes dans la Valorisation des Startups

ABSTRACT : La valorisation des startups est une question clé et un sujet de débat intense dans le champs de la finance entrepreneuriale. Toutefois, la recherche sur ce sujet est plus diversifiée, moins unifiée et moins cohérente que la recherche plus générale sur la valorisation des actifs financiers sur les marchés. Cela s'explique par le rôle joué par les facteurs microéconomiques et macroéconomiques, par les risques spécifiques aux écosystèmes entrepreneuriaux, mais aussipar l'intangibilité ou à l'indisponibilité des chiffres clés des start-ups pour leur valorisation. Afin de clarifier ce domaine, cette thèse aborde la valorisation des startups à l'aide de plusieurs approches méthodologiques.

Keywords: *Startup Valuation, Venture Capital, Entrepreneurial Finance, Machine Learning, SEM, Methodology*

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1. Introduction

In 2020 and 2021, worldwide Venture Capital (VC) markets reached records both in terms of value invested and in number of deals (Pitchbook, 2023). Records were also dramatically surpassed in terms of startup-valuations. The number of unicorns growing from 45 in 2014 (Wall Street Journal, 2014) to 1,056 in 2021 (Hurun Research Institute, 2021).

Startup valuations are also an area in which entrepreneurial, startup, and venture capital markets divert from classical economic theory. Although some commentary is already offered by existing academic literature on some details of this, the valuation of startups remains a topic of open academic debate (Kohn, 2018; Wessendorf, 2019). Fundamentally, this dissertation is intended as an exploration of startup valuations, their architecture, and the diverse taxonomy of drivers and deterministic factors that influence them.

Over the past thirty years, the academic community have been attempting to formalize the understanding of startup valuation. While overall published knowledge is dispersed across several academic fields, Bellavitis et al. (2017) and Budhwar et al. (2022) concur on the importance of focusing on startup-valuations as a key avenue of research, with the potential to tie together macroeconomic, entrepreneurial, financial and microeconomic theoretical perspectives to forge dynamic and innovative insights.

The purpose of this thesis is to understand how the valuations of startups are formed. In principle, despite the fact that company-valuation is well-understood at the theoretical level, as well as explained in detail in the literature, the valuation of startups is demonstrated to be a challenge in the domain of entrepreneurial finance. In light of their histories, and intangible assets, startups are notably difficult to value (Damodaran, 2009).

Indeed, even if the techniques and practices of valuation of start-ups by venture capital investors and business-angels are known, the relative impact of different valuation determinants are relatively little studied as well as relatively little modeled, such as macroeconomic conditions and economic cycles, economic geography, international investment, course and profile of entrepreneurs, competitive pressure, content of the different shareholder agreement clauses, etc.

The contribution of this 14dissertation to the development of the debate, as well as the understanding of startup valuations consists of multiple aspects. To capture pre-existing academic knowledge on this topic, a meta-model for startup valuation is established, assembling entrepreneur characteristics, firm characteristics, investor characteristics, market conditions, and deal conditions into an aggregation-based meta-model for startup valuation.

Subsequently, several of the chapters of this dissertation elaborate on the role of market conditions such as macroeconomic business-cycles, sectoral risk, economic geography, and international legal and institutional differences. While firm characteristics are included in each study as control variables, due to their role in the DCF model, the role of business model is also examined in detail.

From the methodological point of view, this dissertation represents substantial innovation. While the vast majority of studies in the entrepreneurial finance field depend on either theoretical modeling or OLS as methodological approaches in order to examine startup valuation, this dissertation examines startup valuation using a diversified collection of approaches.

1.1 Research Questions

The primary objective of this dissertation is to understand startup valuations and venture capital markets in specific detail. Specifically, the aim of the dissertation is to understand how valuations of young startup companies emerge and how they are influenced by their contextual environments. In order to arrive at this understanding, this research seeks to answer several key questions, which relate essentially to various types of determinants, such as firm characteristics and firm performance indicators, as well as various aspects of the context in which startups operate, such as the macroeconomic and macro-institutional environment, sectoral market conditions, and local-level economic geography. Furthermore, this dissertation finds that the development of insights into these areas might require deployment of innovative methodological approaches. In the literature, it is clear that startup valuations have substantial numbers of drivers (Kohn, 2018; Wessendorf, 2018) They include firm performance and risk-indictors (Damodaran, 2009), entrepreneur characteristics (Kaplan et al., 2009; Miloud and Cabrol. 2011), and macroeconomic market conditions.

Specifically, questions that demand examination in order to better understand startup valuations as well as the role and architecture of the causal structures that influence valuations include:

- What role do business cycles and macroeconomic market conditions play in influencing startup valuations? Given that startups are primarily financed by venture capital markets rather than bank intermediaries, are startup markets relatively insulated from impacts of general macroeconomic trends? Or are they in fact deeply impacted by macroeconomic conditions? Certainly, the literature outlines that venture capital firms are highly responsive to market signals of investment opportunities (Gompers et al., 2008). But what is the specific architecture of their causal relationship towards startups?

- What role do international and cross-border investments play in determining startup valuations? Do investor differences matter? Do macroeconomic differences matter? Do institutional differences matter? We know that financial markets in general are dramatically influenced by regulatory and institutional cross-border differences (La Porta et al., 2006). Are similar things true specifically in startup markets?

- Do startup valuations have any wider socioeconomic impacts beyond their immediate startup and venture capital markets? The literature describes that socioeconomic market conditions are driven by the firm level (Card et al., 2016; 2018) and the industry level (Goldin, 2014). Do startups have the possibility to influence this? Are valuations indicative of this ability (or lack thereof)?

In principle, addressing these research questions can be considered a major step forward in terms of the alleviation of the information asymmetries and black-boxes that set startup valuations and the understanding of their mechanical architecture as a subject which finds itself being sometimes in deviation from wider financial markets and from economic theory overall.

1.2 Principal Concepts

At the heart of this thesis concerning the valuation of startups are several key concepts, which are defined specifically in the literature as well as within the framework of the research contained in this thesis. Fundamentally, an investigation of the specific drivers and causation influencing the valuation of startups requires specific definition and citation describing and defining startups, valuations, and valuation drivers (i.e., valuation determinants).

1.2.1 Startup

Legal definitions for startups exist in both the US and the European Union. In the United States, startups are legally defined very broadly. In the US, the 2012 Jumpstart Our Business Startups Act references firms younger than five years, from the date of their initial registration, for the purposes of disclosure regulation exemption.

In contrast, EU law describes startups in finer detail. Art. 22(2) of EU Commission Regulation No. 651/ 2014 describes startups as unlisted small-enterprises that have existed for less than five years,

have not taken-over activity of another firm, have not yet distributed profits, and were not formed as the result of a merger. This definition exists as part of EU competition law.

1.2.2 Valuation

Cumming and Dai (2010) define startup-valuation as the price for the firm (or price-of-shares) paid by equity-investors for early-stage investments. This definition is specific to valuations observed in startup investments and excludes exit-events such as trade-sales or IPOs, which cannot be considered to belong to the firm's emerging phase.

1.2.3 Driver, Valuation Determinant

Valuation drivers are the observable variables that act as information-subsets that influence startup-valuation. This goes beyond a firm's balance sheet, income statement, and financial disclosures, including both external information, such as market structure, and privileged information and access held by stakeholders.

While the term "driver" is taken to mean factor-determinant for the purposes of valuation and within entrepreneurial finance more broadly, a factor per se, is described by Fama (1970) as "information-subsets" ranging from historical-values to disclosures and privileged-information, which impact valuations and market-prices (Fama, 1970, pp. 383-88).

2. Conceptual Framework

Fundamentally, the need for a unified theoretical framework to a unified conceptualization of the valuation of startups is an identified need within the entrepreneurial finance literature, which has been described by both theoretical literature (e.g., Damodaran, 2009), as well as numerous bibliometric studies and systematic literature reviews (e.g., Kohn, 2018, Wessendorf, 2019; Colombo et al. 2022). While startup valuations are theorized to be influenced by both internal and external factors, described by divergent theoretical traditions, as is described in this introduction, unified models and unified approaches aim specifically to incorporate factors from various theoretical approaches (Damodaran 2002; 2009; Kohn, 2018).

In general, the theoretical underpinnings of this research, in its various chapters, and examining its various dimensions is inspired by the resource-based view, which describes the central role assumed by internal factors to the firm, in driving valuations, such as technology and human resources

(Wernerfelt, 1984) or business models (Barney, 1986), as well as the opposing market-based view, which emphasizes external market factors and the role of industry structure in determining firm performance (Porter, 1990), and ultimately valuation. Because much of the literature covering startup valuations, which has emerged over the past two decades draws from both, it can be considered unified, an idea which is explicitly described in both literature describing the details of the discounted cashflow approach (Damodaran 2002; 2009), as well as relative approaches (Damodaran, 2010), and even literature examining the literature on startup valuations, (Kohn, 2018)

Essentially, the resource-based view elements underpinning this dissertation propose that in startup markets, valuations signal firm-level competitive advantage, and derive from the mobilization of internal, firm-level resources, opportunities, synergies, and capabilities. Key to this view within entrepreneurship studies is the "jockey and horse" debate described by Kaplan et al. (2009) as well as by Gompers et al. (2020), which describes internal, firm-level resources may be tied to concrete firm-specific resources, which are often more tangible, referred to as "horse" factors, or human-resource-related internal capabilities and network connections, referred to as "jockey" factors. While startups need both of these internal factors to survive and grow – hence valuations are influenced by both internal factors (Damodaran, 2009) – "jockey" factors can be considered the most influential valuation-factors which investors bet on (Kaplan et al., 2009). The theoretical framework established in the early chapters of this dissertation outlines a summation-based approach, which can also be expressed as a multi-stage valuation model, specifically labels valuation-factors drawn from the resource-based view as Startup Value factors, consisting essentially of "jockey" factors (i.e., entrepreneur characteristics) and "horse" factors (i.e., firm characteristics).

External to the "jockey" and "horse", a market-based view, which describes firm performance as resulting from factors external to the firm, focuses mainly on industry-level, national-level, and market forces such as industry structure, market dynamics, and competitive forces, is also described by the theoretical literature as highly deterministic for startup valuations, with industry-level and national risk-conditions influencing the discount rates used in DCF valuations (Damodaran, 2002; 2009), industry-level dynamics serve as the basis of relative valuation (Damodaran, 2010), overall economic linkages and sector-level relationships drive the development of ecosystems, as well as country-level trade and comparative advantage (Porter, 1990), and business cycle dynamics drive startup markets at large (Gompers and Lerner, 1998; Bonini and Alkan, 2006).

Much of the theory describing the role played by ecosystem-related external market conditions can be tied to Porter's Diamond, described by Porter (1990). According to the Porter (1990) conceptualization, competitive advantage is determined by four interconnected determinants: factor conditions, demand conditions, related and supporting industries, and firm strategy, structure, and rivalry. The theoretical framework established in the early chapters of this dissertation describes the role of these external market-based factors as influencing startup valuations for firms with existing internal Startup Value conditions. Essentially, Deal Value conditions (i.e., market conditions), are proposed to have the effect of filtering and biasing the firm-level value-signals expressed by Startup Value factors, and as such occupies an intermediate-stage position in the conceptual Berre-Le Pendeven Startup Valuation Meta-Model (Berre Le Pendeven, 2022).

Lastly, after a given firm-level value-signal has been sent, and subsequently influenced by external market conditions, it is ultimately interpreted and negotiated-upon by investors, according to their preferences, specializations, capabilities, and negotiating power. While it is very likely that investor characteristics and sophistication play an important role in startup valuation, the theoretical literature is divided on the nature of this impact, with Porter (1990) describing the role had on overall comparative advantage, while Kaplan and Stromberg (2003) describe the development of deal-conditions as flowing from contracting theory relating to investor expectations and information asymmetry.

2.1 Key Dimensions

Given that the theoretical literature describes a diverse range of valuation-determinants, ranging from internal and firm-level, to external, and market-level, and ultimately to investor level, determinants to startup valuations, it is necessary to organize them into a coherent series of factors, in order to better understand their joint influence on startup valuations.

2.1.1. Jockey and Horse Factors: Inputs to Value

These are the internal factors to the firm, which the resource-based view describes as being key determinants of competitive advantage and superior performance. In the entrepreneurial finance context, it should be noted that these factors are able to drive not only performance, but also startup selection and startup valuation as well (Gompers et al., 2020).

Entrepreneur Characteristics

Fundamentally, the literature describes that the startup's founder team and its internal human resources are among the most important value-drivers for a startup, influencing both the startup's selection likelihood and its valuation (Kaplan et al. 2009; Gompers; 2020). Inclusion of these factors within this dissertation's conceptual framework is driven by input-based valuation approaches, which explicitly include entrepreneurial human-resources as a valuation driver. Examples of these can be found not only in peer-reviewed literature, such as Miloud and Cabrol (2011) and Miloud (2012), but also among valuation-models in use by practitioners, including those described by Payne (2011) and Berkus (2016).

While theory describes the key entrepreneurial factors driving valuation as being team composition, founder experience, and founder education, disentangling the effect of each of these on valuation presents its own unique challenge. Furthermore, each provides its own layer of nuance, as experience can refer to industry experience, specialized technical experience or prior founder experience (Hsu, 2007; Chatterji, 2009; Miloud and Cabrol , 2011; Yoo et al., 2012), while education can refer to either a business-related education background (e.g., an MBA), or a research-specific educational background (e.g., a PhD), or juridical educational background (e.g., a JD), while founder teams can consist of combinations and permutations of all of these.

An additional important detail for this dissertation's conceptual framework, is the potential for driver-interaction. Zacharakis and Shepherd (2005), describe that entrepreneurial experience in particular has strong potential to complement other valuation factors such as firm-level intellectual property, or market conditions. This implies that any conceptual model taking entrepreneur characteristics into account should also model the potential interaction-effects.

Firm Characteristics

Firm characteristics, such as assets and performance-indicators are inputs in established valuation-models, which can be tied to the resource-based view outlining that that a firm's internal resources and capabilities are the fundamental drivers of sustained competitive advantage. While the firm's assets are what can strictly be considered its resources, the firm's performance indicators can rather be characterized as how the firm makes use of these resources (Damodaran, 2002; Foulquier et al., 2019; Brealey et al. 2020). While the latter serve as the basis for the discounted-cashflow valuation approach (Damodaran, 2002), and the former for the relative valuation approach (Damodaran, 2010), both factors have been used for summation-based valuation approaches such as Hand (2005) and Sievers (2013).

In terms of the "jockey and horse" factors described by Kaplan et al. (2009) and Gompers et al. (2020), these can be considered "horse" factors (i.e., factors internal to the firm rather than to the firm's founding team or its human resources), and broadly consist of revenue-related indicators drawn from a firm's income statement or cashflow statement, as well as asset-related indicators drawn from the balance sheet, which convey the firm's size, resources, and productive capabilities (or subsets thereof, such as inventory, PP&E, or intangible assets), as well as business-models, revenue-models, and stage of development.

Conceptually, accurate valuation and firm-level performance evaluation on the basis of firm-level resources and performance indicators requires measures to be "multi-dimensional" in nature, drawing from both the balance sheet and the income statement, and if possible, include further dimensions (Foulquier et al., 2019). This is necessary in order to avoid bias and measurement error flowing from the use of firm-level metrics (Foulquier et al. 2019).

2.1.2. Deal Value and Market Conditions: External Factors

Fundamentally, market conditions consist of valuation-factors which describe the startup's context in the market. These factors, influenced theoretically by the market-based view, range from sectoral conditions to conditions relating to the prevailing macroeconomic sectors (and indicators thereof), the business cycle, and conditions relating to the intermediate financial markets (e.g. size and condition of the venture capital market). Conceptually, these can have both direct and indirect impacts on valuations in startup markets (Bernoth and Colavecchio, 2014; Trancoso and Gomes 2020).

Business models, which vary over time and across countries, impact investment success, performance (Barney, 1986), and valuations (Dieppe at al., 2017). This arises as more successful VC deals take place during boom periods (Heughebaert and Manigart, 2012) and as capital-flows from institutional investors fluctuate across the business cycle' s periods (Schwienbacher, 2013).

These factors are expressed in numerous valuation models, including principally various DCF valuation-approaches, as well as relative-valuation approaches (Damodaran 2002; 2009; 2010). While relative valuation and DCF models estimate the impacts of macro-level market conditions on valuations, via their multipliers and the discount and growth rates respectively, a wholistic conceptualization of these factors also requires capturing their interactive, synergetic, and/or complementary relationships with other valuation-factors. In particular, economic theory describes the interaction of business cycles with survival rates (Damodaran; 2009), firm-level assets

(particularly intangible assets), firm-level financial performance indicators (Gavious and Schwartz, 2011), and investor-experience (Gompers et al., 2008).

As financial intermediary markets, VC markets are driven by business cycles and macroeconomic conditions, and in turn, they drive start-up valuations. Examples in the literature include the Chan (1983) theoretical model, which outlines how investment allocations at the macro-level depend on VCs' intermediary role, as a means to manage sector-specific information asymmetries.

A further layer of complexity can be added here by taking international capital flows and international capital markets into consideration. When this becomes the case, sources of theory include not only macroeconomic views, but also those relating to information asymmetries and legal investor-protections (La Porta et al. 1998; 2002; 2006), but also gravity models (Carrère et al., 2020), which alongside economic factors, examine the roles of economic geography factors such as geographic distances (Cumming and Dai, 2010), and investor-startup travel-times (Chemmanur et al., 2016).

2.1.3. Investors, Environment, and Deal Conditions: Deal Environment

Investors, Investor Strategy, and Nature of Investors

In terms of economic theory, the literature describes that investors are able to both add value, and also find and select startups and deals which will successfully bring them positive returns on the basis of investor ability to overcome information asymmetry (Holmstrom and Tirole, 1997). Formally Holmstrom and Tirole describe that for a given rate of return, β, investors decide whether the monitoring cost is justified by the payoff:

Holmstrom-Tirole Venture Capital Investment Decision

$$I_{vc}(\beta) = \frac{C_{PH}}{\beta_{(PH-PL)}}$$

Here, the volume of funds allocated by venture capital markets, I_{vc} is driven by the monitoring costs required to drive payoff probability from PL to PH, in comparison to the economic value to the investor represented by such a payoff. Venture capital's rate of return meanwhile, is given by the share firm-level performance driven payoffs.

Holmstrom-Tirole Venture Capital Rate of Return

$$\beta = {}_{PH}R_{vc}/I_{vc}$$

Here, the Holmstrom and Tirole rate of venture capital return is driven directly by firm-level performance, along the lines derived from venture capital monitoring activities. Nevertheless, while Holmstrom and Tirole (1997) theorize this value-contribution as consisting specifically of monitoring, the literature describes that active venture capital participation may also take the form of investor-specialization, and coaching (Keuschnigg and Nielsen, 2004), as well as access to related business networks (Rohm, 2018).

Investor Size and Investor Reputation

While economic theory describes how investor characteristics are able to add value to startups by driving their growth rate, connectivity and network access, while reducing information asymmetry and entrepreneurial self-dealing (Holmstrom and Tirole, 1997), the direct impact on startup valuations does not necessarily flow in the same direction as their prospects might.

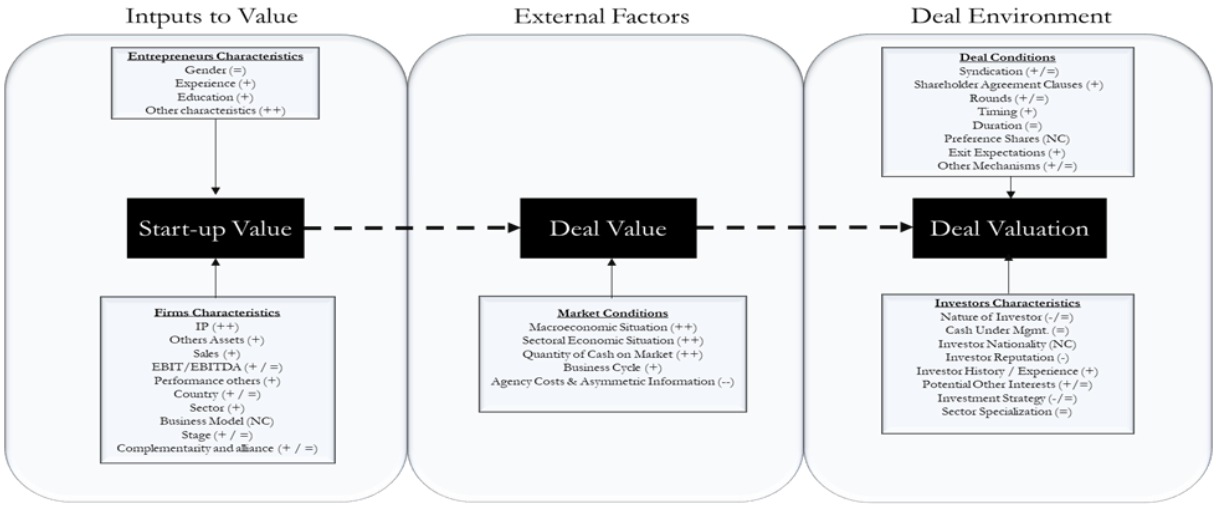
For example, specialized or prestigious investors may be able to command valuation-discounts (Hsu, 2004; Cumming and Dai, 2011), ultimately having a mitigating impact on startup valuations whereas highly experienced VC investors are able to leverage their experience in order to better take advantage of entrepreneur characteristics, as well as specialized market conditions (Franke et al., 2008; Gompers et al., 2008).

2.1.4. Towards a Unified Model

Lastly, is it conceptually possible to organize the valuation factors examined within this dissertation into a summation-based model, which includes the views of both the resource-based view and the market-based view, while also providing a measure which is multi-dimensional in nature in order to minimize bias and measurement error (Foulquier et al. 2019). In addition, any unified conceptual model will need to take into account factor-interactions, which are described by Zacharakis and Shepherd (2005), Gompers et al. (2008), Gavious and Schwartz (2011), and Davila et al. (2015), as well as indirect-effects described by Bernoth and Colavecchio (2014), Trancoso and Gomes (2020).

Figure 1 displays the Berre Le Pendeven meta-model (Berre and Le Pendeven, 2022), a viable conceptual model incorporating and unifying the model elements, as per the diverse strands of economic theory from which this dissertation draws. This model was developed by this dissertation's systematic literature review, and serves as the conceptual basis for the subsequent empirical studies.

Figure 1: Conceptual Meta Model for Startup Valuation



2.2 Contributions

The academic contributions of this dissertation can be classified into contributions to economic theory and theory on entrepreneurial finance on one hand, and methodological contributions on the other hand. In particular, each of the specific studies attached to this dissertation are deliberately intended to establish both a theoretical contribution and a methodological contribution. These contributions respond to existing research questions and gaps in the literature, such as the need to connect entrepreneurial finance to macro-level theory (Budhwar et al., 2022), and the impact of cross-border capital markets (Bellavitis et al., 2017).

2.2.1 Theoretical Contributions

In principle, each study included in this dissertation has noteworthy theoretical contributions, which serve to enrich and develop the entrepreneurial finance field, addressing existing questions and research gaps present in the literature. In addition to the added-value to this dissertation, it is hoped that each of these theoretical contributions eventually promote related future research.

First, the systematic literature review succeeds in constructing and expressing a meta-model of valuation that takes the functional form of an aggregation model – a functional form characterized by the flexibility of being easily reformable and of being able to include easily additional factors – which serves as the basis for many further studies. This model ties together the contributions of numerous studies in the entrepreneurial finance field.

Next, as a response to Budhwar et al. (2022), which describes the general need for the emergence of theory to link entrepreneurial finance to macroeconomic theory, this dissertation develops a detailed explanation of the direct and indirect distribution-channel relationship between macroeconomic business cycles, startup valuations, and intermediate variables.

Concerning the role of international venture capital investment, this dissertation also responds to existing law and finance literature, such as La Porta et al. (2006), which finds that securities law drives macrofinancial investment among various countries. In response, this dissertation finds that within venture capital markets, it is the regulatory differences between markets which are relevant.

In the media, substantial coverage has been given to the role of economic geography, and in particular, to the municipal level. The literature points to differences in terms of reasons different cities cite for their economic impact (Nathan and Vandore, 2014; Berre, 2015), with some cities betting on financial services or trade access, while others bet on commercial and transit infrastructure. While disentangling this extensive taxonomy of potential local valuation-drivers is a challenge, it is certainly well understood that municipalities matter (Porter, 1990; Nathan and Vandore, 2014; Berre, 2015; Ang et al, 2020). This dissertation explores the impact of cities on startup valuations via fixed-effects models, as well as via supervised machine learning. It is demonstrated that while specific city-level factors (or combinations thereof) are difficult to disentangle (Berre, 2015), the impact of cities on startup valuation is comparable to the impact of countries, and is surpassed only by revenues in terms of their explanatory power. While Porter (1990) provides a well-known conceptualization of the way in which local-level economic factors interact to drive comparative advantage and economic productivity, many studies such as Nathan and Vandore (2014) also focus on city-specific factors.

2.2.2 Methodological Contributions

. Because published startup valuation literature within entrepreneurial finance is characterized by insufficient methodological diversification, with approximately 80% of examined studies depending on either formal modelling or regression analysis (i.e., OLS, logit, and probit), noteworthy opportunities for diversification of methodological approaches exist. This can be considered a substantial research gap in entrepreneurial finance.

In particular, this dissertation sets out to demonstrate that methodology inspired by Eisenhardt-style coding (Eisenhardt and Graebner, 2007), which influenced the systematic literature review, as

well as by law and finance methodology, by gravity models, structural equation modelling, and supervised machine-learning all have their place within the entrepreneurial finance field.

While these each represent research gaps and publication opportunities in and of themselves, each also represent new types of information which can be brought to bear in order to better understand startup markets. For example, the use of structural equation modelling in *Business-cycles and Cash-on-Market: Pre-money Startup Valuation in the Macroeconomic Environment:* leads directly to the insight that valuation is influenced not by deterministic drivers, but by transmission-channels that act to transmit business cycle conditions, while the use of supervised machine-learning in *Can Startups Disrupt the Gender Pay Gap? Can they Disrupt Economic Exclusion? A Two-Tiered Approach* grant the ability to both elaborate on OLS findings via use of hierarchical regression trees, to detect special cases and scenarios.

3. Methodology

Overall, this dissertation places emphasis on approaching the valuation of startups via a diversity of methodological approaches. This is done deliberately, as a response to the lack of methodological diversification in this domain which is identified in the systematic literature review. Fundamentally, this lack of diversification represents a substantial weak point within the existing research literature in the entrepreneurial finance field, given that different methodological approaches render possible novel and different findings because they examine the existing data in different ways. Examples of this can be found in Murnieks et al. (2016), which provides fresh perspective regarding entrepreneur characteristics, as well as in Ang et al. (2020), which gives us fresh perspective on the impact of economic geography. The same principle applies research expressed by the chapters of this thesis, which is able to provide new perspectives on the indirect impact and distribution of macroeconomic factors by use of 2SLS in one chapter, the ability to estimate valuation based on categorical variables via the use of supervised machine-learning in another, and a new valuation meta-model via the use of techniques inspired by Eisenhardt in the systematic literature review.

In order to realize this multiple-methodology approach, a substantial, high-dimensionality bespoke and custom dataset of European venture capital investments was gathered. The intention with developing this database, was to develop the basis for multiple empirical studies to explore both diverse valuation factors and diverse methodologies.

3.1 The Startup Deals Database

In order to carry out empirical quantitative studies, a dataset, composed of 1,089 venture capital investments was constructed, containing data from different sources on the characteristics of companies, entrepreneurs, investors and market conditions in order to test the meta-model by means of several empirical studies, which range from macroeconomic studies on venture capital to studies on the characteristics of entrepreneurs, as well as micro-targeted studies in the venture capital market. This dissertation's bespoke venture capital deals dataset consists of an unbalanced panel of high-dimensionality European Union (EU) and European Economic Area (EEA) deals from 2000 to 2020. It examines deals which invest into 673 startups, using 297 variables. These include firm performance measures, venture capital round number, intellectual property, sectoral and macroeconomic risk indicators, national-level macroeconomic and institutional indicators, business cycle indicators, municipal economic indicators, categorical variables for sector, investor-details, economic geography, business model, and interaction variables for several of these variables. Overall, our firm-level characteristics were drawn from Early Metrics, EIKON, and Crunchbase, while our datasets country-risk-premia and industry-level data were drawn from NYU-Stern data. Concerning country level data, country-level legal and institutional data were drawn from the World Economic Forum, as well as La Porta et al., (1998; 2002; 2006), while macroeconomic indicators such as macroeconomic output-gap and VC cash-on-market were drawn from OECD data. Municipal-level indicators were drawn from OECD data and from the Economist Intelligence Unit (EIU). Lastly, data on the gender pay gap, business cycle clock, and industry-level investment were drawn from Eurostat.

On the basis of this dataset, multiple studies exploring the contours and details of startup valuation have been possible. These include studies exploring macroeconomic effects on valuation, as well as the impacts of international and cross-border investment on valuation, and studies involving small-scale sectoral and municipal effects. All of these are endowed with and ample variety of control variables.

3.2 A Portfolio of Approaches

Overall, traditional studies that examine startup valuation depend on a fairly narrow and limited set of methods. Berre and Le Pendeven (2022) explain that with the existing range of published literature on startup valuation, 60% rely on regression analysis (mainly Logit, Probit and OLS). Additionally, 20% of academic studies on startup valuation are theoretical contributions, which establish formal theoretical models for defining startup valuation. Indeed, the systematic literature

review invites the academic community in entrepreneurial finance to consider deploying less used methods to investigate new fruitful questions concerning startup valuation. Examples of this principle proposed by this dissertation include the use of an Eisenhardt-style approach for its literature review (Eisenhardt, 1989), which was able to provide a viable and fruitful conceptual model, a two-stage SEM approach to modeling the valuation-impact of market conditions, which revealed that the impact of market-conditions is a matter of valuation-channels which transmit the impacts of the business cycle across a collection of intermediate variables, rather than direct valuation-factors, and the use of regression trees to provide approaches to valuation which can be microtargeted (i.e., modeled on the basis of information-dense categorical factors rather than numerical factors), and can also add variable hierarchy to valuation-models, which are highly useful for risk-modeling and for conditional-valuation situations.

Fundamentally, what Berre and Le Pendeven (2022) describe, is an ecosystem of studies on valuation, characterized by weak methodological diversification. From an academic research perspective, this lack of methodological diversification in the literature presents a significant opportunity for research aimed at new insights. As a response to this opportunity, this dissertation features a collection of studies which use a diverse collection of methodological approaches. For example, the systematic literature review employs thematic coding across literature sources, leading to the construction of tables demonstrating associations between valuation-drivers and startup-valuations, making possible the construction of a grounded theory meta-model to grant wholistic insight into startup valuation. This is an approach which draws inspiration from not only Tranfield et al. (2003), but also Eisenhardt (1989). Concerning methodology, subsequent studies included in this dissertation approach the question of startup valuation using structural equation modelling, gravity models, law and finance, and supervised machine learning. Each one presents novel insights concerning startup valuation, allowing a more thorough examination of the research questions than is otherwise possible, as is detailed in the remainder of section 3.

3.3 Structural Equation Model

Structural equation modeling allows the analysis of direct as well as indirect relationships among observed variables and unobserved variables. Compared to OLS approaches, the SEM approach has numerous advantages for the analysis of the valuation of startups as well as its underlying determinant factors and drivers.

In principle, this approach allows modeling, examining and understanding impacts and causal relationships which are complex, including even causal relationships difficult to observe directly in

their entirety. This approach is therefore highly relevant to understanding the impact of macroeconomic determinants which are themselves characterized by their complex and indirect impacts, which influence several variables simultaneously, as well as understanding the impact subjective and latent determinants. While Trancoso and Gomes (2020) have used this approach to investigate the direct and indirect relations between financial integration, trade integration, and business cycle dynamics, this dissertation and its chapters present, to the best of our knowledge, represents the first time that an SEM approach has been used to link business cycle dynamics to startup valuations.

3.4 Endogeneity

Because the paper "Business-cycles and Cash-on-Market: Pre-money Startup Valuation in the Macroeconomic Environment" features some proposed relationships which test positive for endogeneity, which the paper subsequently addresses, endogeneity is a key issue for this dissertation to address. Wooldridge (2010) describes that endogeneity emerges due to one of three causes. This consists of either omitted-variable-bias, simultaneity, or measurement-error. Fundamentally, endogeneity-testing serves to indicate whether causality is more-complex than initially detected, or whether causal-relationships are influenced by additional explanatory-variables or measurement-error.

While directly-circular endogenous relationships between business-cycle and startup-valuation are unlikely, given a dataset dominated by startups in large, historically-established European economies, relationships between business-cycles, cash-on-market, and startup-valuation may give rise to circular cash-on-market-relationships whereby business-cycles and cash-on-market may be endogenously-related. Additionally, cash-on-market might be endogenously-related to valuation.

Alternately, endogeneity might be driven by hidden-variable-bias (Wooldridge, 2010), which might be found acting upon the model's dependent-variables, explanatory-variables, or both. While use of two-stage-least-squares (2SLS) can be considered a well-established model-approach in accounting for endogeneity, selection of variable, as well as relationships with both dependent-variables and other explanatory-variables must be given careful consideration.

3.5 Differences and Distances

A key theme concerning the impact of borders and of international venture capital on startup valuation concerns distances, physical, but also institutional and macroeconomic between the

situation of the startup, as well and on the context, it inhabits on one hand, and investors and the contexts they inhabit on the other.

Essentially, in the context of examining the impact of macroeconomic, legal, and institutional factors, the cross-border differences (the size of the differences) between the native startup market, and that of investors is substantially more relevant than these same factors. At the domestic level. This effect serves to corroborate the results of La Porta et al. (1998, 1999, 2002, and 2006), who explain macroeconomic and macrofinancial differences among different markets based on legal and institutional differences.

Physical distance meanwhile, behaves functionally as a trade-barrier, eventually preventing all but the most high-potential international venture capital investments. Mechanically, a large kilometer-distance is an equivalent to a very substantial institutional or macroeconomic distance, in terms of effect on startup valuation.

3.6 Supervised Machine Learning

While various machine-learning approaches exist, machine-learning model-selection is considered to be a key element of the process of use and deployment of machine-learning approaches. In general, supervised machine-learning algorithms can be used for classification, which uses the algorithm to accurately assign data into specific categories, or regression, which uses the algorithm to model the relationship between dependent and independent variables. Essentially, given that supervised machine-learning is used in situations where relevant variables are already labeled, defined, and understood, various model-approaches are generally viable.

Because use of machine-learning approaches is generally confronted relatively early in the process with questions of model-selection and algorithm-selection, the reasons and merits of the approach (or approaches) deployed is an important discussion point. Often, more than one approach – or combination of approaches – is viable, while the specific information communicated can be idiosyncratic. This consideration is at the origin of model-selection.

In particular, this dissertation makes use of regression tree algorithms based on recursive partitioning. Aside from the algorithm's benefits in terms of explanatory power due to its capability of modeling sub-populations and fault-lines within the data, its serves as a viable way to corroborate, elaborate, or refute OLS regression results (or lack thereof).

4. Empirical Studies on Valuation

In order to better understand the dimensions as well as the details of the various drivers that influence the valuation of startups, this dissertation includes several studies that explore the valuation of startups, as well as the causalities and their architectural structures. Each of these studies specifically examines at least one specific aspect of startup valuation as summarized in the meta model.

In principle, the causal structure of startup valuations is explored from a meta-perspective, as well as from a macroeconomic, an international, and a microeconomic perspective. Lastly, the role of startups in influencing the socioeconomic status quo and mitigating economic-exclusion is explored by this dissertation, where industry-relative valuation is found to be indicative of both economic and socioeconomic sectoral disruption.

4.1 What do we know about startup-valuation drivers? A systematic literature review:

This study examines 87 peer-reviewed studies published between 1985 and 2020. The study analyzes these publications in detail and identifies 36 startup-valuation drivers and clusters them into five macro-themes: Entrepreneur Characteristics; Firm Characteristics; Investor Characteristics; Market Conditions; and Deal Conditions.

The drivers identified in the literature lead us to the construction of an integrative meta-model based on the macro-themes, chronologically positioned in the valuation process. Aside from serving as a summation of the various macro-themes, the meta-model expresses interaction-effects among drivers for startup valuations, and also describes the process by which valuation emerges.

The meta-model can be used to understand both valuation models consisting of stages of emergence of valuation, and aggregation of valuation-drivers.

4.2 Business-cycles and Cash-on-Market: Pre-money Startup Valuation in the Macroeconomic Environment:

This work, a quantitative macroeconomic study analyzing startup valuations, was submitted to the Journal of Financial Intermediation. This is a study on the impact of business cycles as well as macroeconomic indicators on the valuation of startups. While this study finds that DCF valuation-factors play a significant role in determining startup valuations, the inclusion of macroeconomic

and business cycle indicators improves the accuracy of valuation models substantially. This is a result which corroborates the Berre & Le Pendeven startup valuation meta model developed in the systematic literature review.

This study uses a structural equation model approach to better understand relationships between business cycles, intermediary financial factors and startup valuations. This approach was selected due to its ability to manage and model endogeneity, as well as the need to model direct and indirect impacts. Among the study's key findings are that a macroeconomic view would indicate that startup valuations are driven by macroeconomic-level business cycle transmission channels rather than direct valuation-drivers.

This study's theoretical contribution is primarily the description of the distribution-channels by which business cycles influence startup markets and startup valuations. Additionally, this study's methodological contributions consist of use of structural equation models to tie together macroeconomic and entrepreneurial finance elements, to describe the financial intermediation in startup markets, and to capture possible endogeneity.

4.3 Cross-Border Venture Capital Valuation: Business-Cycle, Institutional Factors, and Distance:

This study presents an international macro-quantitative analysis of startup valuations. This study on the impact of relative macroeconomic, institutional, and cyclical differences between domestic startup markets and investor markets on startup valuations, finds that relative differences in governance play the most important role in valuation. Principally, the findings of this study are that international and cross-border differences are relevant to startup valuation.

Distances, whether physical or institutional are relevant for startup valuation as well. While international venture capital deals see lower valuations in general, investment capital is attracted by international differences.

Essentially, this means that different valuation drivers impact startup valuations differently. Macroeconomic and business cycle indicators are relevant in the markets where the startups are based, while taxes are relevant in markets where the investors are based. On the other hand, international differences in country-level institutional indicators are much more relevant to startup valuations than is the domestic role of these indicators.

In principle, this study's contribution is to link entrepreneurial finance literature to international finance literature, a substantial theoretical contribution in response to a research gap identified by

Bellavitis et al. (2017). In addition, as a methodological contribution, this also represents an attempt to expand the law and finance literature tradition into entrepreneurial finance.

4.4 Can Startups Disrupt the Gender Pay Gap? Can they Disrupt Economic Exclusion? A Two-Tiered Approach:

This study is an examination of the impact of startups on the gender pay gap. This study demonstrates why startup valuation matters beyond immediate entrepreneur and venture capital circles. Contrary of the preceding papers, this study is not on the drivers of start-up valuation, but on one of its possible social impacts. In other words, this study explores the consequences rather than the causes of startup valuations.

From the methodological point of view, this study uses a combination of econometrics and machine learning to measure the impact of sectoral disruption by startups on the industry-level pay gap and on the industry-level concentration of "insiders" in the company (insider concentration refers to ownership concentration among managers and board members). Sectoral disruption is represented by the valuation of startups, anchored to sectoral dimensions.

This study's empirical results indicate that entrepreneurial disruption serves to demonstrably disrupt the sectoral-level gender pay gap, as well as sectoral-level insider concentration, which acts as a proxy for sectoral-level economic exclusion in general. Moreover, the supervised machine learning results indicate that both dependent variables (gender pay gap and insider concentration), and the impact that entrepreneurial disruption has on them fluctuates with the business cycle.

5. Literature Tracking Index (Journal de Suivi des Articles)

In principle each study which composes this dissertation has been to conference multiple times. Additionally, all of this dissertation's component studies have been submitted to peer review, with one having been published and another already under minor revision. Overall, this segment of the dissertation can be considered a living document, as the number of studies on startup valuation grows, as the heretofore unpublished studies make their way through the submission and peer-review process, and as the number of conferences at which these studies are presented continues to grow. These are summarized below in Table 1.

Table 2 : Literature Tracking Index Summary

Number	Title	Author	Status	Publications and Journals
1	What do we know about startup-valuation drivers? A systematic literature review	Max Berre and Benjamin Le Pendeven	Published in Venture Capital (ABS-2) in 2022.	Peer Review Submission: Venture Capital (2021), Journal of Economic Surveys (2020), Small Business Economics (2020)
				Conferences: EURAM (2019, Turin), AFFI (2020, Nantes)
2	Business-cycles and Cash-on-Market: Pre-money Startup Valuation in the Macroeconomic Environment	Max Berre and Benjamin Le Pendeven	Submitted to peer review in 2023	Peer Review Submission: Journal of Financial Intermediation (2023)
				Conferences: AFFI (2020, Nantes), EntFin (2021, Marseille), FEBS (2021, Lille) FEM (2022, Paris), EntFin (2022, Bath)
3	Cross-Border Venture Capital Valuation: Business-Cycle, Institutional Factors, and Distance	Max Berre	Submitted to peer review in 2023	Peer Review Submission: Research in International Business and Finance (2023)
				Conferences DIF (2021, Lyon), FEBS (2022, Portsmouth), World Finance Conference (Turin, 2022)
4	Can Startups Disrupt the Gender Pay Gap? Can they Disrupt Economic Exclusion? A Two-Tiered Approach	Max Berre	Submitted to peer review in 2022. Currently Under Minor Revision at Finance (ABS-3)	Peer Review Submission: Finance (2022)
				Conferences: JIRF (2022, Lyon), WFC (2022, Turin), ICSB (2022, Washington), World Finance Conference (Turin, 2022)

While one of the studies attached to this dissertation has been submitted to an ABS-4 journal, the majority of this dissertation's submissions have concentrated on ABS-3 and ABS-2 journal targets. These include Small Business Economics, Finance, Research in International Business, and the Journal of Economic Surveys.

Concerning conferences meanwhile, conference selection has focused primarily on generalist finance conferences, such as the Financial Engineering and Banking Society (FEBS), Financial Economics Meeting (FEM), French Finance Association (AFFI), and World Finance Conference, but also included Ent-Fin, an entrepreneurship-focused conference.

6. Future Research

The options for prospective future directions in study are numerous and varied. First off, the Berre-Le Pendeven meta-model provides an adaptable framework for future research into the factors that influence startup valuation. Studies examining the interactions between drivers of startup value as described by the Berre Le Pendeven Meta-Model (i.e., entrepreneur and firm characteristics) and market conditions like business cycle conditions and sectoral conditions are of particular interest.

In addition, studies examining the valuation-impacts of the clauses in the VC contracts negotiated between entrepreneurs and stakeholders, as well as valuation-impacts of the deal negociation process are viable as directions of future research based on this dissertation's research.

Next, studies examining complex causality and complex causal structures within entrepreneurial finance is a crucial area for future research based on the findings of this dissertation. Whereas this

dissertation includes a study which uses SEM to describe complex, multi-stage causal relationships between the business cycle, macrofinancial indicators and startup markets, future studies may examine similar, or possibly more complex relationships, using methodological approaches specifically developed for examining complex causal relationships.

Another avenue for future research exists around downstream effects of startup valuations. Whereas most of this dissertation's studies have focused on modelling and describing the inputs of startup valuations, this dissertation's research has also successfully demonstrated that startup valuation can be used to indicate entrepreneurial disruption, which has measurable industry-level and sector-level socioeconomic impacts. There exist ample grounds along which future studies can examine and investigate the downstream-effects of startup valuations and their dynamics within the wider society and economy.

7. Outline of the Dissertation

This introductory chapter outlines the studies at the core of this dissertation, as well as their individual and novel approaches to startup valuation. Each of these studies addresses key questions surrounding startup valuations, as well as their underlying mechanics and relationship with general economic conditions, beginning with 4.1, the systematic literature review, which examines the field as a whole, in order to attempt construction of a valuation meta-model for startups. Next, 4.2 explicitly links startup valuations to the macroeconomic environment, exploring business cycles and distribution channels. Meanwhile, 4.3 examines the role of international investment in venture capital markets, including both the economic and the legal and institutional sides of this issue. Lastly, 4.4 demonstrates that valuation can also be indicative of economic disruption, and analyzes its possible socioeconomic impact act the sectoral level.

Overall, this dissertation serves as a gateway to ongoing research to broaden the domain of entrepreneurial finance and to provide investors and entrepreneurs with clear and novel insights on the process and causal structure of startup valuations. For practitioners such as venture capital investors, business angels, policy-makers, and entrepreneurs, this collection of research can be deployed directly in the market. For the debate within the literature, this collection of research promises to be a point-of-departure for the expansion and diversification of the entrepreneurial finance field.

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1. Introduction

La valorisation des startups est un domaine qui s'écarte de la théorie économique classique. Fondamentalement, cette thèse se propose d'explorer la valorisation des start-ups, leur architecture et la taxonomie variée des facteurs déterminants qui les influencent.

L'objectif de cette thèse est de comprendre comment sont réalisées les valorisations des start-ups. Bien que la valorisation de l'entreprise soit bien comprise au niveau théorique et expliquée en détail dans la littérature, la valorisation des start-ups demeure un défi dans le domaine de la finance entrepreneuriale. Au regard de leur opacité, leurs courtes histoires et de leurs actifs principalement immatériels, les start-ups sont particulièrement difficiles à valoriser (Damodaran, 2009). Même si les techniques et pratiques de valorisation des start-ups sont connues, l'impact relatif des différents déterminants de valorisation sont relativement peu étudiés et modélisés.

La contribution de cette thèse au développement du débat et des connaissances sur la valorisation des start-ups est multiple. Afin d'intégrer les connaissances préexistantes sur ce sujet, un méta-modèle pour la valorisation des startups est proposé. Ensuite, plusieurs chapitres de cette thèse explorent le rôle des conditions de marché comme les cycles macroéconomiques, le risque sectoriel, la géographie économique et les différences juridiques et institutionnelles entre pays.

1.1. Questions de recherche

L'objectif de cette thèse est d'examiner la façon par laquelle la valorisation des jeunes entreprises émerge, et par quels déterminants celle-ci est influencée. Afin d'y parvenir, cette recherche entend répondre à plusieurs questions. Spécifiquement, les questions qui sont ici examinées pour mieux comprendre la valorisation des start-ups, ainsi que le rôle et l'architecture des structures de causalité qui influencent les valorisations, sont :

- Quel rôle les cycles macroéconomiques et les conditions macroéconomiques du marché jouent-ils dans la détermination des valorisations de start-ups ? Etant donné que les start-ups sont financées par le marché du capital-risque, le marché des start-ups est-il relativement isolé des tendances macroéconomiques générales ?
- Quel rôle les investissements internationaux et transfrontaliers jouent-ils dans la détermination des valorisations de start-ups ? Les différences entre investisseurs, macroéconomiques ou institutionnels, sont-elles déterminantes ?
- Les valorisations des start-ups ont-elles un impact socio-économique au-delà des marchés immédiats des start-ups et du capital-risque ?

1.2 Les Concepts Principales

Au cœur de cette thèse concernant valorisation des start-ups se trouvent plusieurs concepts clés.

1.2.1. La Start-up

Il existe des définitions juridiques des start-ups aux États-Unis ainsi qu'au sein de l'Union Européenne. Aux États-Unis, la définition légale des start-ups est très large et flexible. La législation américaine fait référence aux entreprises de moins de cinq ans, à compter de la date de leur immatriculation juridique. Par ailleurs, la législation européenne décrit les start-ups comme des petites entreprises non cotées en bourse qui existent depuis moins de cinq ans, qui n'ont pas fusionné avec une autre entreprise, qui n'ont pas encore distribué des dividendes et qui n'ont pas été créées à la suite d'une fusion.

1.2.2 La Valorisation

Cumming et Dai (2010) définissent la valorisation des start-ups comme le prix de l'entreprise (ou le prix des actions) payé par les investisseurs en actions pour les investissements en phase de démarrage. Cette définition est spécifique aux valorisations observées dans les investissements en capital-risque, et exclut les événements de sortie comme les fusions ou les introductions en bourse.

1.2.3 Les Déterminants

Les déterminants de valorisation sont les variables observables qui agissent comme des sous-ensembles d'informations influençant la valorisation des startups. Ils vont au-delà du bilan, du compte de résultat et des informations financières de l'entreprise, et comprennent des informations externes, telles que la structure du marché, et des informations et accès privilégiés détenus par les parties prenantes. Alors que le terme « driver » fait référence aux facteurs déterminants de la valorisation et dans la fiance entrepreneuriale, un facteur déterminant en soi est défini par Fama (1970) comme sous-ensemble d'informations tels que des valeurs historiques, des divulgations et des informations privilégiées, qui impactent des valorisations ainsi comme des prix sur les marchés.

2. Cadre Conceptuel

Fondamentalement, la nécessité d'un cadre théorique commun pour une conceptualisation unifiée de la valorisation des start-ups est un besoin identifié dans la littérature sur la finance entrepreneuriale, qui a été décrite à la fois par la littérature théorique (par exemple, Damodaran, 2009), ainsi que par de nombreuses études bibliométriques et revues de littérature systématiques (par exemple, Kohn, 2018, Wessendorf, 2019 ; Colombo et al. 2022). La base théorique de cette recherche s'inspirent par la théorie du management par les ressources, qui décrit le rôle central des facteurs internes à l'entreprise dans le développement des valorisations, comme la technologie et les resources humaines (Wernerfelt, 1984) ou bien le modèle d'affaires (Barney, 1986), ainsi que de la vision basée sur le marché, qui met l'accent sur les facteurs externes du marché et le rôle de la structure de l'industrie dans la détermination de la performance de l'entreprise (Porter, 1990) et, en fin de compte, de la valorisation. Le débat « jockey and horse » décrit par Kaplan et al. (2009) ainsi que par Gompers et al. (2020) est un élément clé de ce point de vue dans les études en finance entrepreneuriale. Les investisseurs parient-ils – et valorisent-ils – plutôt le cavalier, ou sa monture ? L'entrepreneur, ou sa start-up ?

Au-delà du « jockey » et du « cheval », une vision fondée sur le marché, qui décrit la performance de l'entreprise comme résultant de facteurs externes à l'entreprise, se concentre principalement sur les forces du marché au niveau industriel et national, telles que la structure de l'industrie, la dynamique du marché et les forces concurrentielles, est également décrite par la littérature théorique comme hautement déterministe pour les valorisations de start-ups.

2.2. Les Dimensions Clés

Etant donné que la littérature théorique décrit une gamme variée de déterminants de valorisation, il est nécessaire de les organiser afin de mieux comprendre leur influence sur celle-ci.

2.1.1. Les jockeys et chevaux : Facteurs de valorisation

Ce sont les facteurs internes à l'entreprise, que la théorie du management par les ressources décrit comme étant des déterminants clés de l'avantage concurrentiel et de la performance de l'entreprise. En finance entrepreneuriale, ces facteurs sont en mesure de déterminer non seulement les performances, mais aussi la sélection et la valorisation des start-ups (Gompers et al., 2020).

Caractéristiques de l'entrepreneur

Fondamentalement, la littérature décrit que l'équipe entrepreneuriale et ses ressources humaines internes sont parmi les facteurs de valeur les plus importants pour une start-up, influençant à la fois la probabilité de sélection de la start-up par les investisseurs, mais aussi sa valorisation (Kaplan et al. 2009 ; Gompers, 2020).

Caractéristiques de l'entreprise

Les caractéristiques de l'entreprise, telles que les actifs et les indicateurs de performance, sont des intrants dans les modèles de valorisation établis. Ils peuvent être liés à la théorie du management par les ressources qui souligne que les ressources et les capacités internes d'une entreprise sont les moteurs fondamentaux de la valeur économique. En ce qui concerne les facteurs « jockey et cheval » décrits par Kaplan et al. (2009) et Gompers et al. (2020), ils peuvent être considérés comme des facteurs « cheval » et consistent globalement en des indicateurs liés au compte de résultat et bilan, qui expliquent la taille, les ressources et les capacités de production de l'entreprise.

2.1.2. Valeur de l'opération et conditions du marché : Les facteurs externes

Fondamentalement, les conditions du marché consistent en des facteurs de valorisation qui décrivent le contexte de la start-up sur le marché. Ces facteurs, influencés théoriquement par la vision fondée sur le marché, vont des conditions sectorielles aux conditions relatives aux secteurs macroéconomiques dominants (et à leurs indicateurs), au cycle économique et aux conditions relatives aux marchés financiers intermédiaires (par exemple, la taille et la situation du marché du capital-risque). D'un point de vue conceptuel, ces facteurs peuvent avoir des incidences directes et indirectes sur les valorisations sur les marchés des startups. Un niveau de complexité supplémentaire peut être ajouté ici en prenant en considération l'impact des marchés de capitaux nationaux comme internationaux. Dans ce cas, les sources théoriques comprennent non seulement les points de vue macroéconomiques, mais aussi ceux relatifs aux asymétries d'information et aux protections juridiques des investisseurs (La Porta et al. 1998 ; 2002 ; 2006), ainsi que les modèles de gravité (Carrère et al., 2020).

2.1.4. Vers un modèle unifié

Enfin, est-il possible, d'un point de vue conceptuel, d'organiser les facteurs de valorisation examinés dans le cadre de cette thèse en un modèle basé sur la somme, qui inclut les points de vue

de la théorie du management par les ressources et de la vision fondée sur le marché, tout en fournissant une mesure qui est multidimensionnelle par nature afin de minimiser les biais et les erreurs de mesure (Foulquier et al. 2019) ? Le méta-modèle de Berre Le Pendeven, qui incorpore et unifie les éléments du sujet, a été développé dans la revue de littérature systématique et sert de base conceptuelle aux études empiriques subséquentes.

2.2. Contributions

Les contributions de cette thèse peuvent être classées en contributions à la théorie économique et à la théorie en finance entrepreneuriale d'un côté, et en contributions méthodologiques de l'autre. En particulier, chacune des études composant cette thèse est délibérément orientée vers l'élaboration d'une contribution à la fois théorique et méthodologique. Ces contributions répondent à des questions de recherche existantes et à des gaps dans la littérature, telles que la nécessité de relier la finance entrepreneuriale à la théorie au niveau macro (Budhwar et al., 2022), et l'impact des marchés de capitaux transfrontaliers (Bellavitis et al., 2017).

2.2.1. Les contributions théoriques

La revue de littérature systématique réussit à construire et à exprimer une méta-modele de valorisation qui prend la forme fonctionnelle d'un modèle d'agrégation – une forme fonctionnelle caractérisée par la flexibilité de pouvoir être facilement reformé et de pouvoir inclure facilement des facteurs additionnels – qui sert comme base à plusieurs études ultérieures. Ce modèle rassemble les contributions de nombreuses publications dans le domaine de la finance entrepreneuriale.

Ensuite, en réponse à Budhwar et al. (2022), qui décrit la nécessité générale de l'émergence de théorie pour relier la finance entrepreneuriale avec la théorie macroéconomique, cette thèse développe une explication détaillée de la relation directe et indirecte entre les cycles macroéconomiques, les valorisations des start-ups et les variables intermédiaires. Concernant le rôle de l'investissement international en capital-risque, cette thèse répond également à la littérature existante en *droit et finance*, comme La Porta et al. (2006), qui trouve que la régulation financière impacte l'investissement macrofinancier dans différents pays. Cette thèse constate que pour le capital-risque, ce sont plutôt les différences de régulation qui sont pertinentes.

2.2.2. Les contributions méthodologiques

La littérature publiée sur la valorisation des start-ups dans le domaine de la finance entrepreneuriale se caractérise par une diversification méthodologique insuffisante, avec environ 80% des études examinées qui dépendent soit de la modélisation formelle ou bien de l'analyse de régression (c'est-à-dire OLS, logit et probit), et il existe des opportunités notables dans la diversification dapproches méthodologiques.

En particulier, cette thèse cherche à démontrer que la méthodologie inspirée par le codage de style Eisenhardt, qui a influencé la revue systématique de la littérature, ainsi que par la méthodologie du droit et de la finance, par les modèles de gravité, par la modélisation par équations structurelles et par l'apprentissage automatique supervisé ont leur place en finance entrepreneuriale. Chaque approche représente de nouveaux types d'informations qui peuvent être utilisés pour mieux comprendre le marché des start-ups.

3. Méthodologies

Dans l'ensemble, cette thèse met l'accent sur la diversité des approches méthodologiques utilisées pour la valorisation des start-ups. Ceci est fait délibérément, en réponse au manque de diversification méthodologique dans cette discipline qui a été identifié dans la revue systématique de littérature présente dans cette thèse. Fondamentalement, ce manque de diversification représente une limite de taille dans la littérature existante en finance entrepreneuriale, étant donné que différentes approches méthodologiques rendent possibles des résultats nouveaux et différents parce qu'elles examinent les données existantes de différentes manières.

3.1 La base des données des start-ups et leurs investissements

Afin de réaliser des études quantitatives empiriques, un dataset composé de 1 089 investissements européens en capital-risque a été construit, contenant des données provenant de différentes sources sur les caractéristiques des entreprises, les entrepreneurs, les investisseurs et les conditions de marché. L'ambition est de tester le méta-modèle au moyen de plusieurs études empiriques, qui vont des études macroéconomiques sur le capital-risque aux études sur les caractéristiques des entrepreneurs, ainsi qu'aux études micro-ciblées sur le marché du capital-risque dans l'Union européenne (UE) et l'Espace économique européen (EEE) entre 2000 et 2020. Grâce à cette base de données, de nombreuses études explorant les contours et les détails de la valorisation des startups ont été possibles.

3.2 Un portefeuille des approches

Globalement, les études qui examinent la valorisation des start-ups dépendent d'un ensemble de méthodologies assez limité. Berre et Le Pendeven (2022) expliquent que 60% des études sur la valorisation des start-ups reposent sur l'analyse de régression (Logit, Probit et OLS). De plus, 20% des études académiques sont des contributions théoriques. Du point de vue de la recherche académique, ce manque de diversification méthodologique dans la littérature présente une opportunité notable. En réponse à cela, cette thèse présente une collection d'études qui utilisent une variété d'approches méthodologiques. Par exemple, la revue systématique de littérature utilise un codage thématique à travers les sources de littérature, conduisant à la construction de tableaux démontrant les associations entre les facteurs déterministes et les valorisations, ce qui rend possible la construction d'un méta-modèle de la valorisation des start-ups. C'est une approche qui s'inspire non seulement de Tranfield et al. (2003), mais aussi de Eisenhardt et Graebner (2007). Les études suivantes de cette thèse approchent la question de la valorisation des start-ups en utilisant la modélisation d'équations structurelles, les modèles de gravité, la méthodologie en droit et finance, et le machine learning supervisé. Chacune présente nouvelles perspectives et connaissances concernant valorisation des start-ups, ce qui permet un approfondissement des questions de recherche.

4. Études empiriques sur la valorisation

Afin de mieux comprendre les dimensions ainsi que les détails des différents facteurs déterminants qui influencent la valorisation des start-ups, cette thèse inclut plusieurs études qui explorent la valorisation des start-ups, ainsi que les causalités et leurs structures architecturales. Chacune de ces études examine au moins un aspect spécifique de la valorisation des start-ups.

4.1 What do we know about startup-valuation drivers? A systematic literature review :

Cette revue de littérature systématique examine 87 publications académiques entre 1985 et 2020. L'étude analyse ces publications en détail et identifie 36 facteurs de valorisation des start-ups et les regroupe en cinq macro-thèmes. De plus, les facteurs identifiés dans la littérature nous donnent un méta-modèle intégratif basé sur les macro-thèmes, positionnés chronologiquement dans le processus valorisation.

4.2 Business-cycles and Cash-on-Market: Pre-money Startup Valuation in the Macroeconomic Environment:

Cette étude macroéconomique et quantitative étudie l'impact des cycles macroéconomiques ainsi que des indicateurs macroéconomiques sur la valorisation des start-ups. La contribution théorique de cette étude est principalement la description des canaux de distribution par lesquels les cycles macroéconomiques influencent les marchés des start-ups et les valorisations des start-ups.

4.3 Cross-Border Venture Capital Valuation: Business-Cycle, Institutional Factors, and Distance:

Cette étude présente une analyse quantitative internationale de la valorisation des startups. Elle porte sur l'impact des différences macroéconomiques, institutionnelles et cycliques entre les marchés domestiques des start-ups et les marchés domestiques des investisseurs de capital-risque sur la valorisation des start-ups. Elle détermine que les différences relatives de gouvernance jouent le rôle le plus important dans la valorisation. Les résultats montrent principalement que les différences internationales sont importantes pour la valorisation des start-ups. La contribution de cette étude est de relier la finance entrepreneuriale à la littérature sur la finance internationale.

4.4 Can Startups Disrupt the Gender Pay Gap? Can they Disrupt Economic Exclusion? A Two-Tiered Approach :

Cette étude démontre pourquoi la valorisation des start-ups est pertinente au-delà des cercles immédiats d'entrepreneuriat et du capital-risque. Contrairement aux études précédentes, cette étude ne porte pas sur les moteurs de la valorisation des start-ups, mais sur l'un de ses impacts sociaux possibles. Autrement dit, cette étude explore les conséquences plutôt que les causes de la valorisation des entreprises en phase de démarrage. Les résultats indiquent que les variables dépendantes (l'écart salarial et la concentration des « insiders ») ainsi que l'impact de la disruption entrepreneuriale sur ces variables fluctuent en fonction du cycle macroéconomique.

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CHAPTER 1:

What do we know about startup-valuation drivers? A systematic literature review[3]

Max Berre[4], Benjamin Le Pendeven[5]

ABSTRACT

Startup-valuation is a critical area of research within entrepreneurial finance, but research on this topic is less consistent and thorough than overall valuation research. Peer-reviewed studies express a range of divergent views and approaches, and the focus varies widely. To bring clarity to this fragmented field, we conduct a systematic literature review, examining 87 peer-reviewed studies published between 1985 and 2020. We analyze these publications in detail and identify 36 startup-valuation drivers and cluster them into five macro-themes: Entrepreneur Characteristics; Firm Characteristics; Investor Characteristics; Market Conditions; and Deal Conditions. *We then describe the valuation-impact of these drivers on startups.* The range of drivers identified in the literature gives rise to construction of an integrative meta-model based on the macro-themes, placed into appropriate chronological position in the valuation process *Our study also identifies key research-gaps and highlights promising directions for exploring the startup-valuation field.*

Keywords Valuation, Startup, Systematic Literature Review, Venture Capital, Entrepreneurial Finance

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1. Introduction

Extreme startup-valuations make headlines. Consequently, startup-valuation has become a topic-of-interest in entrepreneurial-finance literature and the startup-ecosystem. Located at the heart of discussion between among early-stage investors, startup-valuation symbolizes negotiation-power of parties to startup equity transactions. Its evolution reflects trends in relations between valuation-drivers. In doing so, startup-valuation is crucial not only at micro-level for entrepreneurs and equity-investors, but also at macro-level for policy-makers and professional-associations. In this respect, Grind (2015), for example, points-out that the US Securities and Exchange Commission recently became interested in valuation-practices applied to startups.

Given opacity, short histories, and array of intangible assets, startups are notoriously difficult to value, as outlined by Damodaran (2009). Over the past thirty years, scholars have been attempting to "open the black box" and formalize valuation-drivers of startups. While overall published knowledge is sparse and dispersed across several academic fields, Bellavitis et al. (2017) concur on the importance of focusing on startup-valuations as a key avenue of research, outlining that a number of emergent theoretical perspectives are related to new research questions, which include valuation-impacts driven by the mix of different investors. Overall, potential synergies between potentially competing sources of funding can lead to higher valuations, driving the emergence of unicorns.

The Wall Street Journal reported that there were 45 unicorn companies (i.e., with valuation above $1 billion) in 2014. By September 2016, the figure was 150. By January 2020, TechCrunch reported 558 unicorns with combined valuation of $1.9 trillion. This dramatic growth explains why startup-valuation has become a much-debated topic. Moreover, valuation trends during recent events, have shown the importance of understanding startup-valuations and their drivers.

To understand the debate surrounding this topic, we undertook a Systematic Literature Review (SLR). We examine the role and impact of various valuation-drivers and provide coherent overview of the current state-of-the-art of peer-reviewed research.

Given the interest shown by industry-practitioners and the academic debate on the topic, this literature review caters to many practical and theoretical needs. To this end, we examined 87 peer-reviewed contributions on startup-valuation published between 1985 and 2020.

This study contributes to the advancement of research in several ways. First, we analyze development of the literature, identifying thematic-trends and valuation-drivers. Second, we highlight research-themes, exploring their implications. Third, this study not only examines peer-reviewed literature on startup-valuation, but also develop a bespoke model to describe the process by which valuation emerges, and which drivers play deterministic roles throughout various stages. Fourth, we identify under-reported valuation-drivers and prominent research-gaps.

The rest of this study is organized as follows: Section 2 describes the papers examined, as well as search and selection methodology. Section 3 analyzes publication-trends on the topic and conveys our findings. Section 4 provides discussion about primary gaps and under-researched topics. Section 5 concludes and highlights a number of research avenues.

2. Method

2.1. The systematic literature approach

This study maps knowledge about startup-valuations, identifies gaps in existing research, analyzes trends in peer-reviewed and provides deeper understanding of what we know about startup-valuation drivers. To this end, we employ systematic literature review methodology.

Tranfield, Denyer and Smart (2003) explain that systematic literature reviews feature transparent, replicable process; this aims to minimize bias by means of exhaustive searches of published and unpublished literature, and by providing an audit-trail of procedures and conclusions. Indeed, a systematic review of content, quality, and diversity of sources of startup-valuation literature can detect divergences, as well as gaps in published literature. Along lines of Mochkabadi and Volkmann (2018), this study provides clear overview of literature development and emerging themes. applying an SLR variant that bases literature-exploration on content-based publication evaluation. Furthermore, we employ thematic coding across our literature

sources, leading to the construction of tables demonstrating associations between the drivers and startup-valuations, making possible the construction of a grounded theory meta-model to grant wholistic insight on startup valuation

2.2. Key concepts

Legal descriptions of startups exist in both the US and EU. While the US Startup Act references firms younger than five years, Art. 22(2) of EU Commission Regulation No. 651/2014 describes startups as unlisted small-enterprises that have existed for less than five years, have not taken-over activity of another firm, have not yet distributed profits, and were not formed as result of merger.

Inspired by Cumming and Dai (2010), we define startup-valuation as: the startup-price (or price-of-shares) paid by equity-investors for early-stage investment. Our definition is specific to valuations observed in VC deals and excludes exit-events such as trade-sales or IPOs, which cannot be considered to belong to the firm's emerging phase.

Valuation drivers are the measurable variables that act as information-subsets to influence startup-valuation. This goes beyond a firm's balance sheet, income statement, and financial disclosures, including both external information, such as market structure, and privileged information and access held by stakeholders. Whereas Fama (1970) described prices as reflecting information-subsets ranging from historical-values to disclosures and privileged-information, this study renames these subsets *valuation-drivers* for purposes of startup and entrepreneurial-finance markets.

2.3. Keywords and sources

2.3.1 Theme-clustered search-keywords

The initial literature-search focused on keywords relevant to startup-valuation , venture capital, and price. Keywords were tested for unique-results, the first twenty papers identified by a Google Scholar search using the term "startup-valuation drivers" and close synonyms of these words. To minimize redundancy, search-

keywords with three unique-results were retained.[6] Table 1 displays search-keywords for literature on startup-valuation in seven languages. It was decided to conduct multilingual searches owing to potential added-value of research published in these languages.

Table 1 Theme-clustered keywords in alphabetical-order

ENGLISH	DUTCH	FRENCH	GERMAN	ITALIAN	PORTUGESE	SPANISH
"Start-up" valu*	Waard* "start-up"	Valoris* "start-up"	Bewertung "start-up"	Valuta* "start-up*" Valor* "start-up"	val* "empresa emergente"	val* "empresa emergente"
"Start-up" price	Prijs "start-up*"	Prix "start-up"	Preisgestaltung "start-up*"	Prezzo "start-up" Valore "start-up"	Preço "empresa emergente"	Precio "empresa emergente"
"Start-up" valuation	Waarderen "start-up", Waardebepaling "start-up"	Valorisation "start-up"	Bewertung "start-up"	Valutazione "start-up", valorizzazione start-up,	Valorização"empresa emergente"	Valuación "empresa emergente"
"Young Venture" valuation	Waarderen "jonge bedrij*", Waardebepaling "jonge bedrij*"	Valorisation "jeune entreprise"	Bewertung Jungunternehmen	Valutazione di giovane impresa, valorizzazione giovane impresa,	Valorização"jovem empresa"	Valuación "joven empresa"
"Venture Capital" valu*	Waard* durfkapitaal, Waard* risicokapitaal,	Valoris* "Capitale risque"	Bewertung risikokapital Bewertung Venture Capital	Valuta* di capitale di rischio Valorize* capitale di rischio	Val* "capital de risco", Val* de "capital empreendedor"	Val* de "capital riesgo" Val* de "capital emprendedor"
"Venture Capital" price	Prijs durfkapitaal Prijs risicokapitaal	Valeur "capital risque"	Risikokapitalfinanzierung Preis	Prezzo "capitale di rischio" Valore "capitale di rischio"	Preço "capital de risco" Preço "capital empreendedor"	Precio "capital riesgo" Precio de "capital emprendedor"
"Venture Capital" valuation	Waarderen durfkapitaal Waarderen risicokapitaal	Valorisation "Capitale risque"	Bewertung risikokapital	Valutazione "capitale di rischio"	Valorização"capital de risco" Valorização "capital empreendedor"	Valuación "capital riesgo" Valuación "capital emprendedor"

These search-strings were used to explore peer-reviewed on 31 March 2019 and on 01 December 2021.

2.3.2 Databases searched for peer-reviewed studies

This study uses several sources to ensure comprehensive-coverage of peer-reviewed literature, including both web-based sources and academic databases. The primary academic databases were EBSCO and Web of Science. Choice of these databases is consistent with SLR best-practices in the fields entrepreneurship

[6] The search-keywords not retained are: Startup Price, Young Venture Valu*, Young Venture Price, SME Valu*, SME Price, and SME Valuation.

and small-business-management (see Köhn (2018)), and finance (see Mochkabadi and Volkmann, 2018). Both executed their search via two separate peer-review aggregator-databases, consisting of EBSCO and a secondary-database. Our second database was Web of Science, which is also used by entrepreneurship studies, such as Champenois et al. (2020) and Aliaga-Isla and Rialp (2013).

Google Scholar was employed as a complement to secure studies identified, but not accessible via academic library-sources. According to Mochkabadi and Volkmann (2018), Google Scholar provides coverage of non-English publications and unpublished-contributions.

2.3.3 Journal ranking systems

Field-specific journal-rankings as presented by the Chartered Association of Business Schools (ABS) act as a lens through which to examine peer-reviewed studies. The decision to limit scope through quality criteria—articles published in ABS-ranked journals are peer-reviewed prior to publication—is consistent with SLR protocol-guides, principally Tranfield et al. (2003), as well as examples of published SLR-papers such as Champenois et al. (2020).

2.4. Search methods

Peer-reviewed contributions for 1990-to-2020 were drawn from academic databases and publicly-available resources. Additionally, snowball-tracking as per Horsley et al. (2011) was done for each generation of literature-search. Quality was assured by filtering for journal-relevance, journal-rating, and topical-relevance as per our selection-criteria.

2.5. Selection criteria

As suggested in the SLR protocol guidelines, inclusion criteria and exclusion criteria were applied to search results in the academic-papers database.

2.5.1 Inclusion Criteria

1) The study was published in an ABS-ranked peer-reviewed business and/or economics journal, ranging from the oldest of the database's sources to 2019.

2) Additionally, the study used at least one of the search-keywords in the title, abstract or listed keywords.

3) Book chapters that included the keywords as their primary focus examined for inclusion.

4) Sources using several keywords received first attention and priority.

2.5.2 Exclusion Criteria

1) Papers in peer-reviewed journals that were either book reviews or editorials were not considered primary sources and were excluded in order to focus on scientific papers.

2) Papers published in journals that are not ABS-ranked were excluded.

3) Master's theses were excluded. These might not constitute original-research.

4) Papers whose research field was not entrepreneurial finance were excluded in order to focus specifically on the topic of this study.

5) Papers in English, French, Spanish, German, Portuguese, Italian, or Dutch, considered.

6) Duplicate articles were removed in favor of the most-recently published version.

7) Papers dealing with valuation-techniques (which are of peripheral interest to this study) but not with valuation drivers were excluded.

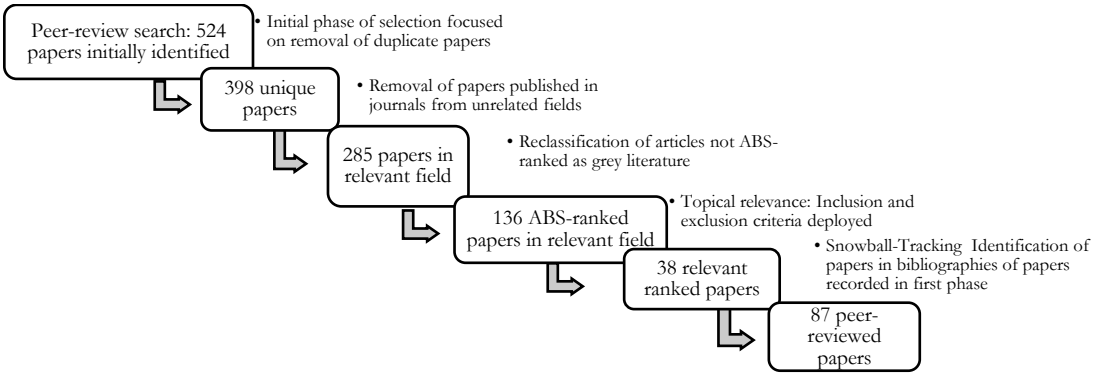
The first-phase consisted of recording papers meeting the inclusion-criteria. Secondary-screening consisted of assessing entrepreneurial-finance relevance.

2.5.3 Selection and snowball-tracking

Initially, 524 peer-reviewed papers were identified. To include both foundational papers and recent research, a thirty-year time-horizon (1990-2020) was used. The first two selection-phases focused on removal of duplicate-papers and papers published in unrelated fields.

The next phase identified relevant papers cited in bibliographies of papers identified in the first phase. Extra attention was given to papers cited by several studies already included under our criteria. The selection-process yielded 87 peer-reviewed studies.

Fig. 1 Selection of peer-reviewed literature



This result was reached after several phases of search-and-examination of peer-reviewed literature, as outlined in Figure 1. Of 524 identified papers, three-fourths survived elimination of duplicates; of these, only one-third had been published in topically-relevant ABS-ranked journals. Nearly half ultimately survived the remaining selection-criteria. Subsequently, 40 papers identified by snowball-tracking were excluded because their focus was on divergent topics, such as: startup-selection, investment-round-determination, or contract-determination. Lastly, a few highly relevant academic working papers discovered to have peer-reviewed iterations were included.

3. Results

The production of literature about startup-valuation is presented and explained in the first part of this section. Subsequently, an overview of drivers describes the extent to which drivers identified are heterogeneous. For each category that emerged from thematic coding, we explain the driver's valuation-impact. Finally, we develop a unified meta-model demonstrating the multi-step mechanics of the valuation process.

3.1. Themes and drivers of startup-valuation in literature

3.1.1 Journals of publication

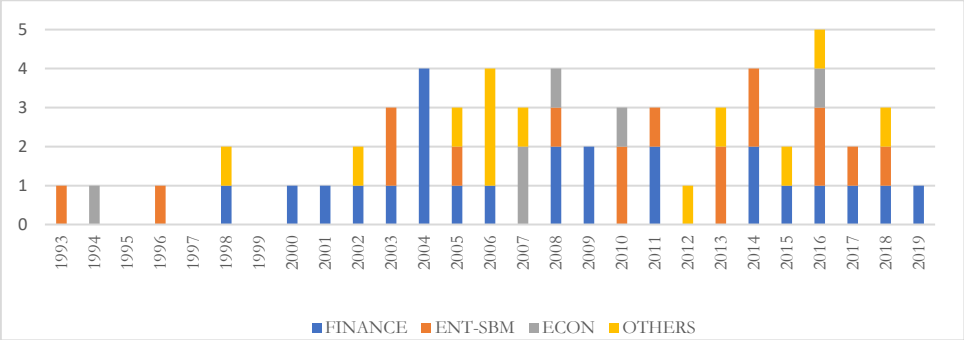
Table 2 outlines the top-eight journals in which selection-criteria-meeting publications appear. 50 of the peer-reviewed papers are drawn from these. In terms of publication field, the journals either deal with small business and entrepreneurship or with finance.

Table 2 Top-eight journals publishing research on startup-valuation

Journal	Field	No. of Papers	Share of Total
Journal of Business Venturing	ENT-SBM	16	17.8%
Journal of Financial Economics	FINANCE	11	12.2%
Venture Capital	ENT-SBM	5	5.6%
Review of Financial Studies	FINANCE	4	4.4%
Journal of Finance	FINANCE	4	4.4%
Journal of Financial Intermediation	FINANCE	4	4.4%
Small Business Economics	ENT-SBM	3	3.3%
Entrepreneurship Theory and Practice	ENT-SBM	3	3.3%
TOTAL		50	55.6%

Figure 2 outlines evolution of peer-reviewed papers. Most were published in Finance, which saw the fastest growth. This is followed by Entrepreneurship-Small Business Management, which experienced a post-2003 publication-boom, after the dotcom-bubble. Economics, meanwhile, saw fast 2006-2009 publication-growth. The oldest paper to survive the selection process dates to 1993. During some years, no studies survived the selection process.

Fig. 2 ABS publication-fields in which startup-valuation research appears



3.1.2 Thematic coding

Following selection, double-reading of abstracts was undertaken to identify key-themes. After via inductive-search, we classify startup-valuation-drivers along thematic-lines. Table 3 outlines the resulting classification: Drivers are categorized as specific to entrepreneur, firm, investor, or external environment. Five themes were identified: *Entrepreneur Characteristics*; *Firm Characteristics*; *Investor Characteristics*; *Market Conditions*; and *Deal*

Conditions. This approach is similar to Hand (2005), who segments valuation-drivers into financial and non-financial, while Sievers et al. (2013) segment drivers into financial, non-financial, and deal-conditions.

Table 3 Thematic classification of 36 startup-valuation drivers

Entrepreneur Characteristics	Firm Characteristics	Investor Characteristics	Market Conditions	Deal Conditions
Entrepreneur- gender	Assets - IP	Nature of the investor	Macro-Economic situation	Syndication and Investor Competition
Entrepreneur- experience	Assets - others	Quantity of cash under management	Sectorial economic situation	Shareholder's agreement clauses
Entrepreneur - education	Performance - sales	Investor's nationality	Quantity of cash on the VC market	Funding Round
Entrepreneur - background other	Performance - EBIT and EBITDA	Investor's reputation	Business Cyde	Timing of the deal
	Performance - others	Investor's history/exp	Agency Costs and Asymmetric Information	Duration of the deal
	Impact of the country	Potential other interest (corporate relation, etc.)		Preference shares in the deal?
-	Impact of the sector	Investment strategy		Other mechanisms for investor's protection ROI
	Impact of the business-model	Sector Specialization of VC		Exit expectations and strategies
	Stage of the start-up			
	Complementarity and Business Alliances			

3.1.3 Methodologies and authors

Figure 3 examines methodologies used in peer-reviewed contributions. We classified methodologies into: qualitative case study; literature review/meta-study; narrative, qualitative non case-study; regression analysis; survey/questionnaire; and theoretical.

Overall, studies relying on "regression analysis", which we used to label papers whose methodology depends primarily on OLS, logit, or probit regressions, and whose dataset does not come from surveys or questionnaires, constitute nearly two-thirds of selected peer-reviewed literature. This is followed by "theoretical contributions", which establish formal theoretical models to describe valuation. These papers constitute one-fifth of the total, while a small minority are either case-studies or qualitative studies.

Fig. 3 Methodologies used in peer-reviewed literature

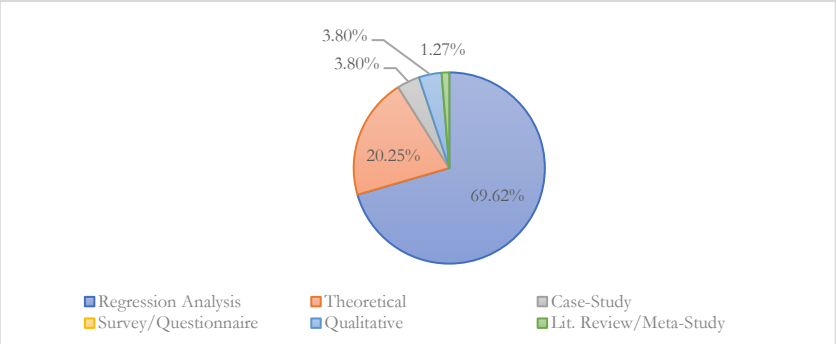


Table 4 Methodologies in peer-reviewed literature

Methodology	Studies	Share of total
Regression Analysis	55	69.62%
Theoretical	16	20.25%
Case-Study	3	3.80%
Survey/Questionnaire	0	0.00%
Qualitative	3	3.80%
Lit. Review/Meta-Study	1	1.27%

Figure 4 outlines countries in which peer-reviewed authors (and their institutions) are based.

Fig. 4 Countries of author affiliation

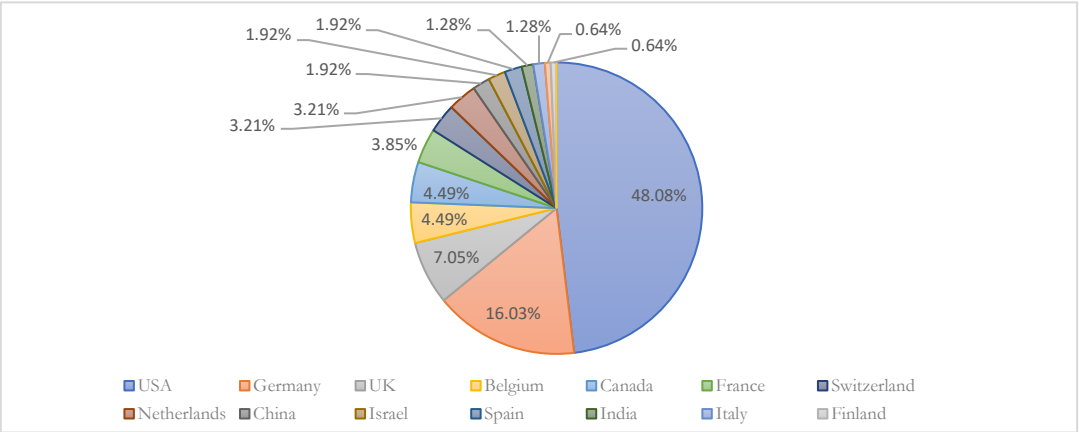


Table 5 Author-affiliations

Author's country affiliation	Number of studies	Share of total
USA	75	48.08%
Germany	25	16.03%
UK	11	7.05%
Belgium	7	4.49%
Canada	7	4.49%
France	6	3.85%
Switzerland	5	3.21%
Netherlands	5	3.21%
China	3	1.92%
Israel	3	1.92%
Spain	3	1.92%

The US is the most prolific source of peer-reviewed literature. Following the US are Germany and UK, where 16.03% and 7.05% of authors are based.

3.2. Entrepreneur characteristics

Entrepreneur Characteristics consist of four drivers: Gender, Experience, Education, and Other Entrepreneur Background. Inclusion of these is driven by input-based valuation approaches, which explicitly include entrepreneurial human-resources as a valuation-driver.

3.2.1 Entrepreneur gender

Two peer-reviewed papers explore gender's valuation-impact. Poczter and Shapsis (2011), the most-cited study, finds that female entrepreneur-teams receive less capital and provide more equity, even when controlling for determinants of investment such as industry and prior company success. Other studies, such as Murnieks et al. (2016), who control for Gender, either do not find substantial value-impact or find impact to be very mild.

3.2.2 Entrepreneur experience

Relevant entrepreneur-experience has positive valuation-impact. Sievers et al. (2012) consider founder-team experience—both prior startup-experience and prior management-experience—to be a primary non-financial valuation-driver. Miloud and Cabrol (2011), who explore industry-experience, entrepreneurial-experience, and managerial-experience, explain that experience consists of both quantitative and qualitative dimensions.

In Miloud and Cabrol's input-driven model, industry-experience, entrepreneurial-experience, and management-experience impact valuation differently, with management-experience having the largest coefficient. Hsu (2007) also attributes experience-related valuation-divergences to founder-experience: Experienced entrepreneurs are better at negotiating and can raise equity-funds with higher valuation. Chatterji et al (2009) examine medical-device-industry startups and also find that incumbent-firm entrepreneur-experience leads to higher valuation in the last round of private-financing. Additionally, Yoo

et al. (2012) find that entrepreneur expertise also positively impacts startup-valuation. A prominent dissenting view is Gompers et al. (2010), who outline that serial-entrepreneurs do not benefit from higher valuations for their new startups.

In further nuance, Zacharakis and Shepard (2005), argue that VCs value entrepreneurial-experience in complement to other valuation-drivers, such as leadership-experience, proprietary technology, and market familiarity. The greater an entrepreneur's previous startup-experience, the less important their general leadership-experience. While human-capital inputs behave as complements, the specific type of human-capital input plays a role in the importance given by venture capital firms to entrepreneurs. This view is reinforced by Siegel et al (1993), who stress the role of a manager's industry-experience and by Hsu (2007), who outlines that entrepreneurs without prior founding-experience may have difficulty regarding both *actual* and *perceived* new venture development-ability. This undermines valuation.

3.2.3 Entrepreneur education

Concerning education, Hsu (2007) finds that impacts of education on VC-valuations are specific to the internet industry, while divergences exist between managerial educational backgrounds on one hand, and technical or scientific backgrounds on the other. In emerging-industry contexts, the signal-value of PhD-holders is important in attracting the attention of VCs (and receiving a better pre-money valuation), whereas MBA-holders invest more into developing ties with the VC community at large. Other studies find that educational-effects are industry-specific. Miloud and Cabrol (2011) explore impacts of industry-expertise on pre-money valuation. The literature indicates that scale of human-capital valuation-impacts depend on specialization.

An alternate view, Pollock et al. (2010), outline that education and experience have prestige-signaling effects. Studies point to differences between education-types, suggesting elite-education (Pollock et al. 2010) or specialized-education, such as PhD or MBA training (Hsu 2007), as the value-adding factor.

3.2.4 Other entrepreneur-characteristics

This parameter consists of drivers ranging from easy-to-measure size and entrepreneur team-completeness, to intangible drivers, such as organizational and social capital, tenacity, motivation, and willingness-to-take-risks. Some of these interact with other drivers, as shown by Franke et al. (2008), where age, education, mutual-acquaintance, and experience are more appreciated by experienced VC investors. Subjective entrepreneurial qualities, such as strong ties, outlined by Batjargal and Liu (2004), or perceived tenacity and perseverance, outlined by Murnieks et al. (2016), also have positive valuation-impacts. Entrepreneur cultural-background can also impact valuation. Bengtsson and Hsu (2015) find that cultural similarities between investors and entrepreneurs in the US lead to higher valuations.

Several studies outline that more-complete entrepreneurial founder-teams lead to higher valuations. Miloud and Cabrol (2011) and Wasserman (2016) indicate this explicitly.

Table 6 describes valuation-impacts of Experience, Education, and Other Entrepreneur-Characteristics as positive. The latter is the most-positive driver. While no studies communicate neutral or negative-findings, interactive-effects are also present. Valuation-impact of gender is neutral. Studies that explore this driver find neutral or mild impact.

Table 6 Entrepreneur characteristics

Author	Year	Entrepreneur-gender	Entrepreneur-experience	Entrepreneur - education	Entrepreneur - background other
Batjargal, B.; Liu, M.	2004				P
Berk, J. B.; Green, R. C.; Naik, V.	2004		P		
Chatterji, A. K.	1998		Neut		P
Colombelli, A.	2010		Neut	Neut	P
Cumming, D. J.	2008				P
Davila, A.; Foster, G.; Jia, Ning	2015		Control, Neutral		
Dhochak, M.; Doliya, P.	2000		P		P
Dittmann, I.; Maug, E.; Kemper, J.	2004		P		P
Franke, N.; G., M.; Harhoff, D.; Henkel, J.	2008		P	P	Interactive
Gompers, P.; Gornall, W.; Kaplan, S. N.; Strebulaev, I. A.	2020		P		
Gompers, P.; Lerner, J.	2013				
Greenberg, G.	2013		Neut		
Hsu, D. H.	2007		MP	P	P
Lall, S. A.; Chen, L.; Davidson, A.	2019				P
Manigart, S.; De Waele, K.; Wright, M.; Robbie, K.; Desbrieres, P.; Sapienza, H.; Beekman, A.	2000		P	P	
Manigart, S.; Wright, M.; Robbie, K.; Desbrières, P.; De Waele, K.	1997		P	P	P
Miloud, T.; Cabrol, M.	2011		P	P	Interactive, P
Munieks, C. Y.; Cardon, M. S.; Sudek, RR; White, T. D.; Brooks, W.T.	2016	Control, Neut			P
Pintado, T.R.; de Lema, D. G. P.; Van Auken, H.	2007		P		MP
Poczter, S.; Shapsis, M.	2018	N		Neut	
Pollock, T. G.; Chen, G.; Jackson, E. M.; Hambrick, D. C.	2010		P	P	P
Siegel, R.; Siegel, E.; MacMillan, I. C.	1993		VP		P
Sievers, S.; Mokwa, C. F.; Keienburg, G.	2013		P		P
Tyebjee, T. T.; Bruno, A.V.	1984	P	P		
Yoo, C.; Yang, D.; Kim, H.; Heo, E.	2012		P		P
Zacharakis, A.; Shepherd, D. A.	2005		VP, Interactive		
Zhang, J.	2011		P		
Totals: Peer-review literature		2	21	9	17
Summarized Driver Direction in Model		=	+	+	++

Legend: P = Positive; MP = Mildly-Positive; VP = Very Positive; N = Negative; MN = Mildly-Negative; VN = Very Negative; NC= Not Clear; Neut. = Neutral or Non-significant

3.3. Firm characteristics

Firm characteristics, such as assets and performance-indicators are inputs in established valuation-models. We coded ten *Firm Characteristics*, more drivers than any other thematic-category. This is due to popularity of classical valuation-models (and variations thereof). *Firm Characteristics* consists of: Intellectual Property and Intangible Assets; Other Assets; Performance—Sales and Revenue; Performance—EBIT and EBITDA; Performance—Other Performance Metrics; Country; Sector; Business-model; Stage of startup; and, Complementarity and Business Alliances.

3.3.1 Intangible assets and intellectual property

Intangible assets and intellectual property, which proxy knowledge-generation-capability, are among the most-salient firm-characteristics. Baum and Silverman (2017), Hoenen et al. (2014), and Czarnitzki et al.

(2016) find that number of patents and patent-applications drives valuations. This emerges regardless of patent-value, as also demonstrated by Greenberg (2013). A divergent-view is Hand (2005): In biotech-startups, round-by-round value-relevance of patents is low.

An important aspect of IP-related assets is asset-complementarity (including with IP-assets). Zhou et al. (2016) find that patents and trademarks not only have direct-effects on VC-financing, but also synergetic-effects. Meanwhile, trademarks signal market-access and marketing-capabilities— thus increasing VC-funding—but both acting in-unison have positive valuation-synergies.

3.3.2 Financial information: sales, EBIT, EBITDA and management control systems

While EBIT and sales are Discounted-Cash-Flow (DCF) model-inputs, Manigart et al. (2000) outlines that EBIT and earnings are scaling-denominators used in relative valuation. Sievers et al. (2013) find both revenues and cash to have positive valuation-impact, pointing explicitly to relative-valuation approaches. Similarly, Wright and Robbie (1996), Hand (2005), and Smith and Cordina (2014) find financial-statement performance-measures increasingly-impactful as startups mature.

Conversely, Davila and Foster (2005), find that explanatory-power of firm-size outweighs that of revenue. Administrative-expenses also undermine valuation (Armstrong et al., 2005). Management control systems have positive valuation-impact, according to Davila et al. (2003, 2015), who highlight that valuation is especially impacted in highly-competitive or high-growth environments.

3.3.3 Country and sector

Country and Sector impacts are captured in relative-valuation models. Gompers and Lerner (2000) find that valuations are higher in computer hardware, communications, medical, and semiconductor industries, as well as in key geographic regions of the US. Meanwhile, Gompers et al. (2018) argue that while team is important to startup success, technology, business model, and industry also play an important role. Dealing with both country-impact and sector-impact, Helmann and Thiele (2015), identify explicitly both cross-country and cross-sector differences in legal investor-protections. In equilibrium, lower investor-protection

would lead—theoretically—to a thinner angel-market, lower valuations, and therefore less entrepreneurial-entry.

The legal view is reinforced by Kaplan et al (2007), who find that pre-money startup-valuations vary across legal regimes; weaker outside investor-protection leads to smaller and less-liquid capital-markets, more concentrated corporate-ownership, lower corporate-dividends, and lower valuations.

Keuschnigg and Nielsen (2004), explore how capital-gains taxes and subsidies to startup costs affect venture capital-backed entrepreneurship. Because venture-returns determine incentives to found firms and add value in the startup-phase, tax-levels negatively-impact startup-valuation even if only collected from mature firms.

Another way Country impacts startup-valuation is via local-preferences in valuation-approaches, (Lockett et al. 2002, Manigart et al. 2000). For example, late-stage UK investors emphasize P/E multiples, while late-stage French investors place emphasis on third-party bids or on book-values (Manigart et al. 2000). Meanwhile, Wright et al. (2004) find DCF-valuation more prominent in German civil-law jurisdictions than common-law jurisdictions. Popularity of DCF-valuation is also expressed by Dittmann et al. in Germany, Pintado et al. (2007) in Spain, Sander and Koomagi (2007) in Estonia, and Karsai et al. (1997) and (1998) in Hungary and Poland.

Manigart et al. (1997) discuss national-level investor-focus on different information-sources, with French VCs placing emphasis on personal-references and entrepreneur track-record, while Belgian, British, and Dutch VCs attach more weight to their due-diligence reports.

Additionally, these can interact with and complement other valuation-drivers. For example, Zheng et al. (2010), who find sector-coefficient largest in the biotechnology-sector's protein-engineering segment, also describe sector-specific human-capital (i.e., human-capital that interacts with sector and industry-effects to drive firm-value).

3.3.4 Stage of startup and product development

Hsu (2004) points out that early-stage investors weigh heavily in determining subsequent-investors (via referrals or reputation), which positively impacts valuation directly and also via network-access and

coaching, indirectly impacting valuation. Zheng et al. (2010) examine relative temporal-impact of innovative-capability and inter-firm network, finding that the positive-effect of network-status diminishes as firms mature, an interactive valuation-impact.

Yoo et al. (2012) outline that product-development-stages have valuation-impact. Stage of Startup has positive valuation-impact, owing to lower information-asymmetries and discount-factors, innovative-capability-sensitivity and inter-firm network fades as firms mature.

3.3.5 Business model

Issues covered include product-diversity: Streletzki and Schulte (2013), control-for and find mildly-positive non-significant effects. Siegel et al (1993) find that high-growth firms are characterized as more-likely to have diversification-plans. Another issue is B2B vs. B2C focus, which is controlled-for by Rohm et al. (2018), while innovation-strategy is explored by Schwienbacher (2008), whose model describes valuation driven by profit-maximization-effects of innovation-level-choice.

3.3.6 Complementarity and strategic alliances

Firm-level complementarity between firm and acquirer/investor drives both idiosyncratic valuation and investor-firm relations. Complementarity is a factor when acquirer/investor strategy and synergy-potential are considered. Literature exploring the corporate-venture-capital (CVC) landscape often elaborates on complementarity in CVC-selection and CVC-valuation. According to Chemmanur et al. (2014), CVCs pursue strategic-objectives of parent-companies and their fund managers' compensation is tied to parent-company performance (providing incentive for CVCs to select highly-complementary startups, which positively-impact valuation). According to Masulis and Nahata (2009), complementary CVC investors have substantial strategic-incentives to provide active support, since CVCs are not only concerned with a startup's share-valuation, but also with parent-company-impact. This drives startup-growth and accelerates valuation-development-rate.

Chemmanur et al. (2014) support the idea that synergies play positive roles in CVC valuation. Startups enjoying technological-synergies with a CVC's parent-firm generate more patents than independent venture

capital (IVC)-backed firms. These findings are reinforced by Rohm et al. (2018), who find that CVCs with strategic-motivations can help investees aggressively-scale by providing complementary-assets for startups. In exchange, investee startups are prepared to accept valuation-discounts. Potential value-enrichment from complementary-investors is thus paid-for by valuation-discount. Masulis and Nahata (2009) observe higher startup purchase-prices by competing CVCs relative to complementary CVCs, corroborating Chemmanur et al. (2014). Strategic alliances between startups and suppliers, distributors, or other parts of supply-chains also increase valuation, as outlined by Nicholson et al. (2005), Miloud and Cabrol (2011), Sievers et al. (2013), and Hand (2005). However, Zhang et al. (2010) find that valuation-impact of alliances diminishes as startups mature.

Table 7 indicates that *Firm Characteristics* have generally-positive or mildly-positive valuation-impact. The exception to this is Business Model, whose valuation-impact is tracked as "Not Clear".

Table 7 Firm characteristics

Author	Year	Assets - IP	Assets - others	Performance - sales	Performance - EBIT and EBITDA	Performance - others	Impact of the country	Impact of the sector	Impact of the business-model	Stage of the start-up	Complementarity and Business Alliances
Armstrong, C.; Davila, A.; Foster, G.	2006	MP	P	P		P				P	
Audretsch, David B.; Link, Albert N.	2012	P						N			
Baeyens, K.; Vanacker, T.; Manigart, S.	2006						P	NC			
Batjargal, B.; Liu, M.	2004		Interactive								
Bayar, O.; Chemmanur, T. J.	2002							P			P
Berk, J. B.; Green, R. C.; Naik, V.	2004					P				P	
Birch, K.; Chiappetta, M.; Artyushina, A.	2020	P	P			P			P		
Black, B. S.; Gilson, R. J.	1998						N	P			
Black, E.	2003		P	Interactive	Neut	P				Interactive	
Block, J. H.; De Vries, G.; Schumann, J. H.; Sandner, P.	2014	P, Interactive		Control, P		Parabolic		Control	Parabolic	P	
Boucher, C.	2009			P							
Bygrave, W. and Timmons, J.	1985						P				
Chemla, G.; Habib, M. A.; Ljungqvist, A.	2015										
Chemmanur, T. J.; Chen, Z.	2014							P		P	
Chemmanur, T. J.; Loutskina, E.; Tian, X.	2014	Dependent	Control	Control		NC		P			VP
Collewaert, Veroniek; Manigart, Sophie	2016	MP	P							P	
Colombelli, A.	2010	P						Control	P	Control, N	
Cumming, D. J.	2005					N	P	N			
Cumming, D. J.	2008						NC	Control		Neut	
Cumming, D. J.; Dai, N.	2011							Control		P	
Cumming, D. J.; Zambelli, S.	2017			Dependent	Dependent		N	Control			
Davila, A.; Foster, G.; Jia, Ning	2015							P			
de Rassenfosse, Gaetan; Fischer, Timo	2016	P				P		Control	Control		
Dhochak, M.; Doliya, P.	2020							P			P
Dittmann, I.; Maug, E.; Kemper, J.	2004		P	P	P	P					
Evraert, F.	2006		P	P	P						
Fitza, M.; Matusik, S. F.; Mosakowski, E.	2009							Neut			
Fulghieri, P.; Sevilir, M.	2009							P			Neut
Gompers, P.; Gornall, W.; Kaplan, S. N.; Strebulaev, I. A.	2020	P						P	P	NC	
Gompers, P.; Kovner, A.; Lerner, J.; Scharfstein, D.	2008							Interactive			
Gompers, P.; Lerner, J.	2000			P				P		P	
Greenberg, G.	2013	VP, Interactive		VP				Dependent		Interactive	
Hand, J. R. M.	2005	N		MP		Neut					
Hellmann, T.	2002	P						NC			P
Hellmann, T.; Thiele, V.	2015	Dependent					P				
Hering, T.; Toll, Christian; Schneider, J.	2012							N	N		
Heughebaert, A.; Manigart, S.	2012	Control, Neut				Neut		P			
Hoenen, S.; Kolympiris, C.; Schoenmakers, W.; Kalaitzandonakes, N.	2014	P								Interactive, P	
Hottenrott, H.; Hall, B. H.; Czarnitzki, D.	2016	VP				P		P			
Houlihan Valuation Advisors; Venture One	1998							P		P	
Hsu, D. H.	2007	Control	P					P			
Hsu, D. H.	2004	Control, MP								P	

Janney, J. J.; Folta, T. B.	2003	P									
Kaplan, S.; Martel, F.; Stromberg, P.	2007						P				
Keeley, R. H.; Punjabi, S.; Turki, L.	1996			Neut				P			
Keuschnigg, C.; Nielsen, S. B.	2004						N				
Korteweg, A., Sorensen, M.	2010			P	P					Interactive	
Lerner, J.	1994	P						Control			
Lockett, A.; Wright, M.; Sapienza, H.; Pruthi, S.	2002		P		P		Interactive			Interactive	
Manigart, S.; De Waele, K.; Wright, M.; Robbie, K.; Desbrieres, P.; Sapienza, H.; Beekman, A.	2000		P	P	P		NC				
Manigart, S.; Wright, M.; Robbie, K.; Desbrières, P.; De Waele, K.	1997		P	P			Interactive				
Masulis, R. W.; Nahata, R.	2009	P				P		Control		N	N
Mills, R. W.	1998				P			P	P		
Miloud, T.; Cabrol, M.	2011							P		P	
Moghaddam, K.; Bosse, D. A.; Provance, M.	2016										Parabolic
Norbäck, Pehr-Johan; Persson, Lars	2009								P	P	P
Palan, R.	2013		P	P	P						
Pintado, T.R.; de Lema, D. G. P.; Van Auken, H.	2007			NC	NC					NC	
Poczter, S.; Shapsis, M.	2018			Control, N				Intereactive, N			
Pollock, T. G.; Chen, G.; Jackson, E. M.; Hambrick, D. C.	2010			Control, P				Control			
Röhm, P.; Köhn, A.; Kuckertz, A.; Dehnen, Hermann S.	2018							P	Control	P	N
Schwienbacher, A.	2008		N					P	NC		
Schwienbacher, A.	2013									N	
Siegel, R.; Siegel, E.; MacMillan, I. C.	1993		P			P		P	P		
Sievers, S.; Mokwa, C. F.; Keienburg, G.	2013	P	P	P		P		Control		Neut	P
Smith, J.A, Cordina, R	2014	P, Interactive	P, Interactive								
Streletzki, J.G.; Schulte, R.	2013	MP						Control, P	MP	N	P
Tyebjee, T. T.; Bruno, A.V.	1985	P						P			
Tyebjee, T., Vickery, L.	1988						P	P			
Wright, M.; Robbie, K.	1996		P	P	P	P		P		Interactive	
Wright, M.; Robbie, K.	1998		P	P							
Yang, Yi; Narayanan, V. K.; Zahra, Shaker A.	2009									NC	NC
Yoo, C.; Yang, D.; Kim, H.; Heo, E.	2012										P
Zacharakis, A.; Shepherd, D. A.	2005	P						P			
Zhang, J.	2011									P	
Zheng, Y.; Liu, J.; George, G.	2010	VP						Control, P		Not interactive, MN	VP
Zhou, H.; Sandner, P. G.; Martinelli, S. L.; Block, J.H.	2016	VP, Interactive	P, Interactive					P	N		
Totals : Peer-review literature		27	16	21	12	16	10	44	14	31	12
Summarized Driver Direction in Model		++	+	+	+	+	+/=	+	*NC*	+/=	+/=

Legend: P = Positive; MP = Mildly-Positive; VP = Very Positive; N = Negative; MN = Mildly-Negative; VN = Very Negative; NC= Not Clear; Neut. = Neutral or Non-significant

3.4. Investor characteristics

The role played by *Investor Characteristics* in startup-valuation is another major theme in the literature (Köhn (2018)). Investor characteristics affect valuations observed in VC deals via specialization, synergies, network-value, coaching, and reputational-effects. Another investor characteristic is the relationship among investors. Since coaching plays a role in startup development, involvement of investors specializing in specific industries or early-stage firms increase the startup's value to subsequent investors, and mitigate failure-risk.

Investor Characteristics consist of eight drivers: Nature of the Investor, Quantity of Cash under Management, Investor Nationality, Investor Reputation, Investor History and Experience, Potential Other Interest, Investment Strategy, and Sector Specialization of VC.

3.4.1 Nature of the investor

Masulis and Nahata (2009) observe significantly-higher purchase-prices per startup share paid by competing CVCs—where startup and CVC parent are potential competitors—compared with complementary CVCs where startup and CVC parent have clear operational synergies. Additionally, Masulis and Nahata (2009) also outline that CVCs are willing to give up board seats and pay higher prices for access to new ventures compared to independent VCs. This finding is reinforced by Hand (2005), where positive valuation-effects derive from CVC investment in the biotech landscape. Sievers et al. (2013), meanwhile, find that CVC lead-investors do not significantly impact valuations in the German startup landscape from which their sample is drawn.

Hornuf and Neuenkirch (2017), who examine pricing of equity crowdfunding shares, find that investor sophistication influences backers' willingness to pay.

Business angels also have their own outlook. Block et al (2014), who explore the effects of trademarks on startup-valuation, find that controlling for business angels demonstrates the robust positive valuation-impacts of business angel participation. This is reinforced by Hellman and Thiele (2015), who describe strong investor-side complementarity of value-adding activities subsequent to business angel involvement in a startup, positively impacting valuation. In contrast, Heughebaert and Manigart (2012) explains that investors with stronger bargaining-power are able to impose lower valuations.

3.4.2 Quantity of cash under management

Scale of investor-assets impacts valuation. While Cumming and Zambelli (2017) find that larger cash under management means less VC direct-monitoring, Cumming and Dai (2010) find a convex (U-shaped) relationship between fund size and firm-valuation. Both findings indicate potential VC industry diseconomies-of-scale.

3.4.3 Investor reputation

Table 8 describes Reputation as the second-most extensively-covered investor-characteristic within peer-reviewed literature. Overall, its valuation-impact is ambiguous. Investor reputation drives valuation via signaling-effect. According to Hsu (2004), entrepreneurs pay a premium to "lease" the VC's reputation in order to access external resources. This view is reinforced by Cumming and Dai (2011) and Bengtsson and Sensoy (2011). Zheng et al. (2010) explain that, when faced with uncertainty and incomplete information about technology startups, investors rely on prestige of partners (i.e., network status) to infer quality. Although the ensuing early-stage positive impact is substantial, the effect diminishes as the startup matures. Essentially, early-stage startups with prestigious investors attract higher valuations from subsequent investors.

3.4.4 Investor history and experience

Gompers et al. (2010) outline that more experienced VCs assign higher valuations. Keuschnigg and Nielsen (2004) find that experienced VCs add to startup value via coaching. Examples also include interactive-effects such as Gompers et al. (2008) and Nikolaus et al. (2008), who find that experienced investors are more sensitive to sectoral-market-signals and entrepreneur experience, respectively. With experienced investors, these drivers have stronger positive impacts.

Collewaert and Manigart (2016) find that while business-angel experience drives startup-valuations, different types of experience have diverging valuation-impact, with years of entrepreneurial-experience and prior angel-investments having largest valuation-impact, while legal or financial-experience have no impact.

3.4.5 Investment strategy

While investors may undertake strategies to specialize, maximize revenues, optimize investment or market-timing, and manage risks, valuation-impact on early-stage firms can be more easily influenced by investor-strategy than more mature firms. Hellmann and Thiele (2015) argue that investor preference for early-stage exists (i.e., low-risk-low-return strategies), and can negatively-impact startup-valuation. In contrast, Heughebaert and Manigart (2012) find that higher-risk investment strategies explain lower valuations observed for university and government-VC firms.

3.4.6 Sectoral specialization of investors

Investor-specialization drives startup-valuations. Gompers et al. (2008) outline that industry-specialization is associated with higher investment-levels, once investor-experience is controlled-for. Additionally, Bayar and Chemmanur (2011) outline that investor-specialization has positive valuation-impact via the acquisition process, since specialized investors have more industry-expertise than IPO-investors, allowing them to better-identify high-value investments. Furthermore, Ali et al. (2014) find that withdrawal of specialist-VCs has smaller negative valuation-impact than generalist-VCs.

Table 8 Investor characteristics

Author	Year	Nature of the investor	Quantity of cash under managemnt	Investor's nationality	Investor's reputation	Investor's history/exp	Potential other interest (corporate relation, etc.)	Investment strategy	Sector Specialization of VC
Baeyens, K.; Vanacker, T.; Manigart, S.	2006							NC	
Bayar, O.; Chemmanur, T. J.	2011					P			P
Bengtsson, O.; Sensoy, B. A.	2011				P	P			
Berk, J. B.; Green, R. C.; Naik, V.	2004					P			
Black, B. S.; Gilson, R. J.	1998				P				
Block, J. H.; De Vries, G.; Schumann, J. H.; Sandner, P.	2014	MN				P			
Brander, J. A.; Amit, R.; Antweiler, W.	2002				P				
Broughman, B. J. ; Fried, J. M.	2012				MN				
Chan, Y.	1983					P			P
Chemmanur, T. J.; Chen, Z.	2014	N			NC	NC			
Chemmanur, T. J.; Loutskina, E.; Tian, X.	2014	P			Control, MN	Control, MN	P	P	Control, MP
Collewaert, Veroniek; Manigart, Sophie	2016				NC	P			
Cumming, D. J.	2008				P				
Cumming, D. J.	2005	NC		NC					
Cumming, D. J.; Dai, N.	2011		Parabolic		N				
Cumming, D. J.; Zambelli, S.	2017	N	N			MP	Control		
Fitza, M.; Matusik, S. F.; Mosakowski, E.	2009	P							
Franke, N.; G., M.; Harhoff, D.; Henkel, J.	2008					Interactive, P			
Fulghieri, P.; Sevilir, M.	2009								P
Gompers, P.; Kovner, A.; Lerner, J.; Scharfstein, D.	2008					Interactive, P			MP
Greenberg, G.	2013				P				
Hellmann, T.	2002	NC				Modeled		P	
Hellmann, T.	2006				N				
Hellmann, T.; Thiele, V.	2015	P				P		N	
Heughebaert, A.; Manigart, S.	2012	P		Control, Neut	Control, Neut		Neut	N	
Hornuf, L.; Neuenkirch, M.	2017	Neut				P			
Hsu, D. H.	2007				N				
Hsu, D. H.	2004				N	N			N
Kanniainen, V.; Keuschnigg, C.	2003					P			
Keuschnigg, C.; Nielsen, S. B.	2004					P			
Masulis, R. W.; Nahata, R.	2009	P			N		P	P	
Murnieks, C. Y.; Cardon, M. S.; Sudek, RR; White, T. D.; Brooks, W.T.	2016					MP			
Norbäck, Pehr-Johan; Persson, Lars	2009	P							
Pintado, T.R.; de Lema, D. G. P.; Van Auken, H.	2007					Neut			
Pollock, T. G.; Chen, G.; Jackson, E. M.; Hambrick, D. C.	2010				P	P			
Röhm, P.; Köhn, A.; Kuckertz, A.; Dehnen, Hermann S.	2018	P			N	N	N	N	
Schwienbacher, A.	2008				Dependent				
Schwienbacher, A.	2013	N			P	P		P	
Sievers, S.; Mokwa, C. F.; Keienburg, G.	2013	Neut							
Smith, J.A, Cordina, R	2014					P, Interactive			
Tykvová, T.	2007				Dependent				
Wright, M.; Robbie, K.	1996	Interactive							
Wright, M.; Robbie, K.	1998				NC				
Zacharakis, A.; Shepherd, D. A.	2005							NC	
Zheng, Y.; Liu, J.; George, G.	2010				P				
Zhou, H.; Sandner, P. G.; Martinelli, S. L.; Block, J.H.	2016					P			
Totals : Peer-review literature		19	2	2	21	26	7	11	7
Summarized Driver Direction in Model		-/=	=	NC	-	+	+/=	-/=	=

Legend: P = Positive; MP = Mildly-Positive; VP = Very Positive; N = Negative; MN = Mildly-Negative; VN = Very Negative; NC= Not Clear; Neut. = Neutral or Non-significant

While coverage of *Investor Characteristics* is limited, valuation-impact is mixed overall. Whereas Investor History and Experience have positive valuation-impacts, Sector Specialization and Quantity of Cash under Management are neutral. Each is the object of studies tracking their valuation-impacts as positive, while others track them as negative, neutral, or parabolic. Investor Reputation is tracked as having negative valuation-impact.

3.5. Market conditions

Market Conditions consists of six drivers, which describe context: Macroeconomic Situation, Sectoral Economic Situation, Quantity of Cash on Market, Business Cycle, Type of Market, and Agency Costs and Asymmetric-Information.

3.5.1 Macroeconomic situation

Macroeconomic situation is expressed via output levels, risk-free rates, and financial-market returns. While output levels and financial market-returns serve as benchmarks for investments at all risk-levels, risk-free rates drive discounting. Examples include Gornall and Strebulaev (2020) on the valuation-role of risk-free rates, as well as Hsu (2007), who uses year dummies and observes that valuations tend to be higher when fund inflows are high. Armstrong et al. (2006) control for a benchmark financial index, finding its valuation-impact positive and significant. Moreover, a quarter of peer-reviewed studies that include macroeconomic conditions do so as control variables to examine other factors. Examples include Armstrong et al. (2006) and Block et al. (2014).

3.5.2 Sectoral economic situation

Classically-oriented sources such as Cumming and Zambelli (2017) control for industry-level book-to-market ratios, while Mills (1998) elaborates on sectoral technological-innovations for case-study purposes and more recent literature explores the role of sectoral-effects and sectoral economic situation. Assessments of growth-potential and strategic-potential in a given market are drivers of both valuation-measurement and VC selection. Industry growth rates are taken into account by several studies, including Sievers et al. (2013), Miloud and Cabrol (2011), and Dittmann et al (2004). Aside from sectoral-multipliers, valuations of publicly-traded firms in the same industry contain valuation-relevant information. Hand (2005, 2007) and Lerner (1994) both find that biotech venture valuations are driven by valuations of publicly-traded biotech firms. Sectoral Economic Situation also includes examining market-structure and sectoral-competition. Hellman and Thiele (1998) outline that sector-level product-market competition and intellectual-property landscape, including the rate at which IP becomes obsolete, are considered by investors when assessing valuation and startup-failure-likelihood.

3.5.3 Quantity of cash on market

Quantity of cash on market has an unambiguously-positive valuation-impact, as shown in Table 9. Specific examples include theoretical models, such as Inderst and Muller (2004), where the model predicts that pre- and post-money valuations are positively-related to level of capital-supply and capital-market competition, investment profitability, and capital-market transparency, while negatively-related to entry costs. Empirical examples include Fulghieri and Sevilir (2009), where Quantity of Cash affects entrepreneur-effort, driving future-valuations.

3.5.4 Business cycle

The role played by business-cycles is explored in-detail in the literature. Examples include Gompers and Lerner (2000), who characterize the early internet-bubble period by higher average public equity-values and weaker inflows to VC funds, as well as Gompers et al. (2008), who find correlation between Q and investment-activity very high throughout their observation-period, and Schwienbacher (2013), who finds that during boom-periods, institutional investors channel large amounts of capital to VC funds. Also, some studies find that other drivers interact with Business Cycle. Examples include Gavious and Schwartz (2011), who find valuation-impacts of financial variables to be business-cycle dependent, because reliance on multiples-valuation systematically under-values or over-values firms in an industry or capital-market, as business-cycles evolve.

3.5.5 Agency costs and information asymmetry

This driver negatively influences investor-returns and risk-levels. Examples include Schwienbacher (2013), who outlines that, similar to adverse-selection theory, funding by generalists demands larger risk-compensation, implying lower valuations. Some contributions qualify information-asymmetry and agency costs as "not clear", since a sizable share of literature examines their role in relation to investor-behavior and contracting rather than valuation. While indirect-impact is clear (via effect on contracting and investor-behavior), scale and scope is not made-explicit in some studies.

Table 9 Market conditions

Author	Year	Macro Econmic situation	Sectorial economic situation	Quantity of cash on the VC market	Business Cycle	Agency Costs and Asymmetric Information
Aggarwal, V. A.; Hsu, D. H.	2007		MP	Interactive		
Armstrong, C.; Davila, A.; Foster, G.	2006	Control, P				
Audretsch, David B.; Link, Albert N.	2012	N				
Baeyens, K.; Vanacker, T.; Manigart, S.	1998		NC			
Bayar, O.; Chemmanur, T. J.	2011		NC			NC
Bengtsson, O.; Sensoy, B. A.	2011		P			
Benquet, Foureault, F., and Lagneau-Ymonet	2018				NC	
Berk, J. B.; Green, R. C.; Naik, V.	2004	P				
Bickers, C.	2010		Control			
Black, E.	2003	P	P			
Block, J. H.; De Vries, G.; Schumann, J. H.; Sandner, P.	2014	Control, P	P	Control, P		
Boucher, C.	2003		P			
Brander, J. A.; Amit, R.; Antweiler, W.	2002		P			
Broughman, B. J. ; Fried, J. M.	2012	Control , Neut				
Bygrave, W. and Timmons, J.	1985	P			P	
Chan, Y.	1983					NC
Chemla, G.; Habib, M. A.; Ljungqvist, A.	2007					N
Chemmanur, T. J.; Chen, Z.	2014		P			N
Chemmanur, T. J.; Loutskina, E.; Tian, X.	2014		Control			
Cochrane, J. H.	2005	MP	Control, Neut			
Collewaert, Veroniek; Manigart, Sophie	2016	Neut.			Neut.	
Colombelli, A.	2010		NC			
Cumming, D. J.	2005	MN				N
Cumming, D. J.; Dai, N.	2011		Control			
Cumming, D. J.; Zambelli, S.	2017	Control				N
Davila, A.; Foster, G.; Jia, Ning	2015		Interactive			
Dittmann, I.; Maug, E.; Kemper, J.	2004	P	P			
Dhochak, M.; Doliya, P.	2020		P			
Ewens, Michael; Jones, Charles M.; Rhodes-Kropf, Matthew	2013		P			N
Fitza, M.; Matusik, S. F.; Mosakowski, E.	2004		Neut		P	
Fulghieri, P.; Sevilir, M.	2009			P		
Gavious, I.; Schwartz, D.	2011	Interactive, P			Interactive	
Gompers, P.; Gornall, W.; Kaplan, S. N.; Strebulaev, I. A.	2020		P			
Gompers, P.; Kovner, A.; Lerner, J.; Scharfstein, D.	2008	Interactive, P	Interactive, P		Variable	
Gompers, P.; Lerner, J.	2000	P	P	P	P	
Gornall, W.; Strebulaev, I. A.	2020	P				
Hand, J. R. M.	2005		P	Neut		
Hand, J. R. M.	2007		P			
Hellmann, T.	2002					NC
Hellmann, T.	2006				N	N
Hellmann, T.; Thiele, V.	2015	Control	Control	P		
Heughebaert, A.; Manigart, S.	2012	P	N			
Hornuf, L.; Neuenkirch, M.	2017	P				
Houlihan Valuation Advisors; Venture One	1998		P			
Hsu, D. H.	2007	MP				
Inderst, R.; Muller, H. M.	2004	P	P	P	P	
Keeley, R. H.; Punjabi, S.; Turki, L.	1996	P				
Kirilenko, A. A.	2001					NC
Korteweg, A., Sorensen, M.	2010			P	P	
Korteweg, A.; Nagel, S.	2016	P				
Lerner, J.	1994		Control, P			P
Lockett, A.; Wright, M.; Sapienza, H.; Pruthi, S.	2002					
Manigart, S.; De Waele, K.; Wright, M.; Robbie, K.; Desbrieres, P.; Sapienza, H.; Beekman, A.	2000			P		
Masulis, R. W.; Nahata, R.	2009					P
Mills, R. W.	1998	P	P			
Miloud, T.; Cabrol, M.	2011		P			
Moghaddam, K.; Bosse, D. A.; Provance, M.	2016				P	
Norbäck, Pehr-Johan; Persson, Lars	2009		P			
Palan, R.	2013				VP	
Pintado, T.R.; de Lema, D. G. P.; Van Auken, H.	2007		Neut			
Röhm, P.; Köhn, A.; Kuckertz, A.; Dehnen, Hermann S.	2018					N
Schwienbacher, A.	2008		P			
Schwienbacher, A.	2013			MP	P	N
Siegel, R.; Siegel, E.; MacMillan, I. C.	1993		P			
Sievers, S.; Mokwa, C. F.; Keienburg, G.	2013		Control, Neut	P		
Tyebjee, T. T.; Bruno, A.V.	1984	P	P			
Tyebjee, T., Vickery, L.	1988	P	P	P		
Wright, M.; Robbie, K.	1998					N
Zacharakis, A.; Shepherd, D. A.	2005		VP, interactive			
Zheng, Y.; Liu, J.; George, G.	2010	Control, P	Control, P			
Zhou, H.; Sandner, P. G.; Martinelli, S. L.; Block, J.H.	2016		Control			
Totals: Peer-review literature		27	45	13	14	20
Summarized Driver Direction in Model		++	++	++	+	--

Legend: P = Positive; MP = Mildly-Positive; VP = Very Positive; N = Negative; MN = Mildly-Negative; VN = Very Negative; NC= Not Clear; Neut. = Neutral or Non-significant

Both Macroeconomic Situation and Sectoral Economic Situation have strong positive valuation-impacts, while Agency Costs and Asymmetric have a strongly-negative impact. Business Cycle, however, has milder, positive impact.

3.6. Deal conditions

Deal Conditions include clauses of investment and shareholder agreements. Their relationship with startup-valuation is endogenous and often-indirect rather than strictly-deterministic. *Deal Conditions* aggregates eight drivers that affect observed valuations: Syndication and Investor Competition; Shareholder Agreement Clauses; Funding Rounds; Timing of Deal; Preferential Shares; Other Mechanisms for Investor & ROI Protection; and Exit Expectations and Strategies. *Deal Conditions* are primarily mentioned in peer-reviewed studies published in finance journals.

3.6.1 Syndication and investor competition

Table 10 describes Investor Syndication as a major literature-topic. Cumming (2005) explains that syndication offers several benefits. In terms of monitoring and mitigation of information-asymmetries, they share screening-capacity to mitigate adverse-selection costs and manage risks, impacting valuation positively. Syndication also enables risk-sharing. Mitigation of information-asymmetries and risks increases valuation. Cumming (2005) also outlines a positive-relationship between number of a firm's capital-suppliers and growth-opportunities, increasing future-value.

3.6.2 Shareholder agreement clauses

Startup-valuations can be affected by investors paying for control-rights, as described by Kirlenko (2001). This is also outlined by Black and Gilson (1998) and by Kanniainen and Keuschnigg (2003). Startup success and value depend on entrepreneur-effort and investor-effort, a dynamic described by Hellmann (2006). In terms of risk-management, Chemala et al. (2007) outline that Shareholder Agreement Clauses act as implicit put-and-call options (for which investors would essentially pay a valuation premium), while Gornall and Strebulaev (2020) add that Preferential Shares drive startup-over-valuation via strong cashflow-rights.

3.6.3 Funding rounds and follow-on financing

Table 10 indicates that Funding Rounds emerges in literature very often: in 17 times peer-reviewed studies. Studies that use rounds, or the dynamics thereof consider it a driver with positive valuation-impact. For example, Helmann and Thiele (2015), examine business angel and VC interaction, and find that VCs award higher valuations when a startup has experienced previous business angel rounds. Houlihan Valuation Advisors/VentureOne (1998) reinforces this view, logically finding earlier financing rounds to be associated with lower startup-valuations. Broughman and Fried (2012) argue that inside-rounds (i.e., subsequent funding-rounds including only prior investors) also take place at relatively-higher valuations.

Faust (2013) describes how completed funding rounds are seen as milestones that add value to the firm, while Hellmann (2001) points out that multiple rounds affect the firm's discount-rate. Essentially, an indirect, positive valuation-impact may be inferred in these cases.

3.6.4 Timing of deal

Although sparsely-covered in the literature, Timing of Deal—the matter of *when* investment-deals are made relative to the internal needs of entrepreneurs and investors' constraints—has a mildly-positive valuation-impact. Examples in the literature include Korteweg and Nagel (2011), who outline that funding rounds occur irregularly, being driven by cashflows of VC funds arriving at irregular intervals throughout the life of the fund, which influences the stochastic discount-factor. According to Janney and Folta (2003), firms experience higher abnormal returns on VC placements when the last private equity placement was issued a long time earlier. Essentially, firms have stronger performance with respect to VC investment—hence higher valuations—when the startup has operated longer without any further VC investment.

3.6.5 Preferential shares

While Preferential Shares are employed by investors, their coverage in literature is underwhelming. While investor-side risk-management implications are clear, given uncertainties modeled by Ackerlof (1970), and their use detailed by Kaplan and Stromberg (2002), valuation-effects are seldom-explored. Chemmanur and Chen (2014) outline that under equilibrium-contracts, which can be implemented via convertible debt (or,

debt with warrants) or via convertible preferred equity, investors exert less effort than in later-stage financing. Nevertheless, Gornall and Strebulaev (2020) argue that strong cashflow-rights in preferential shares drive unicorn valuations.

3.6.6 Other mechanisms for investor & ROI protection

This driver consists of various investor-protection mechanisms, such as arm's-length licensing (Aggarwal and Hsu 2007); board-presence (Bengtsson et al. 2011); and fixed-fraction contracts, whereby inside-VCs provide a fraction of future capital required by the firm and then receives the same fraction of the firm's total payoffs (Cumming 2005), which has a neutral valuation-impact.

Novel theoretical examples include Kirilenko (2001), who investigates how optimal-allocation of control-rights can be implemented through indirect mechanisms, either via a competitive market for control or bilateral bargaining procedures. Here, valuation would be impacted as investors pay for control. Entrepreneurs value control and demand that price compensates for loss-of-control, whereas investors are interested in future payoffs and are willing to pay a premium.

3.6.7 Exit expectations and strategies

A key topic explored by the literature is likelihood of IPO-exit *vis-à-vis* likelihood of acquisition-exit. While entrepreneurs prefer IPO-exits, which keeps firms independent and allows entrepreneurs control-retention after VC-exit, investors prefer acquisition-exits, yielding higher returns. By ceding exit-rights, VCs require more cashflow-rights, according to Schwienbacher (2008). Essentially, investors might pay higher valuations to secure acquisition-exit.

Table 10 Deal Conditions

Author	Year	Syndication and Investors Competition	Shareholder's agreement clauses	Funding Round	Timing of the deal	Duration of the deal	Preference shares in the deal?	Other mechanisms for investor's protection ROI	Exit expectations and strategies
Aggarwal, V. A.; Hsu, D. H.	2007							Interactive	
Armstrong, C.; Davila, A.; Foster, G.	2006			NC					
Bayar, O.; Chemmanur, T. J.	2011								Dependent
Bengtsson, O.; Sensoy, B. A.	2011	P	Dependent					NC	N
Berglof, E.	1994		Dependent					P	NC
Black, B. S.; Gilson, R. J.	1998		P						P
Block, J. H.; De Vries, G.; Schumann, J. H.; Sandner, P.	2014	control, P		Interactive					
Brander, J. A.; Amit, R.; Antweiler, W.	2002	P				Neut			
Broughman, B. J. ; Fried, J. M.	2012					P			
Chemla, G.; Habib, M. A.; Ljungqvist, A.	2007		P						
Chemmanur, T. J.; Chen, Z.	2014		Dependent	P	P		N		
Chemmanur, T. J.; Loutskina, E.; Tian, X.	2014			N					
Cochrane, J. H.	2005			Dependent					
Collewaert, Veroniek; Manigart, Sophie	2016			Control, Neut.					
Cumming, D. J.	2005	P	NC	P			Dependent	P	
Cumming, D. J.	2008		P	control, P					Dependent
Cumming, D. J.; Zambelli, S.	2017		Control, Neut						
Davila, A.; Foster, G.; Jia, Ning	2015			control					
de Rassenfosse, Gaetan; Fischer, Timo	2016	Dependent		Dependent					
Dittmann, I.; Maug, E.; Kemper, J.	2004					P			
Gompers, P.; Gornall, W.; Kaplan, S. N.; Strebulaev, I. A.	2020	Dependent							NC, P
Gompers, P.; Lerner, J.	2000				P				
Gornall, W.; Strebulaev, I. A.	2020		P				VP	P	P
Greenberg, G.	2013			Interactive, MP					
Hellmann, T.	2006		VN						VN
Hellmann, T.; Thiele, V.	2015			P					N
Heughebaert, A.; Manigart, S.	2012	P							
Hoenen, S.; Kolympiris, C.; Schoenmakers, W.; Kalaitzandonakes, N.	2014	P							
Hornuf, L.; Neuenkirch, M.	2017				P				
Houlihan Valuation Advisors; Venture One	1998			P					
Hsu, D. H.	2007			MN					
Hsu, D. H.	2004			Dependent					
Inderst, R.; Muller, H. M.	2004		Variable						
Janney, J. J.; Folta, T. B.	2003			MP	P				
Kanniainen, V.; Keuschnigg, C.	2003		P						
Keuschnigg, C.; Nielsen, S. B.	2004		P						
Kirilenko, A. A.	2001		P					NC	
Korteweg, A.; Nagel, S.	2016			Dependent	NC				
Masulis, R. W.; Nahata, R.	2009	control, MN		N				Dependent	
Pollock, T. G.; Chen, G.; Jackson, E. M.; Hambrick, D. C.	2010	control, P, N							control, N
Schwienbacher, A.	2008		P						N
Schwienbacher, A.	2013		N						
Sievers, S.; Mokwa, C. F.; Keienburg, G.	2013			P					
Tyebjee, T. T.; Bruno, A.V.	1984							P	P
Tykvová, T.	2007	P	P	P		NC	P	Interactive	Dependent
Zhou, H.; Sandner, P. G.; Martinelli, S. L.; Block, J.H.	2016	P		P					
Totals : Peer-review literature		16	18	17	5	4	6	13	14
Summarized Driver Direction in Model		+	-	++	+/=	+/=	*NC*	=	+

Legend: P = Positive; MP = Mildly-Positive; VP = Very Positive; N = Negative; MN = Mildly-Negative; VN = Very Negative; NC= Not Clear; Neut. = Neutral or Non-significant

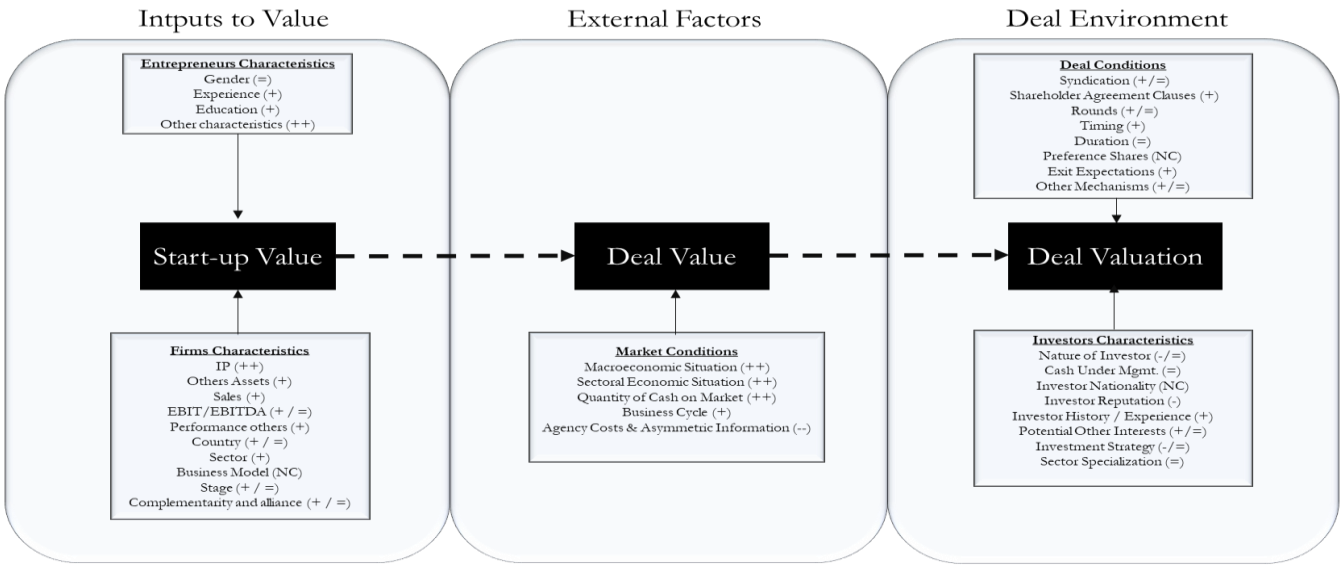
Compared to other driver-families, valuation-impact of *Deal Conditions* is mild. Shareholder Agreement Clauses, Timing of Deal, and Exit Expectations have positive valuation-impacts, while Preferential Shares have unclear impact. Funding Rounds, Syndication, and Other Mechanisms have mildly-positive valuation-impacts.

3.7. A meta-model for startup-valuation

According to Köhn (2018), future studies should take into account the comparative relevance of determinants over time because respective impacts of identified determinants might change over time, while Heughebaert and Manigart (2012) outline the need for future studies to directly examine the valuation process. Mechanically, this can be achieved by examining periodicity, temporal variation, and chronological order of contextual drivers affecting valuation. Taking into consideration the drivers identified in the literature, which outline not only the valuation-drivers and their specific relationship to the startup, but also the interaction they have with each other, the construction of a valuation model, placing the thematic-families into appropriate chronological positions in the valuation process effectively summarizes the process described in the literature. In principle, this is a valuation-process consisting of multiple steps.

The first step considers the startup's value-inputs ("Value-Startup"); both *Entrepreneur Characteristics* and *Firm Characteristics* are included. Thereafter, deal-opportunities navigate contextual external factors, such as Macroeconomic situation and Quantity of cash on market. These drivers stress the environment (*Market Conditions*) within which deals takes place. This is the "Deal Value". Finally, investment opportunities are challenged by characteristics of valuators (*Investor Characteristics*) and *Deal Conditions* affecting investors and entrepreneurs. This ultimately generates "Deal Valuation".

Fig. 5 Integrative meta-model for valuing startups



This three-stage valuation-emergence process is expressed using functional-form taken from Sievers et al. (2013) and Hand (2005), while conceptually inspired by Hurley (2018)'s view on the entrepreneurial field. We describe pre-money startup-valuation as a function of *Startup Value*, as well as the way *Value* is acted-upon by *Deal Value* and by *Deal Valuation*.

Formally, these three steps are described with the following functional form, whereby the aggregate of firm-level *Startup Value* drivers are acted upon by external market condition *Deal Value* drivers, and subsequently by investor-side *Deal Valuation* drivers:

Eq. 1 Integrative meta-model for valuing startups

$$Pre-Money\ Valuation = f(((\sum Startup\ Value)\sum Deal\ Value)\sum Deal\ Valuation)$$

This captures interaction among drivers literature identifies as impacting startup-valuation, as well as indirect driver valuation-impacts, and critically, the order in which each driver plays its role in impacting startup-valuation.

4. Discussion

4.1. Gaps and Critical Issues: An Agenda for Future Studies

At present, our study addresses currently-existing research gaps in the literature. Whereas Köhn (2018) outlines that future studies should take into account the periodicity of contextual factors on valuation, given that respective driver valuation-impacts might change over time. Meanwhile, Budhwar et al. (2022) outlines that methodological approaches in entrepreneurial finance can be – and are actively being – improved by further diversification, elaborating further that at a theoretical level considerable opportunities to develop syntheses between macro and micro-theorizing, as well as the internal dynamics of the entrepreneurial finance ecosystem. This paper's methodological approach, relying on coding, thematic coding across multiple evidence sources, leading to the construction of tables which demonstrates associations between

the valuation-drivers and startup-valuations, according to the authors cited, making possible the construction of grounded theory to provide a wholistic view of startup valuation contributes to addressing these needs.

Budhwar et al. (2022) also outlines the need for develop syntheses between macro and micro-theorizing in entrepreneurial finance. In the field of startup valuation, this can be approached via the modeling of valuation-impacts of macroeconomic market-conditions such as business cycle and changes in sovereign risk conditions, as well as the impact that these may have not only directly on valuations, but also on valuation drivers such as revenues, growth rates, and discount rates. Additionally, the modeling of the valuation-impact of deal conditions serves to capture governance and regulatory conditions, thereby further synthesizing micro and macro theory in entrepreneurial finance.

In addition, thematically-speaking, *Investor Characteristics*, *Entrepreneur Characteristics*, *Market Conditions*, and *Deal Conditions* are known to be under-researched within the peer-reviewed literature on startup-valuation, in comparison with *Firm Characteristics*. In principle, they likely constitute critical research-gaps that need examination to better understand the startup-valuation field.

We identify limitations in current literature and suggest research avenues in entrepreneurial finance. As highlighted by Köhn (2018), Gompers and Lerner (2000), and Damodaran (2009), research on startup-valuation may suffer from lack-of-contextualization. Aiming to generalize results, authors often do not take into account sample-period, nature-of-investors, or locations where deals take place. While many empirical studies do use control variables as fixed-effects on their datasets, authors do not specificities of their settings into account. For instance, it makes little sense to compare valuation-impact research concerning startups raising funds in US biotech between 1995 and 2005 with those concerning startups raising funds in Baltic-region software-industry markets from 2010 to 2015.

On the other hand, our study explicitly mentions the role of business cycles (i.e., the periodicity of market-conditions). In other words, our study directly addresses a key point that Köhn (2018) claims that future studies should mention.

The impact-scale of drivers varies across time, location, and industry. Concurring with Köhn (2018), we identify a research-avenue in comparing driver-impact across time-periods; but we would widen this towards

more comparative studies, to identify differences between sectors, geographic settings, and investor-contexts. Just a few papers adopt this perspective (Wright et al. 2004, 2005; Manigart el al. 1997, 2000).

4.2. Methodology

Overall, the majority of selected peer-reviewed papers rely on regression-analysis, a situation which Budhwar et al. (2022) describe as being able to be improved by methodological diversification. While 69 peer-reviewed studies rely on regression-analysis and 14 are theoretical quantitative studies, three are case studies without interviews, and two employ interview-based qualitative methods. Scholars rely on publicly-accessible data, which are mainly *Firm Characteristics*. While *Entrepreneur Characteristics* are also publicly-accessible and play a deterministic role in investment-criteria literature (e.g., Kaplan et al. 2009; Silva 2004; Hall and Hofer 1993; Macmillan et al. 1985, 1987), they constitute an under-reported macro-theme, especially concerning drivers other than experience and education.

Approaches like Murnieks et al. (2016), who examine subjective entrepreneur characteristics using qualitative methods should develop further, incorporating subjective valuation-drivers such as passion or tenacity into economic-theory.

The majority of quantitative studies explored do not stimulate research on valuation-processes either (Köhn (2018)). Large empirical-samples consider statistically-significant drivers but omit role and process of drivers emerging along different steps of the negotiation-process. Do equity-investors and entrepreneurs debate EBITDA factor? Can entrepreneurs take advantage of investor-competition before, during, or after the start of exclusive-negotiations? Our article invites the academic community in entrepreneurial finance to better consider less used methods – such as the qualitative ones – to investigate new fruitful questions about the start-ups valuations.

4.3 Investor Characteristics

At present, *Investor Characteristics* remain under-researched. Among the five macro-themes, this is the second least-covered family of valuation drivers.

This is an issue for the academic community, firstly because potential theoretical contributions of the characteristics of investors are significant. Contrary to most assets, whose value is intrinsic, the startup ecosystem—where supply of cash, funding demand, information asymmetries, and external factors are substantial —impacts the valuator. This gives rise to a unique context and reality. This issue is often overlooked in the literature.

The second reason is that diversity among equity-investors has increased tremendously over the past ten years (Cumming and Johan 2017; Quas et al. 2020; Bellavitis et al. 2017) but we suffer from a lack of knowledge about the resulting diversity in approaches to startup-valuation drivers. To our knowledge, many types of investor have never been studied *per se* in terms of their impact on startup-valuation. This includes accelerators, equity funding incubators, search funds, family offices, independent business angels (BAs) versus BA networks, and governmental-venture-capitalists. As already highlighted by Köhn (2018), Masulis and Nahata (2009), and Röhm et al. (2017), the CVC landscape is sufficiently-diverse in terms of practices and investor-characteristics as to impact valuations of funded portfolio companies.

4.4 Context Matters: Market Conditions and Deal Conditions

In addition, *Market Conditions* are under-researched, particularly Quantity of Cash on Market. According to KPMG (2019), claims in industry-literature and the press outline that the 2016–2020 worldwide upsurge in startup-valuations seems influenced by cash-quantities on VC markets, to the extent that some established US or European VCs (Jerusamly, 2019) publicly declared that they were now decelerating investments related to "crazy valuations" and would re-invest after the potential bubble's end, after quantity of cash-on-market decreased. The issue seems critically-important for practitioners and policy-makers alike, yet is under-researched—with only six papers in peer-reviewed literature.

Furthermore, *Deal Conditions* remain substantially under-investigated, despite being a major theme in the business-environment. Much of the coverage given to deal-conditions in entrepreneurial finance literature focuses on topics other than startup-valuation. Examples of this include Kaplan and Stromberg (2002), who examine the role of *Market Conditions* and *Firm Characteristics* in determining or influencing *Deal Conditions*. While data on this driver exist and are used for research other than valuation, the valuation-impact that

specific deal-conditions have, remains under-researched. What needs development are concrete theoretical-models describing relationships between deal-conditions and startup-valuation. In particular, understanding the valuation-consequences of shareholder agreement-clauses is crucial. As the preliminary results of Gornall and Strebulaev (2020) show, US startups create on average eight different share-types, each with different rights, protections, preferential liquidation-rights, and so on. Sophistication of contractual-relations and shareholder agreements between entrepreneurs and VCs seems key to driving startup-valuations.

4.5 Startup Selection

Sixth, an overlapping topic within entrepreneurial finance literature is startup selection, with research on this topic published by numerous scholars who examine startup-valuation, including Kaplan, Wright, Manigart, and Zacharakis. Many macro-themes are similar, including *Entrepreneur Characteristics*, *Investor Characteristics*, and *Market Conditions* (see for instance, Kaplan et al. 2009; Manigart et al. 1997; and Zacharakis and Meyer 1998). Similar drivers include objective entrepreneur characteristics, such as entrepreneur management-experience (Macmillan et al. 1985, 1987) and synergies between different types of entrepreneurial-background (Mason and Harrison 1996), but also subjective entrepreneur characteristics, such as passion and willingness-to-sacrifice (Silva 2004).

Entrepreneur Characteristics play a more prominent role in startup selection literature than in valuation literature. In selection literature, *Firm Characteristics* and *Investor Characteristics* relate more closely to startup-development-stage and to its products or services (for example Macmillan 1985, Maxwell et al. 2011), as well as investor specialization. Empirical studies on both topics reveal that *Entrepreneur Characteristics*, while critical to investment-selection, have limited-impact once investors have decided to invest, and negotiate pre-money valuation.

Furthermore, time has come to conduct research on changes concerning impacts of startup selection-criteria used by equity-investors on startup-valuation.

4.6 Recent Developments Concerning Startup Valuation

Lastly, zooming-in on the most recently published papers in the field informs of emerging trends, published in the last five years of our time period (from November 2016 to 2020). Eight papers have been published during the last five years of our time-period, providing substantial insight on startup valuation, some of which were published by highly prestigious authors, including Gompers, Cumming, Kaplan, and Strebulaev, and in high impact journals (e.g. *Journal of Financial Economics* and *Small Business Economics* each published two post-2016 studies examined here), thereby substantially expanding the field. While these eight studies examine drivers in all five of the macro-level drivers we identify, these studies in particular, expand the field by examining largely market conditions and deal conditions, two areas described by Budhwar et al. (2022) as areas where substantial publication opportunities exist due to their ability to tie together micro and macro theory.

Perhaps the most prestigious and highly-cited post-2016 study that we analyze is Gompers et al. (2020), is noteworthy as a substantial source of market condition, deal condition, and firm-characteristic valuation drivers. This study is also noteworthy for having multiple highly-cited second-authors, and can broadly be considered a successor-study to the research work of several of the paper's authors. A second highly-relevant post-2016 publication analyzed by our study is Cumming and Zambelli (2017), which examines the relationship between investor size and monitoring. Third, is Röhm et al. (2018), which focuses on the role of corporate venture capitalists. In principle, corporate venture capital represents another avenue by which Budhwar (2022)'s call to develop syntheses between macro and micro-theorizing going forward.

Overall, it would appear that this field may have moved forward more during the past five years than during many other periods during the topic's history.

5. Limitations and conclusion

5.1. Limitations

This study examines a range of publications on startup-valuation. Using an SLR protocol, we cast a wide net to identify and select relevant literature. This study nevertheless does suffer from several limitations.

The first relates to databases. Even using robust databases complemented by snowball-tracking, Google and Google Scholar searches, one can never be completely certain of identifying all relevant publications.

5.2. Conclusion

This study systematically reviewed the literature on startup-valuation and examined emergent trends. We identify five macro-categories (or themes) of drivers: *Entrepreneur Characteristics*, *Firm Characteristics*, *Investor Characteristics*, *Market Conditions*, and *Deal Conditions*.

The valuation impact of *Entrepreneur Characteristics*, *Firm Characteristics*, and *Market Conditions* are mostly positive, and are extensively, given that these three macro-categories serve as inputs for classical models, including DCF-valuation, multiples-valuation, and input-based valuation. Nevertheless, the literature also points to nuanced valuation impacts, such as complementary and interactive effects of different types of intellectual property (Block et al. 2014), or the description of patents as a signal of a startup's ability to generate new knowledge (Zheng et al. 2010). Another example is Black (2003)'s finding that valuation at different maturity stages reacts differently to financial statement components. For their part, *Investor Characteristics* and *Deal Conditions* have a more ambiguous impact and receive less coverage.

The analysis section explores the nature of impacts on startups outlined in the literature, and explores incentives, goals, and divergences, while the appendices elaborate on details of the trends, evolution, and structure. The discussion section identifies limitations of established on startup-valuation literature. Therein, we highlight primary research-avenues along which further investigation could advance.

While each macro-theme contributes relevant drivers to understanding to startup-valuation, divergent coverage levels are driven by practical issues such as data-availability, novelty, measurability, methodology, and context. In particular, future published research is likely to see an expansion in coverage of under-represented entrepreneur, firm-characteristic, and deal-condition drivers such as intellectual property, shareholder agreement-clauses, and subjective entrepreneur-characteristics, as methodology and data-access evolve.

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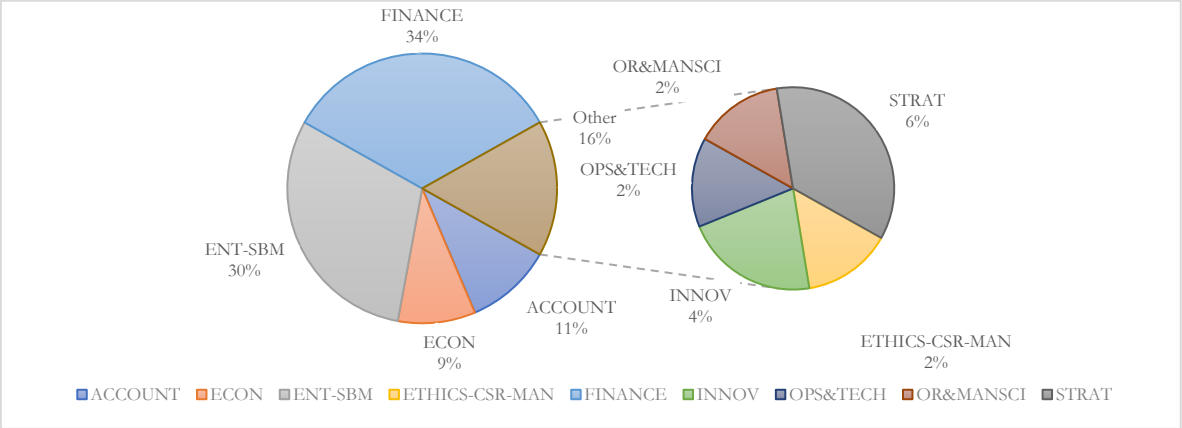
7. Appendices

Appendix I: Classification of Peer-Reviewed Literature

Peer-reviewed studies meeting inclusion criteria can be classified by source, theme, and publication-field, given that most are published within a narrow range of fields. For the most part, peer-reviewed studies were published in finance journals, economics journals, or ENT-SBM journals. While this accounts for four-fifths of peer-reviewed papers, the rest were published in six fields dominated by accounting journals, as seen in Figure 6.

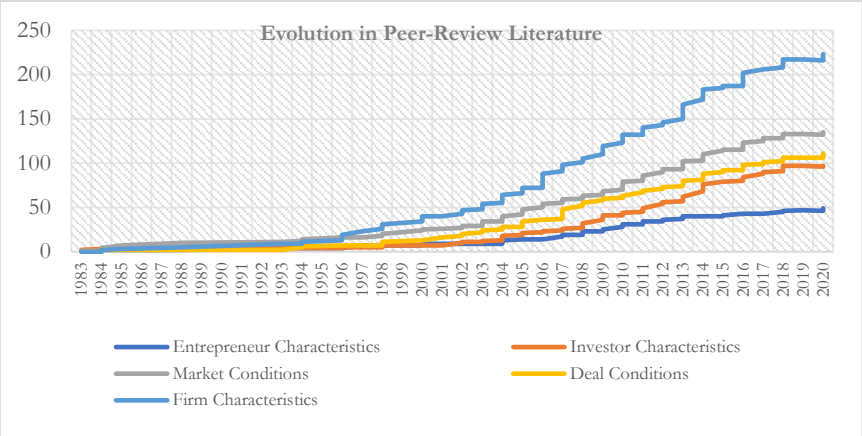
Fig. 6 ABS fields of journal publications

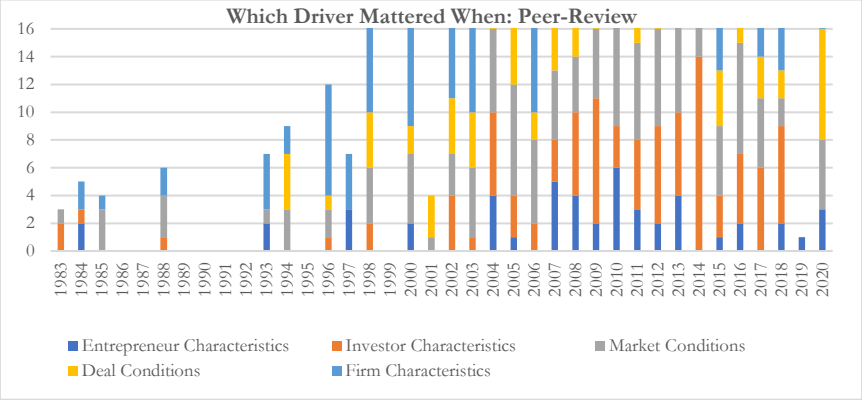


Appendix II: Driver Evolution and Trends

Figure 7 demonstrates content-evolution of the five thematic macro-categories. While *Firm Characteristics* dominate across all studies and time-frames, the post-2007 period has seen their dramatic acceleration across all literature.

Fig. 7 Evolution of thematic startup-valuation macro-categories





Because both DCF and multiples-valuation make extensive use of firm characteristics, this dominance is understandable. *Market Conditions* and *Deal Conditions* evolved along similar trajectories in peer-reviewed literature, both experiencing similar increases in 2002 and 2007. *Deal Conditions* saw their largest increase in peer-reviewed coverage in 2002. Moreover, publication trends emerged in waves, with 2000, 2006/07, 2014, and 2018 as pivotal-years for peer-reviewed literature.

Appendix III: Content-Differences Among Publication-Fields

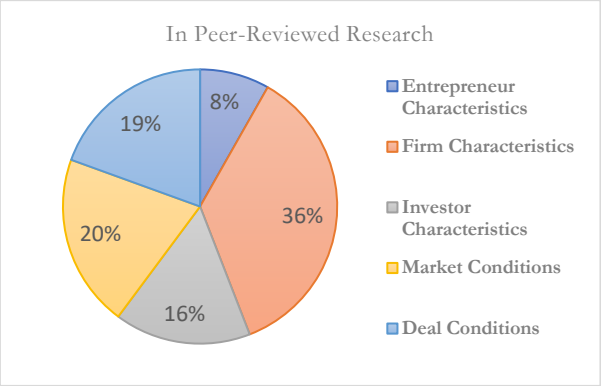
Thematic-content can be grouped along lines of publication-fields. Table 11 outlines per-field totals for peer-reviewed literature. Distinct schools-of-thought on valuation-drivers appear within the literature.

Tables 11 Per-Field Content Totals: Percentages and No. of Quotes

Per Field Totals	*Entrepreneur Characteristics*	*Firm Characteristics*	*Investor Characteristics*	*Market Conditions*	*Deal Conditions*
ENT-SBM	11% (18)	39% (66)	13% (22)	22% (37)	15% (26)
FINANCE	3% (7)	27% (58)	21% (45)	25% (52)	24% (51)
ECON	10% (5)	31% (15)	6% (3)	18% (9)	35% (17)
OTHERS	10% (17)	46% (77)	14% (24)	20% (33)	10% (17)

Figure 8 outlines shares of thematic-categories expressed in peer-reviewed papers. The percentages represent the coded-content covered within the literature. Overall, *Entrepreneur Characteristics* and *Firm Characteristics* receive most attention within peer-reviewed literature.

Fig. 8 Thematic macro-categories: peer-reviewed literature



CHAPTER 2:

Business Cycles and Cash-on-Market: Premoney Start-Up Valuations in Macroeconomic Environments[7]

Max Berre[8] and Benjamin Le Pendeven[9]

Abstract

How do business cycles affect start-up valuations? Uniquely, we delve into the influences of macro-level economic factors on start-up deal valuations. Using a data set of 1,089 European VC investments, we examine macroeconomic, cyclical, and macro-sectoral influences on premoney valuations, revealing that business cycles affect start-up valuations directly and indirectly. Beyond discounted cashflow factors, they depend on business cycles and the size of the local VC market. Using structural equation modeling, this study contributes to financial intermediary literature, investigating indirect and endogenous relationship possibilities. We find transmission-channels rather than independent drivers. These findings link insights on valuations, intermediary-markets, and macroeconomic determinants.

Keywords: Valuation, Start-up, Venture Capital, Entrepreneurial Finance, Business cycle, Structural Equation Model

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1. Introduction

In 2020 and 2021, worldwide venture capital (VC) markets reached record highs, in terms of both value invested and the number of deals, reaching $730.5 billion and around 33,000, respectively, by the end of 2021 (Pitchbook, 2023). At the same time, start-up valuations were shattering prior levels; for example, the number of unicorns increased from 45 in 2014 (*The Wall Street Journal*, 2015) to 1,056 in 2021 (Hurun Research Institute, 2021). Valuations of funded start-ups range from $5.08 million (Europe) and $11.4 million (U.S.) for angel financing to $1.73 billion (Europe) and $1.22 billion (U.S.) for Round-D financing (Pitchbook, 2022). Yet by the second half of 2022, worldwide VC markets showed slowed momentum, potentially signaling decreased premoney valuations, even in an industry with nearly $300 billion in dry powder (NVCA, 2023; *The Economist*, 2023). Questions of causality thus are salient, for practitioners (Payne, 2011; Berkus, 2016), policy makers (Dieppe at al., 2017; Popov, 2009), and academics (Gompers et al., 2020; Kaplan et al., 2009). Yet entrepreneurial finance literature in this realm tends to be limited to stakeholder (entrepreneurs and investors) factors or deal conditions, without sufficient attention devoted to macroenvironmental factors (Berre and Le Pendeven, 2022; Köhn, 2018).

Fundamentally, startups differ substantially from mature firms in terms of information environment, time structure of transactions, and linkages between investors and investees, suggesting that the relationship with the broader macroeconomic landscape in the two markets may be different (Bellavitis et al., 2017). Even if VC markets are deeply procyclical investment intermediaries, such that they channel investment funds into the entrepreneurial landscape during booms and recession recovery periods, limited considerations address their consequences for the premoney valuation of funded start-ups, after the selection stage. Heughebaert and Manigart (2012) find that more and more successful VC deals occur during strong domestic economic growth; Schwienbacher (2013) describes how markets for VC financing are subject to variations in capital supply over business cycles, such that institutional investors channel capital to VC funds during

booms. But as the VC unicorn bubble appears to be shrinking (The Economist, 2020), and vision and sound financials become equally central to successful fundraising, VC funds (i.e., non-bank financial intermediaries) have demonstrated greater responsiveness to macroeconomic conditions compared with banking sectors or other parts of the economy. Furthermore, reputational costs on VC markets may be lower during booms, due to their greater capital availability (Schwienbacher, 2013), unlike the valuation impacts of financial variables, which appear deeply dependent on the business cycle (Gavious and Schwartz, 2011).

Such trends suggest an effect of nuanced macroeconomic distribution channels, as well as a prime opportunity to draw novel insights by synthesizing macro-level and entrepreneurial finance, in line with calls by Budhwar et al. (2022). This gap is pertinent, considering how few finance studies examine the impacts of the business cycle or macroeconomic drivers on VCs and start-up markets. Some exceptions, such as Fitza et al. (2009) and Korteweg and Sorensen (2010), show empirically that business cycles affect valuation, but this phenomenon clearly needs further modeling and research. Doing so is critical to understanding VC market dynamics and the balance between investors and entrepreneurs' value holdings, as proclaimed in attention-grabbing headlines in recent years, when unicorns emerged in several key markets.

Using a novel data set of 1,045 European Union (EU) and European Economic Area (EEA) deals from 2000 to 2020, we explore the impacts of macroeconomic and business cycle–related factors on start-up valuations. These factors range from macroeconomic output gaps to dry powder, as well as country risk premiums and VC cash-on-market. Because the EU's supranational decision-making and regulatory powers mainly pertain to trade policy, economic regulation, and macrofinancial regulation (Jopp, 2017), examining European market data grants enables us to peer more closely into markets that feature distinct macroeconomic and macrofinancial landscapes but unified financial regulations. In this context, we argue and demonstrate that many traditional valuation drivers, classically shown to affect firm and start-up valuations, such as macrofinancial

or intermediary market indicators, actually are mediators that channel business cycle effects to the entrepreneurial landscape. That is, start-up valuation drivers are distribution channels, not independent valuation factors. Furthermore, because start-up valuations reflect discounted cashflow (DCF) models, we control for discounted cashflow–based firm and performance characteristics, in addition to market conditions. Thus, we derive a viable factor-based start-up valuation model that can encompass both external information, such as the sectoral market structure or macroeconomic situation, and contextual details, such as interaction or indirect effects.

Our contributions are twofold. First, this study addresses a gap related to the link between entrepreneurial finance and macroeconomic theory (Budhwar et al., 2022). Second, our results present the relationship between business cycles and start-up valuations as nonlinear, comprised of multiple, independent valuation channels that connect valuations with business cycles through partially mediating, intermediate variables. This new conceptualization of start-up premoney valuation and our empirical results, obtained through structural equation modeling (SEM), contribute to entrepreneurship and financial intermediary literature, in that our empirically supported model can reveal how business cycles affect start-up valuations both directly and indirectly, through multiple, independent, macro-level valuation channels.

In the next section, we review prior literature pertaining to the impacts of country-level and macroeconomic factors on VCs and start-ups, along with their role in determining premoney start-up valuations. We then detail the data set, key variables, and empirical approaches we use to establish the impact of macroeconomic and business cycle market conditions on start-up valuations. Section 4 contains the empirical results of our baseline scenario, ordinary least squares (OLS) models, and fixed-effects models. After we discuss the key findings in detail, we conclude with some implications and avenues for further research.

2. Literature Review

According to several systematic literature reviews, such as those by Köhn (2018), Wessendorf (2019), and Berre and Le Pendeven (2022), most studies of premoney valuation investigate entrepreneurs, investors, or deal-related factors, not macroeconomic determinants. Articles that include macroeconomic drivers tend to feature them as control variables. The lack of detailed investigation into the role of macroeconomic market conditions constitutes a notable gap; even fewer studies explore indirect effects on valuation in entrepreneurial settings. Yet macroeconomic and macrofinancial factors clearly drive start-up investments, as identified by authors who show that VC markets behave as procyclical financial intermediaries (Bygrave and Timmons, 1985; Korteweg and Sorensen, 2010).

2.1 Macroeconomic Impacts of Funding Availability: VCs' Intermediary Role

As financial intermediary markets, VC markets are driven by business cycles and macroeconomic conditions, and in turn, they drive start-up valuations. Chan's (1983) early theoretical model outlines how investment allocations at the macro-level depend on VCs' intermediary role, as a means to manage sector-specific information asymmetries. Focusing on VC fund availability, Gompers and Lerner (1998) use a two-stage model to estimate the probability that funds get raised, then predict the amount raised. They show that firm characteristics have the strongest effect, but fundraising also depends on gross domestic product (GDP) growth rates. Capital gains taxes affect the amount raised but not the funding probability.

The total value of stocks traded also can explain divergent levels of VC intensity, along with real interest rates, total number of stocks traded, corporate income tax rates, and business expenditures on R&D (Bonini and Alkan, 2009). Other key determinants include inflation and total entrepreneurial activity (Bonini and Alkan, 2009). Thus, VC markets can reflect both macroeconomic factors and start-up market activity.

Private equity activity is driven by the institutional environment, economic activity, unemployment rates, equity market capitalization, and unit labor costs (Bernoth and Colavecchio, 2014), as well as by output levels and long-term interest rates (Fuss and Schwweizer, 2012). In principle, country-level variables should influence the overall impact of private equity in an economy. But even if private equity investments, relative to GDP, indicate investor confidence, they do not necessarily signal returns or valuations.

With regard to funding availability, inflows of capital to VC funds increases valuation by their investment targets (Gompers and Lerner, 2000), whereas activity in private equity markets is deterministic for start-up valuations (Inderst and Muller, 2004; Hellmann and Thiele, 2015). According to Inderst and Muller (2004), describing endogeneity between VC fund scarcity, entry costs, and investment profitability, investment profitability drives start-up valuation and VC market entry. Cash-on-market also affects start-up valuations, though this relationship might be subject to endogeneity and indirect valuation influences.

2.2. Business Cycles

Business cycle dynamics influence start-up valuation, as business cycles affect the difficulty with which startups can raise early-stage capital (Cumming and Vismara, 2017; Dieppe at al., 2017). More successful VC deals take place in conditions of strong economic growth in Finland and Belgium for example (Maula and Murray, 2003; Heughebaert and Manigart, 2012). More generally, a global macroeconomic spillover analysis model defines financial variables as determinants of domestic output and predicts that financial spillovers occur through four channels: equity prices, interbank rate spreads, lending tightness, and sovereign risk premium relationships (Dieppe at al., 2017). Lending tightness in turn depends on momentum and expected GDP growth. In this intermediary role, lending tightness has a deterministic effect on the real economy and itself is affected by key macroeconomic variables, which is informative for understanding the structural relationships between macro-level variables and the real economy. The transmission of financial

shocks to the real economy also implies that financial variables exert time-stable impacts, even as business cycles progress (Dées 2016), which can clarify how structural relationships influence valuations.

Still, VC markets are subject to substantial variations in capital supply over the business cycle, with inflows from institutional investors during boom periods (Schwienbacher, 2013). Financial integration drives business cycle synchronization through indirect effects, promoting trade integration and economic structural similarity, even if direct qualitative and quantitative financial integration effects indicate otherwise (Trancoso and Gomes, 2020). By distinguishing the direct and indirect impacts on business cycles, we can demonstrate the inherent complexity of the relationship between business cycles and the overall economic situation, as well as acknowledge the possible need for a SEM. With regard to the specific functional form, the relationship between direct and indirect determinants is unclear.

2.3. Macrofinancial Interaction Effects

Sectoral, macroeconomic, and business cycle factors all might determine start-up markets, and so might their interactions. For example, macroeconomic indicators and industry-level indicators might interact, with VC markets functioning in variable financial intermediary roles. Industry-level sensitivity to VC markets drives firm-level size and establishes that the relationships of financial market conditions with start-ups is industry-specific (Popov, 2009) (i.e., influenced by sectoral variables and subject to multivariate functional forms). Meanwhile, firm characteristics are weighed differently in various countries (Lockett et al., 2002), as lower risk-free rates drive overvaluation, and illiquidity premiums reduce overvaluation. Thus, valuation discount factors appear driven by cyclical and macrofinancial conditions (Gornall and Strebulaev, 2020). The valuation effects of DCF factors (e.g., revenues, discount factors) are affected by macroeconomic and cyclical market conditions. Even if existing literature establishing the relationships among VC markets, inputs to start-up value (firm and entrepreneur characteristics), and start-up valuations has noted the direct,

indirect, and interactive influence of market conditions, separate from sectoral or macroeconomic conditions, the question of specifically where and how these effects occur begs further investigation, particularly for complex, indirect, or multistage functional forms.

2.4. Background and Research Hypotheses

Market conditions represent macrofinancial, macroeconomic, sectoral, and cyclical indicators. Hsu (2007), who uses year dummies, observes that valuations are higher when fund inflows are high. Armstrong et al. (2006) control for a benchmark financial index and find a positive and significant valuation impact. Moreover, the interaction effects between market conditions and firm characteristics create additional valuation synergies. For example, the valuation impact of a firm's balance sheet financials shifts with the business cycle, growing in importance during a post-bubble recession (Gavious and Schwartz 2011), and interaction effects arise between sectoral conditions and investor characteristics (Gompers et al., 2008).

Start-up valuations thus may be driven by overall economic and cyclical activity. Several studies suggest this influence, such as by noting that more successful VC deals occur during boom periods (Heughebaert and Manigart, 2012). Moreover, business cycles drive valuation (Fitza et al., 2009; Korteweg and Sorensen, 2010), and overall economic activity directly influences the share of the macroeconomy accounted for by private equity activity (Bernoth and Colavecchio, 2014). Among the various ways that business cycles directly affect valuation, both revenues and discount factors (e.g., beta, country risk premium) can be modeled directly. Business cycles might directly affect valuations through potential future revenue growth, industry growth, or macroeconomic growth, all of which serve to attract investors and thus influence both investor selection and start-up valuations (Wessendorf et al., 2019). Business cycle growth might determine valuations through the growth of business networks, partnerships, and relationships (Streletzki and Schulte, 2013). Alternatively, macroeconomic business cycle conditions might inflate short-run valuations during

booms, which must be corrected later (Michel, 2014). Thus, macroeconomic indicators can drive overall activity but also valuations.

In contrast, start-up valuations reflect market conditions specific to VC markets. Not only does VC cash-on-market directly influence premoney valuations (Inderst and Muller, 2004), but entrepreneur effort (Fulghieri and Sevilir, 2009) also increases valuations directly, serving as a value signal to investors. For European market deals, as in our data set, we test this prediction by measuring the distinct impacts of business cycles, macroeconomic indicators, and country-level VC sector size on start-up valuations. Formally:

> *H1a: The macro-level drives the market, such that start-up valuations stem from macroeconomic, macrofinancial, and macro-level indicators. They are the basis for revenue and discount rate projections, so a direct valuation impact exists.*
>
> *H1b: Start-up valuations are driven by VC cash-on-market, such that domestic cash-on-market impacts indicate relatively insular VC markets, whereas global cash-on-market impacts indicate cross-border valuation effects.*

Meanwhile, VC market conditions may reflect the business cycle conditions that affect start-up valuations. Non-bank financial intermediary markets (including VC and other investment markets) reflect business cycles in a procyclical manner. Macroeconomic activity affects overall private equity activity, such that as a macroeconomy grows, investment in its emergent firms grows too (Bernoth and Colavecchio, 2014). Then financial spillovers occur through equity prices, the interbank rate spread, lending tightness, and sovereign risk premium relationships. Fundamentally, cash-on-market likely transmits the financial spillovers of the business cycle that originate elsewhere in the macroeconomy (Dieppe at al., 2017). Meanwhile, lending is subject to macroeconomic-level variations driven by (macro-level) tail risks (Chu and Zhang, 2022), and VC financing markets are subject to substantial variations in capital supply over the business cycle (Schwienbacher, 2013). As implied by Dieppe at al. (2017), VC markets function as financial spillover transmission channels, together with equity prices and lending tightness. Because cash-

on-market captures VC sector size in a country, it is pertinent to test whether it is deterministically influenced by macroeconomic and business cycle indicators. Formally,

> *H2: Cash-on-market is driven by macroeconomic and cyclical indicators. Because the direct valuation impact of both cash-on-market and macrofinancial indicators exists, second-order valuation impacts emerge.*

In principle, even if we know that start-up valuations are driven by revenue and risk premiums (Damodaran, 2002; 2009), the *manner* and *degree* of this impact might be specific to a country or industry (Damodaran, 2010), as well as influenced by distinct conditions within countries, cities, and industries. The nature and scale of the impact of DCF valuation factors could depend on macro-level market conditions, which might be regulatory or macroeconomic in nature (Bernoth and Colavecchio, 2014; Gompers and Lerner, 1998; Lockett et al., 2002). Alternatively, they might be influenced by industry-level effects (Chan, 1983; Damodaran, 2009). Accordingly, Manigart et al. (1997, 2000) identify different valuation impacts across sectors, geographic settings, and investor contexts. Alternate views also describe national-level economic outcomes driven by local, investor-side, or supply chain effects (Porter, 1990).

In terms of functional forms, we describe divergent impacts of DCF valuation factors across cities, countries, industries, and investors, or combinations thereof, which might be specific to industries, cities, investors, and countries or whose valuation divergences might be driven by such differences. Functionally, industry fixed-effects might explain differences in valuations, because they can capture industry-level business relationships, business models, and firm survivability differences (Damodaran, 2009). Country-level fixed-effects could capture national-level differences in macroeconomic fundamentals, governance, and economic policies (Bernoth and Colavecchio, 2014; Gompers and Lerner, 1998). Such governance and policy differences likely lead to divergent valuation approaches and variations in the relative importance of different drivers (Rojo-Ramirez, 2013). City fixed-effects might capture economic clustering, as well as city-level investor and industry concentration (Porter, 1990).

Fundamentally, if the impact of DCF valuation factors can be influenced by country-, industry-, or local-level dynamics, it is important to compare them while also examining the specific nature of the functional form of each factor and its specific influence on the valuation impact of those DCF valuation factors. To do so, we control for categorical variables, such as country, industry, and city, using fixed effects, and we test our prediction that

> *H3: The macroeconomic situation affects VC investors and start-ups in some subsets of the data set more than others. Fixed-effects regressions should tell a dramatically different story than baseline macroeconomic or macro-level regressions.*

With regard to the influence of market conditions on the valuation impact of DCF factors, an alternate approach to the functional form question pertains to indirect effects and relationships. The role of business cycles (booms in particular) in determining the valuation impacts of other variables, such as financial variables (Gavious and Schwartz, 2011) or reputation costs (Schwienbacher, 2013), indicates that business cycles exert both direct and indirect effects, along with influences on intermediate factors such as VC industry variables, country risk premiums, and macroeconomic determinants, which influence valuation further.

This study is not the first to model indirect effects. Empirical evidence reveals that formal entrepreneurship reflects the availability of economic opportunities, which in turn depend on macro-level resource availability (Thai and Turkina, 2014). Financial variables function as key determinants of domestic output, and as noted, financial spillovers occur through four channels (equity prices, interbank rate spread, lending tightness, and sovereign risk premium relationship). Lending tightness reflects both momentum and expected GDP growth (Dieppe at al., 2017). In principle, the relationships of start-ups, macroeconomic cycles, and intermediary financial valuation channels likely follow a similar pattern, involving intermediate variables, such that they might imply endogenous, fully or partially circular causal relationships, which can be modeled with generalized variance autoregressive approaches (Dées, 2016) and SEM (Trancoso and Gomes, 2020). Both are well-suited to examining business cycle dynamics and relationships. In addition to capturing

indirect effects, SEM facilitates the capture of endogenous, fully or partially circular relationships among dependent, independent, and mediating variables. Essentially, indirect effects across valuations, intermediate variables, and wider macro-cyclical conditions can be captured by multistage econometric models (Dées, 2016; Thai and Turkina, 2014; Trancoso and Gomes, 2020). What remains to be seen is the precise shape of the direct and indirect relationships, as well as whether any parts of this relationship architecture are endogenous in nature. This relationship shape can be tested with SEM techniques, which can map the specific structure of indirect effects in detail.

> *H4a: Business cycles and financial intermediary market conditions affect start-up valuations directly and independently of each other.*
>
> *H4b: Business cycle effects on start-up valuations are non-circular, full or partial mediation effects that influence valuations both directly (partial mediation) and through other market conditions.*
>
> *H4c: Business cycle impacts on start-up valuations are circular, full or partial mediation effects that influence start-up valuations through an endogenous, circular relationship between mediating financial market conditions and start-up valuations.*

3. Data and Methodology

In this section, we outline the modeling approaches we used to capture and describe the indirect and contextual effects of market conditions on valuations, through DCF-related valuation drivers.

3.1. Scorecard-Based Valuation

Premoney start-up valuations refer to the prices paid by equity investors to make early-stage investments (Cumming and Dai, 2010). Scorecard valuation methods are modular and relatively straightforward, such that they sum key characteristics, market conditions, and deal conditions; they have been developed mainly by industry practitioners. In economics literature, summation-based valuation models adopt similar methods (Hand, 2005; Sievers et al., 2013). In principle, scorecard approaches can model indirect valuation influences, non-financial features, and deal characteristics that are prevalent in a given market or a subset of it.

In their model of contextually dependent start-up valuation processes, Berre and Le Pendeven (2022) assign factors to appropriate process and chronological positions. The value inputs include external market conditions as part of the valuation-forming process. Thus, their model implies both direct and interaction effects of market conditions on start-up valuations:

Equation 1: Berre-Le Pendeven Start-up valuation Meta-Model

$$\boldsymbol{Pre-Money\ Valuation} = \boldsymbol{f}(((\sum \boldsymbol{Startup\ Value}) \sum \boldsymbol{Deal\ Value}) \sum \boldsymbol{Deal\ Valuation})$$

To gain a holistic view of the explanatory power and valuation impact of macroeconomic factors and macrofinancial factors in start-up ecosystems, empirical models should include factors used in classical firm valuation models, such as DCF-related factors. Including classical factors provides a means to establish the conceptual and theoretical soundness of the data set; it also provides some controls for elements that need to be taken into account to isolate macroeconomic and macrofinancial effects. Thus, our empirical approach centers on the valuation impact of the business cycle, tax rates, and VC cash-on-market levels.

3.2. SEM Approach

Regardless of the functional form, accurate measures of the valuation impacts of market conditions confront two main obstacles: endogeneity and indirect effects (e.g., partial or full mediation). To overcome such obstacles, we employ partial least squares structural equation modeling (PLS-SEM), which offers several relevant advantages. In particular, an SEM approach explicitly addresses the nestedness of our observed data (Maula and Stam, 2020), allowing us to analyze complex, indirect relationships (Gefen et al., 2000; 2011), which feature both direct and indirect effects (Little et al., 2007) and are appropriate for exploratory theory building and prediction. As a nonparametric estimation technique (Wold, 1982), PLS-SEM also provides an iterative combination of empirical analyses that relates measures with constructs and path analysis, mapping the direct and indirect relationships of key valuation drivers.

3.2.1. Indirect Effects

The impact of business cycles on start-up valuations is likely indirect, acting through financing costs and conditions, as well as direct, acting on firm revenues, business opportunities, local market demand, and firm-level asset values, which link the firm's fortunes directly to business cycles. With SEM, we can measure direct and indirect effects simultaneously, accounting for full, partial, and inconsistent mediation, as well as latent and unobserved variables, such that the observed relationships might be part of a complex, qualified relationship system (Little et al., 2007). As noted, SEM is particularly well-suited to investigating business cycle effects, dynamics, and drivers (Trancoso and Gomes, 2020).

3.2.2. Endogeneity

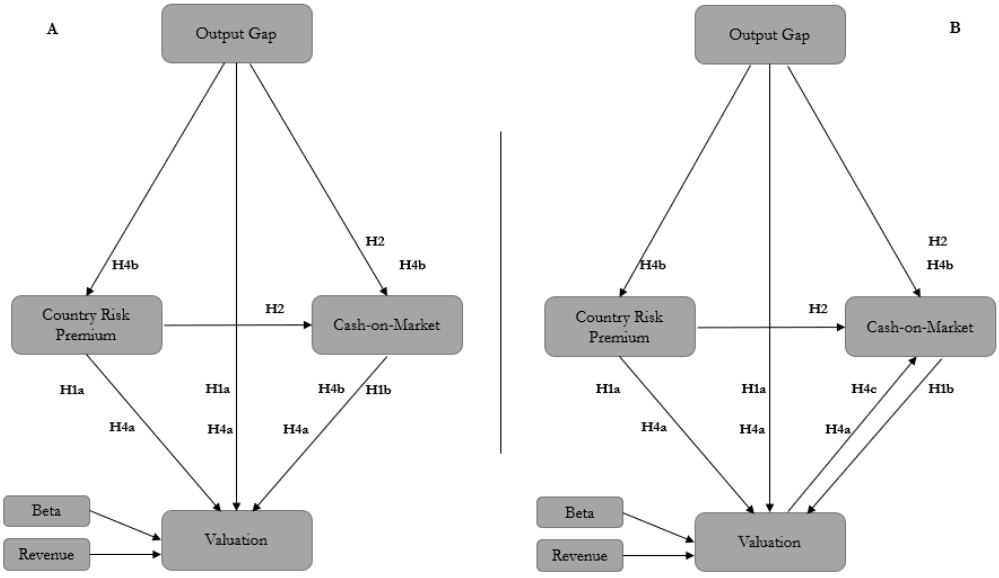
As Wooldridge (2010) explains, in principle, endogeneity arises from one of three causes: omitted variable bias, simultaneity, or measurement error. Testing for endogeneity can indicate whether the causal relationship is more complex than detected at first or if the causal relationships are influenced by additional explanatory variables or measurement error. Although a directly circular endogenous relationship is unlikely between business cycles and start-up valuations in a data set dominated by start-ups competing in large, historically well-established European economies, the relationships among business cycles, cash-on-market, and start-up valuation could give rise to circular cash-on-market relationships in which business cycles and cash-on-market relate endogenously. Cash-on-market also could be endogenously related to valuation.

Alternatively, endogeneity might be driven by hidden variable bias (Wooldridge, 2010), which might act on the model's dependent variables, explanatory variables, or both. Using two-stage least squares is a common approach to account for endogeneity, but the selection of variables and the relationships with both dependent and other explanatory variables demands careful consideration. Accordingly, we present an SEM in Figure 1. The two-stage least squares regression analysis, used to analyze structural equations (Gefen et al., 2011), is essentially an extension of

ordinary least squares (OLS), and it is useful when the dependent variable's error terms correlate with the independent variables (Wooldridge, 2010).

Figure 1 depicts the valuation impact of direct business cycle effects, as well as indirect effects through financing conditions. In Panel A, the business cycle–valuation relationship is non-circular, subject to partial mediation through financing conditions; in Panel B, this relationship appears subject to partial mediation through financing conditions, with endogenous relationships between business cycles and cash-on-market and between valuation and cash-on-market.

Figure 1: Structural-Equation-Model Valuation-Relationship Path-Diagram: Non-Circular and Circular Models



3.2.3. Equation Structure

Figure 3, Panel A, reflects a two-tiered SEM subject to partial mediation involving the country risk premium and cash-on-market as mediating variables, such that:

Equation 2: Output-Gap and Start-up valuation

$$[1]\ Cash-on-Market_t = \sum_{t=1}^{T} \beta_{1t}(Output\ Gap_t) + \sum_{t=1}^{T} \beta_{2t}(Credit-Risk-Premium_t) + \varepsilon_{1t}$$

$$[2]\ Valuation_t = \sum_{t=1}^{T} \beta_{3t}(Revenue_t) + \sum_{t=1}^{T} \beta_{4t}(Sectoral-Risk-Beta_t) + \sum_{t=1}^{T} \beta_{5t}(Credit-Risk-Premium_t) + \varepsilon_{2t}$$

Although circular relationships between business cycle indicators and cash-on-market might be possible in principle (Fuss and Schwweizer, 2012), they are unlikely, given the composition of our data set (i.e., established, industrial EEA markets, comparatively smaller VC markets, business cycles driven by European-level cyclical transmission channels; Weyerstrass et al., 2006). They also are difficult to measure, given the need for an instrumental variable that affects business cycles but not cash-on-market. Partial endogeneity, with an endogenous relationship between valuation and cash-on-market, instead is both measurable and supported by economic theory. Figure 3, Panel B, meanwhile, describes a partially circular relationship, featuring an endogenous relationship between cash-on-market and contemporaneous endogeneity of the start-up valuation, as follows:

Equation 3: Output-Gap and Start-up valuation under partial endogeneity

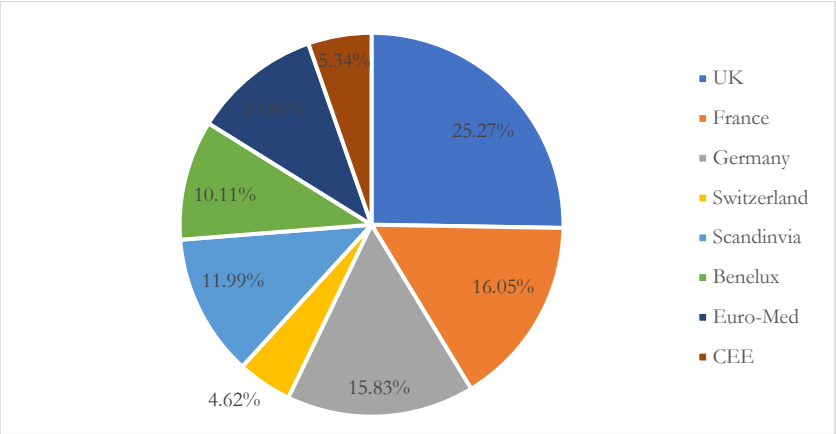
$$[1]\ Cash-on-Market_t = \sum_{t=1}^{T} \beta_{1t}(Output\ Gap_t) + \sum_{t=1}^{T} \beta_{2t}(Valuation_t) + \sum_{t=1}^{T} \beta_{3t}(Credit-Risk-Premium_t) + \varepsilon_{1t}$$

$$[2]\ Valuation_t = \sum_{t=1}^{T} \beta_{4t}(Revenue_t) + \sum_{t=1}^{T} \beta_{5t}(Sectoral-Risk-Beta_t) + \sum_{t=1}^{T} \beta_{6t}(Credit-Risk-Premium_t) + \varepsilon_{2t}$$

3.3. Europe's VC Market

Although the GDP of the pre-Brexit European Single Market was comparable in size to that of the United States, Europe's VC market is substantially smaller, equivalent to roughly one-tenth the size of the U.S. VC market. Additionally, Europe's VC market is known to be less liquid than the US market (Schwienbacher, 2008; 2009). According to OECD data, United Kingdom accounts for one-quarter of Europe's VC market (see Figure 2), and adding France, Germany, Scandinavia, and the Benelux makes up roughly 80% of this market.

Figure 2: Breakdown of 2020 European VC Market[10]



3.4. Data Set

Our data set consists of an unbalanced panel drawn from multiple sources. The first tranche of observations consists of proprietary deal data shared by Early Metrics, a Paris-based start-up ratings and research agency (78 observations). Then we add EEA-located start-up deals drawn from EIKON and Crunchbase (397 and 614 observations, respectively; see Table 1). These supplementary sources offer similar content to Early Metrics data, and they have been used regularly in entrepreneurial finance research. To enrich the data set, we cross-reference each deal with firm performance and industry-level, municipal, and national-level macroeconomic data, which is described in detail in Appendix I. We leverage both proprietary and commercially available data, for an extensive variety of value-adding categorical variables. The categorical variables have substantial explanatory power in their own right, and they add further value by virtue of their interaction with firm characteristics and the macroeconomic and business cycle market conditions that are the focus of this study.

By limiting our analysis to European data, our study gains several strengths, including macroeconomic diversity sufficient to reveal meaningful fixed effects. Each entry in our data set refers to a specific investor and deal; multiple investor deals occupy multiple lines, so we can identify relevant data for each start-up and investor. That is, each unique investor–start-up pair

[10] OECD Venture Capital Investments Data

constitutes a separate observation. This data set structure is similar to that used by Masulis and Nahata (2009). With 1,089 observations, representing 1,042 deals and 673 start-ups, ranging from Q1 2000 to Q1 2020, the data set is substantial, though only 582 observations offer firm-level revenue figures. Nevertheless, the sample size is larger than in prior entrepreneurial finance studies, such as Masulis and Nahata (2009), Greenberg (2013), and Gompers et al. (2020), which feature 273, 317, and 444 observations, respectively.

Table 3: Data Set

Source	Number of Observations
EIKON	397
Early Metrics	78
Crunchbase	614
Total	**1089**

3.5. Dependent Variable

The primary dependent variable is premoney start-up valuation. In this study, we apply the definition for startup-valuation used by both Cumming and Dai (2010) and by Berre and Le Pendeven (2022): the startup-price (or price-of-shares) paid for an early-stage investment by equity-investors. This definition is specific to valuations observed in venture capital investment deals and excludes exits such as IPOs or trade-sales, which cannot be considered a part of a startup's emerging phase. Valuations are expressed in EUR. Data drawn from outside the Eurozone (Denmark, Poland, Norway, United Kingdom, Sweden, and Switzerland) were converted into EUR using that year's average exchange rate. Table 2 lists the summary statistics. Although the time and sectoral distributions of these data are somewhat uneven, the set covers major business cycle events, including the end of the dotcom bubble, the Eurozone crisis, and the start of the COVID-19 pandemic.

Table 4: Start-up Deal Data Set Summary Statistics

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Totals
Mean Valuation	109 000 000	49 700 000	32 900 000	21 800 000	50 800 000	12 000 000	25 700 000	15 200 000	4 181 531	511 000 000	11 900 000	33 300 000	40 100 000	10 300 000	65 400 000	182 000 000	90 100 000	298 000 000	286 000 000	1 130 000 000	1 170 000 000	222 000 000
Std. Dev	239 000 000	155 000 000	29 800 000	15 500 000	29 400 000	7 679 114	32 100 000	9 378 568	3 352 995	690 000 000	.	9 424 469	135 000 000	36 100 000	234 000 000	363 000 000	232 000 000	634 000 000	787 000 000	1 300 000 000	1 420 000 000	602 000 000
Min	795 216	83 579	57 287	6 969 987	30 000 000	762 500	2 970 006	1 708 426	762 500	1 558 441	11 900 000	9 999 972	55 714	53 833	50 000	63 330	63 330	80 000	2 160 000	1 412 881	2 354 802	50 000
Max	1 490 000 000	1 280 000 000	120 000 000	43 700 000	71 500 000	16 500 000	48 400 000	24 000 000	8 899 903	1 270 000 000	11 900 000	36 700 000	556 000 000	229 000 000	1 560 000 000	1 920 000 000	1 920 000 000	2 140 000 000	2 230 000 000	5 380 000 000	5 060 000 000	5 380 000 000
Austria	-	3	-	-	-	-	-	-	2	-	-	-	-	-	1	-	-	-	-	-	-	6
Belgium	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	3	5	-	5	17
Croatia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Czech	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6
Denmark	-	3	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	3	-	8
Finland	1	-	-	-	-	-	-	-	-	-	-	7	-	1	1	5	2	4	1	-	-	22
France	29	11	4	-	-	5	-	-	-	2	-	1	1	4	-	5	27	16	-	1	-	106
Germany	19	11	3	-	1	-	-	-	2	-	-	-	2	3	5	12	14	33	-	31	2	138
Ireland	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	5	8	5	-	-	-	20
Italy	3	-	-	-	1	-	-	-	-	-	-	-	1	1	-	1	2	1	-	-	-	10
Latvia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1
Lithuania	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	-	7
Luxembourg	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	3	-	-	-	-	6
Netherlands	2	1	2	-	-	-	-	-	-	-	-	-	-	-	5	-	-	1	-	-	-	11
Norway	2	4	-	-	-	-	-	2	-	1	-	-	-	-	-	-	-	1	-	-	-	10
Poland	9	8	-	-	-	-	-	-	-	1	-	-	-	-	1	1	2	-	-	-	-	22
Portugal	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	1	2	2	1	-	-	8
Romania	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	6
Spain	5	-	1	-	-	-	-	-	-	-	-	-	-	2	1	2	4	2	-	4	-	21
Sweden	5	3	-	-	-	-	-	-	-	-	-	1	1	-	1	13	-	2	-	1	-	27
Switzerland	4	1	1	-	-	-	-	-	-	-	1	-	-	-	1	-	2	3	-	-	-	13
UK	43	59	6	4	-	2	1	2	1	1	-	-	12	30	89	151	116	54	5	26	21	623
Total	133	108	17	4	2	7	2	5	5	5	1	9	17	42	106	200	182	130	12	73	28	1089
Business / Consumer Services	-	-	-	-	-	-	-	1	-	-	-	-	5	8	30	33	21	12	-	-	-	110
Aerospace	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
Retail	12	9	-	-	-	-	-	-	-	-	-	-	1	3	9	22	31	2	-	7	-	96
Automotive	-	2	-	-	-	-	-	-	-	-	-	-	-	1	1	-	2	9	-	-	-	15
Finance	5	4	2	-	1	-	-	1	-	1	-	-	1	4	5	45	23	23	1	17	4	137
Food/Agro	3	-	-	-	-	-	-	-	-	-	-	-	-	4	16	12	16	16	1	-	1	69
Machinery / Industrial	6	4	1	2	-	-	-	-	-	-	-	-	-	1	-	2	5	3	-	-	-	24
Power	1	1	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	6
ICT / Software	62	45	6	1	-	5	2	2	3	-	-	9	5	9	23	27	35	33	5	36	18	326
Pharma / Healthcare	18	21	7	-	1	2	-	-	2	1	1	-	-	1	-	11	13	3	1	1	5	88
Education	-	1	-	-	-	-	-	-	-	-	-	-	1	-	1	3	4	3	1	-	-	14
Electronics	2	1	-	-	-	-	-	-	-	-	-	-	1	2	-	3	2	1	1	-	-	13
Leisure / Entertain/ Tourism	5	3	1	-	-	-	-	-	-	-	-	-	2	2	10	15	18	5	-	3	-	64
Clean-Tech	-	1	-	-	-	-	-	1	-	-	-	-	1	-	-	1	1	4	2	-	-	11
Home	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	2
Real Estate	1	2	-	-	-	-	-	-	-	-	-	-	-	-	1	11	3	8	-	9	-	35
Office	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	1	-	-	-	3
Fossil	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Transport	1	-	-	-	-	-	-	-	-	2	-	-	-	2	1	11	6	6	-	-	-	29
Media	7	3	-	-	-	-	-	-	-	-	-	-	-	1	8	1	-	-	-	-	-	20
Total	123	98	17	4	2	7	2	5	5	5	1	9	17	42	105	200	180	130	12	73	28	

3.6. Independent Variables: Macroeconomic and Macrofinancial Market Conditions

By connecting macro-level market conditions to the micro-level valuations in startup markets, a micro-foundational lens is applied, which enriches and refines our understanding of startup markets (Bellavitis et al., 2024). In line with both Gompers and Lerner (1998) and Bonini and Alkan (2006), who assert that valuations are driven by macroeconomic indicators, cyclical indicators, and tax rates, our macroeconomic data consist of country risk premiums, cyclical indicators, and tax rates, whose mutual independence we test via multicollinearity testing, as presented in Appendix II. Hypothetically, GDP growth offers a viable gauge of business cycle conditions, but our data set consists mainly of recessionary period data (i.e., positive but below trend GDP growth, with smaller deterministic effects during booms), so it requires cyclical contextualization to be a reliable explanatory variable. Therefore, we select the macroeconomic output gap, drawn from OECD figurers, as a primary macroeconomic market condition indicator. In Appendix III, we dive deeper into the valuation impact of GDP growth, which varies substantially across the business cycle. Overall, the statistical significance of GDP growth is present only in the most recessionary 50% of the data set observations. Furthermore, the coefficient magnitude of GDP growth increases when the business cycle enters boom phases.

At the macroeconomic level, we include an IMF tax rate figure, tax revenue as a share of GDP, and a country risk premium, drawn from the NYU Stern database. Because country risk premiums are core components of risk-adjusted discount rates (Damodaran, 2009), we include them in the baseline scenario, which is driven by DCF valuation models. Then we add total VC market size, at both the country level and on global markets, which Inderst and Muller (2004) describe as key determinants of start-up valuations, as well as dry powder, which might act as an intermediate variable in the valuation

process. Total VC market size figures come from OECD annual data related to total VC investments per country. Meanwhile, dry powder, a form of heretofore unspent capital, which can be defined as investor's committed but unallocated capital on hand (Nörthemann, 2022), are available from Invest Europe, which provides annual dry powder figures for six multi-country regions in Europe. Functionally, while dry powder may influence valuations, dry powder also has the effect of temporally-stretching relationships between macroeconomic market conditions and startup markets (The Economist, 2023). To estimate national-level, annual, dry power figures, we use each country's fraction of total VC investments in the region. As an alternative to capturing business cycles with a macroeconomic output gap, we use the Eurozone Growth Cycle Coincident Indicator (GCCI); we outline the results of this robustness check in Appendix IV.

3.7. Valuation–Driver Interaction

In addition to direct valuation impacts of DCF-related factors and the macro-level drivers of start-up valuation, we consider the impacts those variables have on one another. The overall impact of economic indicators varies as business cycles progress (Blanchard and Leigh, 2013). For example, Gompers et al. (2010) find interactions between investor experience and macroeconomic indicators, and Gavious and Schwarz (2011) identify interaction effects between business cycles and a start-up's firm characteristics. Thus, the inclusion of interaction effects is justified by both theory and existing literature. To this end, we include interaction variables for the potential interaction of each DCF variable with cash-on-market and the business cycle.

3.8. Baseline Model: Control Scenario

Depending on the approach taken, valuations might be driven by firm performance and revenue indicators, such as sales revenue, net income, cash flow from operations, EBIT, or EBITDA; discounted by risk factors such as industry risk premiums, country risk premiums, WACC, and CAPM-

betas, as in DCF models; contextualized by the balance sheet or income statement figures, as occurs in multiple valuation models; and moderated by growth rates, such as in the Gordon growth model (Damodaran 2002; 2005; 2009; 2010). Functionally, a DCF approach can be approximated using OLS and regressing valuation against revenue indicators, as well as DCF discount factors, such as the sector-level unlevered beta or country risk premium. Existing valuation approaches either apply DCF directly or borrow from assessments caried out by others (Damodaran 2005; 2009; 2010), so the impacts of DCF valuation determinants need to be controlled for, both to establish the theoretical consistency of the data set and to determine the concrete value-added of non-DCF valuation factors, such as macroeconomic market conditions, financial intermediaries, and business cycle conditions.

The start-up revenues are available in the Early Metrics deals data set, and a few deals were drawn from EIKON. Then we gathered additional revenue figures from Dun & Bradstreet, as well as Zoominfo, which provided revenue figures for approximately half of the data set. Sectoral unlevered beta, an industry-level measure of systemic risk, comes from the NYU Stern data set and reveals industry-level sensitivity to financial market benchmark volatility. Damodaran (2009) uses these figures as inputs for risk-adjusted discount rates in DCF-based valuation models. The c*ountry risk premium* from the NYU Stern data set's country default spreads and risk premium page was accessed on 31 January 2021. It should represent sovereign bond ratings and appropriate default spreads for different countries. Even if DCF-related valuation factors can be used to construct DCF-based regressions to test data set soundness, for subsequent regression analyses, the DCF regression variables also serve as control variables.

3.9. Categorical Variables and Fixed Effects

In addition to DCF-related control variables and macroeconomic and macrofinancial variables, several categorical variables may have deterministic effects on start-up valuations. At least some of them also

might modulate the valuation impact of both macro-level variables and DCF-linked control variables. Specifically, the nature and scale of the impact of DCF valuation factors might be influenced by macro-level market conditions, which could be regulatory or macroeconomic in nature (Bernoth and Colavecchio, 2014; Gompers and Lerner, 1998; Lockett et al., 2002); by industry-level effects (Chan, 1983; Damodaran, 2009; Manigart et al., 1997, 2000); or by local-level, investor-side, or supply-chain effects (Porter, 1990). Combinations of these factors influence the relationship between start-up valuations and valuation drivers too, in VC markets in different countries. Therefore, their inclusion is justified. We include firm, industry, country, city, year, and investor type data, drawn primarily from EIKON deals data, as well as from secondary sources such as U.K. Companies House, which corroborates U.K. firm-level data and offers geographic data for a substantial level of detail.

4. Direct Regression Results

By establishing DCF consistency in this section, we provide a viable means to test the hypotheses. Specifically, we describe the direct regression results that refer to H1a, H1b, and H2. With fixed-effects regressions, we also examine the deterministic role of relevant categorical variables, as a test of H3. To verify the soundness of the data set, we employ a regression inspired by the discounted cashflow valuation, according to which start-up valuations reflect both revenues and risk-adjusted discount rates. Damodaran (2009) describes discount rates as driven by both sector-level risk characteristics and country risk premiums.

Table 3 details the valuation impact of revenues, the sector-unlevered beta, and the country risk premium. All of them are statistically significant, individually and jointly. These findings match our theoretical expectations and also affirm the theoretical consistency of the data set, in that revenue exerts a positive impact, whereas the beta and country risk premium have negative impacts. According to the goodness-of-fit indicators, the log of revenue is the DCF driver with the greatest explanatory power; according to the *p*-values, the log of the sectoral beta has the weakest. Yet the generally low R-squared values and consistent statistical significance of the intercept term indicate that the DCF-based regression model captures only part of the start-up valuation dynamic.

Table 5: Baseline Valuation Model

DCF-based Regressions

VARIABLES	(1) Ln_Valuation	(2) Ln_Valuation	(3) Ln_Valuation	(4) Ln_Valuation	(5) Ln_Valuation	(6) Ln_Valuation
Ln_Revenue	0.6861***			0.6660***	0.6692***	0.6514***
	[0.034]			[0.034]	[0.034]	[0.034]
Ln_Beta		-2.7738***		-1.1629***		-1.0886***
		[0.395]		[0.389]		[0.388]
Country Risk Premium			-70.7055***		-40.7742***	-38.3685***
			[11.701]		[13.134]	[13.092]
Constant	6.4565***	17.8453***	16.7791***	7.4278***	7.0425***	7.9171***
	[0.503]	[0.254]	[0.133]	[0.596]	[0.534]	[0.615]
Observations	646	1,045	1,045	646	646	646
R-squared	0.39	0.05	0.03	0.40	0.40	0.41
Adjusted R-squared	0.393	0.0442	0.0329	0.401	0.401	0.408

Notes: Standard errors in brackets
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

4.1. Direct Business Cycle Impacts on Start-Up Valuation

To examine the valuation impacts of country-level macro market conditions, we deploy DCF drivers from the baseline model as control factors. Empirical research often treats macro-level market condition indicators as control factors (Armstrong et al., 2006; Hellmann and Thiele, 2015), whereas classical approaches such as DCF assume macroeconomic conditions are key valuation drivers. Table 4 reveals the direct valuation impacts of tax rates, macroeconomic output gaps, and domestic and global VC cash-on-market. Compared with the baseline model, these regressions offer wider insights, and each regression increases the goodness-of-fit.

In detail, the most deterministic direct macro-level driver is VC cash-on-market, whose inclusion elevates the R-squared value to 0.43 at the country level and 0.53 at the global level. The coefficients for both these values are extremely small though. The explanatory power of the output gap is notable too, with an R-squared value of 0.42. Adding dry powder to the regression elevates the R-squared value to 0.42, despite its extremely small coefficient, such that a substantial amount of dry powder would be required to prompt even small increases in valuation. Counterintuitively, the tax rates show a positive and significant effect, which may indicate causality from tax rates rather than toward start-up valuation.

Table 6: Direct Impact of Macro-Level Start-Up Valuation Drivers

Macro-based Regressions

VARIABLES	(1) Ln_Valuation	(2) Ln_Valuation	(3) Ln_Valuation	(4) Ln_Valuation	(5) Ln_Valuation	(6) Ln_Valuation
Ln_Revenue	0.6514***	0.6540***	0.6512***	0.7060***	0.6862***	0.6071***
	[0.034]	[0.034]	[0.035]	[0.037]	[0.036]	[0.034]
Ln_Beta	-1.0886***	-1.3509***	-1.1753***	-0.8804**	-0.9448**	-0.9861***
	[0.388]	[0.383]	[0.394]	[0.406]	[0.390]	[0.374]
Country-Risk-Premium	-38.3685***	-15.3681	-13.3416	-43.2772***	-23.8422*	-41.5507***
	[13.092]	[13.622]	[15.048]	[15.708]	[14.386]	[13.232]
Tax Rate		0.1130***				
		[0.020]				
Business-cycle			0.2101***			
			[0.070]			
Dry-Powder				0.00000009**		
				[0.000]		
Cash-on-Market					0.0006***	
					[0.000]	
World-Cash-on-Market						0.00003***
						[0.000]
Constant	7.9171***	3.8202***	7.9414***	6.6447***	6.4131***	5.3569***
	[0.615]	[0.933]	[0.634]	[0.687]	[0.648]	[0.639]
Observations	646	636	632	557	578	550
R-squared	0.41	0.44	0.42	0.45	0.48	0.53
Adjusted R-squared	0.408	0.438	0.421	0.447	0.473	0.526

Notes: Standard errors are in brackets.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

To understand the direct effects on valuation, we also need to examine business cycle interaction effects. Table 5 presents the interaction effects between DCF and macroeconomic factors, such that Panel A pertains to the DCF–output gap interaction and indicates that output gaps lead to significant interaction effects on risk-adjusted financing costs; they act on both country risk premiums and sectoral betas. Panel B, which features the DCF–dry powder interaction effects, reveals that dry powder has (slight) interaction effects with country risk premium. In Panel C, related to DCF–cash-on-market interaction effects, we note that cash-on-market mainly shows interaction effects with country risk premium, so cash-on-market likely has a more relevant role in determining the impact of the country risk premium on start-up valuation. Finally, Panel D demonstrates that the interaction effects of global cash-on-market are negligible, so interaction effects are driven by domestic economic trends rather than international ones. Relative to Table 3 though, we note that the inclusion of world cash-on-market interaction effects improves goodness-of-fit figures, whereas the inclusion of an output gap and domestic cash-on-market interaction effects have either no or slightly negative effects on goodness-of-fit values.

Table 7: Macroeconomic Interaction Direct Effects

Panel A: Output Gap Interaction Effects

VARIABLES	(1) Ln_Valuation	(2) Ln_Valuation	(3) Ln_Valuation	(4) Ln_Valuation
Ln_Revenue	0.6480***	0.6498***	0.6390***	0.6470***
	[0.040]	[0.041]	[0.040]	[0.040]
Ln_Beta	-0.9043**	-0.9022**	-0.9306**	-1.2815***
	[0.440]	[0.440]	[0.439]	[0.490]
Country-Risk-Premium	-17.8211	-17.7684	-29.7066	-15.5717
	[17.098]	[17.115]	[18.470]	[17.116]
Output Gap	0.2715***	0.2693***	0.4149***	0.6988***
	[0.081]	[0.082]	[0.117]	[0.260]
RevenuexOutput Gap		0.0000		
		[0.000]		
Country-Risk-PremiumxOutput Gap			-9.6545*	
			[5.733]	
BetaxOutput Gap				-0.4522c
				[0.262]
Constant	7.9412***	7.9145***	8.1827***	8.1886***
	[0.702]	[0.714]	[0.715]	[0.715]
Observations	547	547	547	547
R-squared	0.41	0.41	0.41	0.41
Adjusted R-squared	0.402	0.401	0.404	0.404

Panel B: Dry Powder Interaction Regressions

VARIABLES	(1) Ln_Valuation	(2) Ln_Valuation	(3) Ln_Valuation	(4) Ln_Valuation
Ln_Revenue	0.7060***	0.7297***	0.6691***	0.7055***
	[0.037]	[0.051]	[0.037]	[0.037]
Ln_Beta	-0.8804**	-0.5114	-1.0815***	-0.9664
	[0.406]	[0.455]	[0.397]	[0.730]

Country-Risk-Premium	-43.2772***	-52.4704***	48.6125**	-43.0770***
	[15.708]	[17.187]	[22.685]	[15.786]
Dry-Powder	0.00000009**	0.0000001***	0.0000006***	0.0000
	[0.000]	[0.000]	[0.000]	[0.000]
Revenue x Dry-Powder		-0.0000		
		[0.000]		
Country-Risk-Premium x Dry-Powder			-0.0001***	
			[0.000]	
Beta x Dry-Powder				0.0000
				[0.000]
Constant	6.6447***	6.1210***	6.1716***	6.6993***
	[0.687]	[0.857]	[0.675]	[0.788]
Observations	557	494	557	557
R-squared	0.45	0.43	0.48	0.45
Adjusted R-squared	0.447	0.421	0.475	0.446

Panel C: Cash-on-Market Interaction Effects

	(1)	(2)	(3)	(4)
VARIABLES	Ln_Valuation	Ln_Valuation	Ln_Valuation	Ln_Valuation
Ln_Revenue	0.6859***	0.6824***	0.6298***	0.6583***
	[0.039]	[0.051]	[0.042]	[0.042]
Ln_Beta	-0.5289	-0.4084	-0.6685	1.9392***
	[0.430]	[0.479]	[0.467]	[0.729]
Country-Risk-Premium	-33.4035**	-42.9594**	49.1285*	-40.5828**
	[15.701]	[20.361]	[25.972]	[19.785]
Cash-on-Market	0.0008***	0.0007***	0.0016***	0.0014***
	[0.000]	[0.000]	[0.000]	[0.000]
RevenuexCash-on-Market		-0.0000		
		[0.000]		
Country-Risk-PremiumxCash-on-Market			-0.1306***	
			[0.024]	
BetaxCash-on-Market				-0.0012***
				[0.000]
Constant	6.1254***	6.1676***	6.4098***	5.3686***
	[0.703]	[0.841]	[0.749]	[0.784]
Observations	514	455	455	455
R-squared	0.47	0.43	0.46	0.45
Adjusted R-squared	0.461	0.424	0.458	0.446

Panel D: World Cash-on-Market Interaction Effects

	(1)	(2)	(3)	(4)
VARIABLES	Ln_Valuation	Ln_Valuation	Ln_Valuation	Ln_Valuation
Ln_Revenue	0.5917***	0.5586***	0.5819***	0.5944***
	[0.038]	[0.047]	[0.038]	[0.039]
Ln_Beta	-0.6105	-0.6690	-0.6581	0.0246
	[0.413]	[0.416]	[0.412]	[1.480]
Country-Risk-Premium	-55.1308***	-53.6501***	-166.5205***	-54.1948***
	[14.513]	[14.555]	[47.848]	[14.676]
World Cash-on-Market	.000032***	.000036***	.000028***	.000036***
	[0.000]	[0.000]	[0.000]	[0.000]
RevenuexWorld Cash		0.0000		
		[0.000]		
Country-Risk-PremiumxWorld Cash			0.0010**	
			[0.000]	
BetaxWorld Cash				-0.0000
				[0.000]
Constant	5.2088***	5.5788***	6.2778***	4.7879***
	[0.689]	[0.751]	[0.813]	[1.167]
Observations	486	486	486	486
R-squared	0.52	0.52	0.52	0.52
Adjusted R-squared	0.514	0.514	0.519	0.513

Notes: Standard errors are in brackets.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

These findings confirm the direct effects on start-up valuations that we predicted in H1a and H1b. The increasing goodness-of-fit values in Tables 3–5 also provide evidence of the direct effect valuation impacts.

4.4. Cash-on-Market

In addition to their valuation impact on start-ups, business cycles might drive cash-on-market, which in turn has a deterministic role for premoney start-up valuation, so we regard the macro-level impacts on cash-on-market as *second-order effects*. In Table 6, we present these influences, such that Panel A refers to univariate regressions and Panel B presents multivariate regressions. According to the goodness-of-fit indicators, the output gap and world cash-on-market have the greatest explanatory power, followed by country risk premium. Both tax rates and country risk premiums have negative impacts on domestic cash-on-market, in line with economic theory. The Panel B regressions, which combine these drivers, indicate that though business cycles and funding costs drive domestic cash-on-market, the inclusion of world cash-on-market more than doubles the goodness-of-fit—strong evidence of cross-border impacts on cash-on-market.

Table 8: Determinants of Cash-on-Market

Panel A: Cash-on-Market Regressions

	(1)	(2)	(3)	(4)
VARIABLES	Cash-on-Market	Cash-on-Market	Cash-on-Market	Cash-on-Market
Output Gap	165.2337***			
	[17.563]			
Tax-Rate		-20.0792***		
		[5.848]		
Country-Risk-Premium			-25,101.1220***	
			[4,057.279]	
Cash on World Market				0.0148***
				[0.001]
Constant	1,362.4216***	1,943.5066***	1,438.5839***	-210.4132**
	[30.122]	[209.957]	[44.071]	[83.367]
Observations	800	810	816	787
R-squared	0.10	0.01	0.04	0.27
Adjusted R-squared	0.0987	0.0132	0.0437	0.272

Panel B: Joint Cash-on-Market Regressions

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Cash-on-Market	Cash-on-Market	Cash-on-Market	Cash-on-Market	Cash-on-Market	Cash-on-Market
Output Gap	174.6744***	132.9126***	111.6870***	105.3422***	54.5474***	45.2741**
	[17.420]	[20.934]	[14.746]	[14.872]	[18.119]	[17.700]
Tax-Rate	-23.8595***	-28.1054***	-15.4146***			-22.0115***
	[5.681]	[5.767]	[4.630]			[4.627]
Country-Risk-Premium		-17,418.2210***			-18,805.5999***	-25,471.4445***
		[4,919.879]			[3,939.687]	[3,962.853]
Cash on World Market			0.0126***	0.0127***	0.0134***	0.0135***
			[0.001]	[0.001]	[0.001]	[0.001]
Constant	2,224.7143***	2,489.1710***	646.5089***	76.6646	129.0050	957.9061***
	[205.521]	[217.284]	[189.237]	[89.485]	[88.921]	[190.679]
Observations	795	795	766	771	771	766
R-squared	0.12	0.14	0.33	0.31	0.33	0.36
Adjusted R-squared	0.119	0.132	0.326	0.312	0.331	0.360

Notes: Standard errors are in brackets.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Overall, our data set shows that domestic cash-on-market appears driven by business cycle indicators, tax rates, and country risk premiums, in support of H2. Essentially, we establish that macro-level market conditions exert *two-channel impacts* on start-up valuations, so the total market condition effect appears more complex than described by Berre and Le Pendeven (2022). We corroborate these results with multicollinearity testing that establishes the independence of each valuation channel, as presented in Appendix II.

In addition to the macro-level drivers, we gather several categorical variables that can capture localized, small-scale effects related to the firm, sector, investor type, city, and country. Table 7 includes fixed-effects regressions of the direct valuation impacts we outlined in Table 4. Panel A entails firm fixed-effects, Panel B conveys sector fixed-effects, Panel C outlines investor type fixed-effects, Panel D refers to city fixed-effects, and Panel E reveals the year fixed-effects. In terms of overall goodness-of-fit, the sector, year, and investor-type fixed-effects models capture greater variation in start-up valuation in our data set, whereas firm fixed-effects capture the least. The macro-regression of the between-group R-squared value is particularly large for year and city fixed-effects, and it indicates that the dominant explanatory effects involve the investor type, city, and year. The within-group R-squared value instead highlights the explanatory power of industry fixed-effects.

Because all panels include the baseline DCF model as regression 1, as well as regressions for both the output gap and cash-on-market, we compare the effects of the categorical variables on the explanatory power of DCF factors against that on macro-level factors. Differences in the goodness-of-fit indicators between Tables 5 and 7 indicate that the added value of our fixed-effects models is concentrated in their effect on macro-level indicators. In terms of driver impacts, domestic cash-on-market is the most consistently influential valuation driver. Country risk premium loses its statistical significance in all panels, indicating that our categories replicate at least some of the descriptive power expressed country risk premiums.

Table 9: Direct Fixed-Effect Regressions

Fixed-Effects Macro-Regressions Panel A: Firm Fixed-Effects

VARIABLES	(1) Ln_Valuation	(2) Ln_Valuation	(3) Ln_Valuation	(4) Ln_Valuation	(5) Ln_Valuation	(6) Ln_Valuation
Ln_Revenue	0.4878***	0.4704***	0.5678***	0.5611***	0.5307***	0.5102***
	[0.044]	[0.043]	[0.045]	[0.049]	[0.048]	[0.047]
Ln_Beta	-1.6991***	-1.9726***	-1.0180*	-1.4501**	-1.6331***	-1.6174***
	[0.542]	[0.527]	[0.540]	[0.568]	[0.559]	[0.546]
Country-Risk-Premium	-66.0262***	-58.8327***	12.6377	-84.4909***	-72.5969***	-69.7739***
	[10.093]	[10.002]	[16.880]	[11.659]	[11.151]	[10.860]
Tax-Rates		0.1232***				
		[0.025]				
Output-Gap			0.3408***			
			[0.059]			
Dry-Powder				0.0000		
				[0.000]		
Cash-on-Market					0.0000	
					[0.000]	
Cash on World Market						0.0000
						[0.000]
Constant	10.3814***	6.3451***	8.3925***	9.1870***	9.6259***	9.8025***
	[0.624]	[1.012]	[0.707]	[0.705]	[0.685]	[0.668]
Observations	646	636	632	557	578	550
chi2	153.7	187.1	191.4	161.9	155.2	149.7
Within R2	0.0551	0.0551	0.0551	0.0549	0.0496	0.0495
Between R2	0.293	0.343	0.350	0.349	0.331	0.321
Overall R2	0.394	0.413	0.418	0.431	0.433	0.440

Fixed-Effects Macro-Regressions: Panel B: Sector Fixed-Effects

VARIABLES	(1) Ln_Valuation	(2) Ln_Valuation	(3) Ln_Valuation	(4) Ln_Valuation	(5) Ln_Valuation	(6) Ln_Valuation
Ln_Revenue	0.6318***	0.6367***	0.6397***	0.6943***	0.6787***	0.6091***
	[0.034]	[0.034]	[0.035]	[0.037]	[0.036]	[0.034]
Ln_Beta	-0.3805	-0.8452	-0.4637	0.7676	0.8712	1.3837**
	[0.578]	[0.528]	[0.584]	[0.717]	[0.702]	[0.700]
Country-Risk-Premium	-38.3666***	-15.7142	-18.1501	-40.7037***	-25.0954*	-40.9948***
	[12.737]	[13.328]	[14.747]	[14.972]	[13.765]	[12.543]
Tax-Rates		0.1089***				
		[0.019]				
Output-Gap			0.1604**			
			[0.069]			
Dry-Powder				0.0000000765*		
				[0.000]		
Cash-on-Market					0.0006***	
					[0.000]	
Cash on World Market						0.0000***
						[0.000]
Constant	7.6960***	3.8480***	7.5952***	5.7472***	5.4232***	3.8673***
	[0.690]	[0.951]	[0.709]	[0.814]	[0.779]	[0.776]
Observations	643	633	630	554	575	547
chi2	395.5	452.4	406.0	397.9	450.9	554.0
Within R2	0.356	0.387	0.366	0.406	0.429	0.501
Between R2	0.691	0.720	0.705	0.654	0.681	0.685
Overall R2	0.409	0.443	0.423	0.435	0.457	0.493

Fixed-Effects Macro-Regressions: Panel C: Investor-Type Fixed-Effects

VARIABLES	(1) Ln_Valuation	(2) Ln_Valuation	(3) Ln_Valuation	(4) Ln_Valuation	(5) Ln_Valuation	(6) Ln_Valuation
Ln_Revenue	0.4049***	0.4173***	0.4192***	0.4268***	0.4252***	0.4073***
	[0.034]	[0.035]	[0.035]	[0.036]	[0.036]	[0.036]
Ln_Beta	-1.1420***	-1.2143***	-1.0146***	-0.8366**	-0.7996**	-0.7228**
	[0.363]	[0.367]	[0.367]	[0.364]	[0.361]	[0.361]
Country-Risk-Premium	-24.6074*	-11.3366	-12.5279	-20.3562	-17.4586	-26.9445**
	[12.611]	[13.439]	[14.542]	[14.702]	[13.912]	[13.556]
Tax-Rates		0.0568***				
		[0.022]				
Output-Gap			0.0419			
			[0.069]			
Dry-Powder				0.0000000677 *		
				[0.000]		
Cash-on-Market					0.0003**	
					[0.000]	
Cash on World Market						0.0000***
						[0.000]
Constant	11.4272***	9.1675***	11.1241***	10.7342***	10.6453***	9.1087***
	[0.693]	[1.065]	[0.700]	[0.759]	[0.748]	[0.757]
Observations	528	518	514	460	467	447
chi2	185.8	194.7	188.3	173.9	182.8	216.8
Within R2	0.253	0.264	0.260	0.264	0.271	0.295
Between R2	0.619	0.654	0.653	0.640	0.673	0.769
Overall R2	0.399	0.434	0.409	0.436	0.451	0.495

Fixed-Effects Macro-Regressions: Panel D: City Fixed-Effects

VARIABLES	(1) Ln_Valuation	(2) Ln_Valuation	(3) Ln_Valuation	(4) Ln_Valuation	(5) Ln_Valuation	(6) Ln_Valuation
Ln_Revenue	0.6022***	0.6084***	0.5958***	0.5756***	0.5834***	0.5615***
	[0.037]	[0.037]	[0.037]	[0.037]	[0.035]	[0.035]
Ln_Beta	-1.3550***	-1.3592***	-1.4484***	-1.5668***	-1.4295***	-1.3792***
	[0.401]	[0.401]	[0.402]	[0.379]	[0.365]	[0.371]
Country-Risk-Premium	-43.0762*	-20.8989	-12.2993	-16.7040	-1.9419	-56.0570**
	[23.707]	[24.087]	[25.540]	[30.958]	[25.205]	[23.186]
Tax-Rates		0.0912**				
		[0.036]				
Output-Gap			0.3019***			
			[0.089]			
Dry-Powder				0.0000000677***		
				[0.000]		
Cash-on-Market					0.0015***	
					[0.000]	
Cash on World Market						0.0000***
						[0.000]
Constant	9.0680***	5.4461***	9.2576***	7.7852***	7.7240***	6.5933***
	[0.695]	[1.533]	[0.703]	[0.696]	[0.663]	[0.700]
Observations	588	580	576	519	539	511
chi2	302.7	312.1	319.0	467.3	534.4	439.6
Within R2	0.325	0.324	0.336	0.518	0.533	0.438
Between R2	0.410	0.464	0.473	0.180	0.273	0.605
Overall R2	0.418	0.445	0.427	0.328	0.420	0.532

Fixed-Effects Macro-Regressions: Panel E: Year Fixed-Effects

VARIABLES	(1) Ln_Valuation	(2) Ln_Valuation	(3) Ln_Valuation	(4) Ln_Valuation	(5) Ln_Valuation	(6) Ln_Valuation
Ln_Revenue	0.5561***	0.5563***	0.5678***	0.5837***	0.5943***	0.5857***
	[0.031]	[0.030]	[0.031]	[0.033]	[0.033]	[0.033]
Ln_Beta	-1.3717***	-1.5432***	-1.2613***	-1.1638***	-1.2216***	-1.1624***
	[0.345]	[0.338]	[0.344]	[0.350]	[0.348]	[0.358]
Country-Risk-Premium	-41.2498***	-21.1418*	-49.6215***	-55.9876***	-47.8448***	-41.1296***
	[11.507]	[12.059]	[13.736]	[13.533]	[12.975]	[12.651]
Tax-Rates		0.0911***				
		[0.018]				
Output-Gap			-0.1358*			
			[0.072]			
Dry-Powder				-0.0000***		
				[0.000]		
Cash-on-Market					-0.0002*	
					[0.000]	
Cash on World Market						0.0000
						[0.000]
Constant	9.6748***	6.2565***	9.5069***	9.7472***	9.3843***	7.8145***
	[0.644]	[0.930]	[0.672]	[0.735]	[0.708]	[1.056]
Observations	646	636	632	557	578	550
chi2	427.5	466.9	439.7	456.7	449.6	413.8
Within R2	0.409	0.433	0.423	0.459	0.446	0.432
Between R2	0.000880	0.00580	0.00588	0.121	0.206	0.297
Overall R2	0.409	0.440	0.397	0.406	0.416	0.507

Notes: Standard errors are in brackets.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

In Table 8, we demonstrate that including joint fixed-effects renders the valuation impacts of both the sectoral beta and macroeconomic output gap statistically insignificant. The categorical variables in this joint fixed-effect regression capture similar value signaling information as the sectoral beta and business cycle indicators. Nevertheless, because both cash-on-market and the country risk premium remain statistically significant, this model's categorical variables might capture and substitute for direct, but not indirect, business cycle impacts on valuations.

Table 10: Direct Fixed-Effect Regressions: Sector, City, Investor-Type

Fixed-Effects Macro-Regressions: Joint Fixed-Effects

VARIABLES	(1) Ln_Valuation	(2) Ln_Valuation	(3) Ln_Valuation	(4) Ln_Valuation	(5) Ln_Valuation	(6) Ln_Valuation
Ln_Revenue	0.4962***	0.4946***	0.4944***	0.5014***	0.5057***	0.4677***
	[0.039]	[0.039]	[0.040]	[0.041]	[0.040]	[0.040]
Ln_Beta	0.1123	-0.2099	0.0956	0.1780	0.2403	0.0264
	[0.593]	[0.591]	[0.601]	[0.629]	[0.613]	[0.586]
Country-Risk-Premium	-76.3381***	-37.3387	-60.0232**	-73.4863**	-58.7941**	-83.6040***
	[23.359]	[26.552]	[27.346]	[28.933]	[26.648]	[24.629]
Tax-Rates		0.1181***				
		[0.036]				
Output-Gap			0.1176			
			[0.094]			
Dry-Powder				0.0000000908***		
				[0.000]		
Cash-on-Market					0.0006***	
					[0.000]	
Cash on World Market						0.0000***
						[0.000]
Constant	9.8603***	5.5521***	9.8881***	9.0741***	8.8663***	7.6748***
	[0.759]	[1.501]	[0.779]	[0.826]	[0.815]	[0.809]
Observations	474	466	462	425	431	411
chi2	185.7	198.6	183.1	179.6	191.2	244.0
Within R2	0.190	0.185	0.184	0.239	0.230	0.263
Between R2	0.391	0.422	0.408	0.391	0.416	0.503
Overall R2	0.412	0.444	0.419	0.413	0.439	0.495

Notes: Standard errors in brackets
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

The findings of the fixed-effects models thus are generally similar to those of the macro-based OLS, in terms of coefficient significance and model goodness-of-fit. The only exception is the results of the joint fixed-effects model, which indicate that the model's categorical variables eclipse the explanatory power of the sectoral beta and output gap, which are statistically non-significant in the joint fixed-effects model.

5. Functional Form and Structural Equation Results

In addition to direct regression results, we examine functional form questions and indirect regression results to test H4a–H4c, using mediation structure testing, endogeneity testing, and SEM regressions, according to both circular and non-circular functional forms.

5.1. Functional Form

Sobel tests can establish mediation and partial mediation structural relationships. Table 9 presents the mediation structure likelihood for business cycles and start-up valuation, in relation to the mediating role of domestic cash-on-market, dry powder, and credit risk premium. Although it establishes the mediation structure for cash-on-market and credit risk premium, dry powder does not emerge as a significant mediating variable, in line with OECD (2015) and Rosenbloom (2022),

which indicates that dry powder separates the timing of VC investment from the timing of macroeconomic and macrofinancial market conditions.

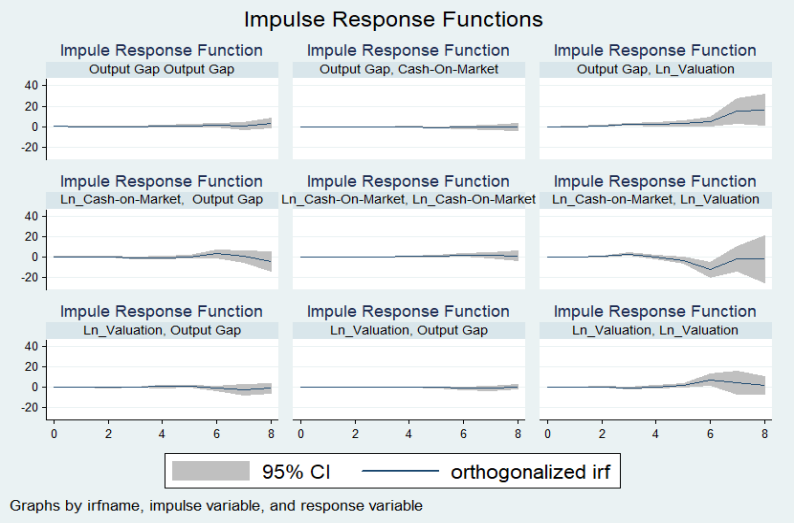
Table 11: Sobel Tests for Mediation

Sobel: Output-Gap, Cash-on-Market, Valuation				Test statistic:	SE	P-value:
Output-Gap and Cash-on-Market	Coefficient	165.23370	Sobel test:	5.91092	0.02825	0.000***
	SE	17.56309	Aroian test:	5.89081	0.02834	0.000***
Cash-on-Market and Valuation	Coefficient	0.00101	Goodman test:	5.93123	0.02815	0.000***
	SE	0.00013				
Sobel: Output-Gap, Country-Risk Premium, Valuation				Test statistic:	SE	P-value:
Output-Gap and Country-Risk Premium	Coefficient	-0.00190	Sobel test:	5.60841	0.02399	0.000***
	Standard Error	0.00013	Aroian test:	5.59798	0.02403	0.000***
Country-Risk Premium and Valuation	Coefficient	-70.69590	Goodman test:	5.61890	0.02394	0.000***
	Standard Error	11.71862				
Sobel: Output-Gap, Dry-Powder, Valuation				Test statistic:	SE	P-value:
Output-Gap and Dry-Powder	Coefficient	313042.60000	Sobel test:	1.66041	0.01623	0.09683148*
	Standard Error	52544.28000	Aroian test:	1.63925	0.01644	0.10116
Dry-Powder and Valuation	Coefficient	0.0000000861	Goodman test:	1.68242	0.01602	0.09248829*
	Standard Error	0.0000000498				

5.4.**Endogeneity**

With a VAR model, impulse response function, and optimal lag selection testing, we examine the likelihood, impact, and impact decomposition of endogeneity, particularly by considering the possibility of circular causality. The log-transformation of all dependent and independent variables provides a scaled, readable impulse response function, as depicted in Figure 3. It shows that the majority of the macro-level effects manifest only after an approximately five-year delay.

Figure 3: Impulse Response Functions: Output Gap, Cash-on-Market, Valuation



This long time horizon is corroborated by Table 10, which summarizes our optimal lag tests. The optimal number of yearly lags is seven. Thus, it is possible that start-up valuations give rise to endogeneity through circular causality, by attracting increased domestic cash-on-market, but the relationship between valuations and cash-on market is extremely slow to develop.

Table 12: VAR Model Optimal Lag Selection

Selection-order	criteria					Observations	53	
Sample:	26	-1068	but with gaps					
lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-595.428				2.00E+06	23.035	23.2495	23.5926
1	-523.693	143.47	9	0.000	191186	20.6677	21.0108	21.5599
2	-512.626	22.133	9	0.008	178868	20.5897	21.0614	21.8165
3	-492.2	40.852	9	0.000	118582	20.1585	20.7589	21.7199
4	-479.089	26.222	9	0.002	104834	20.0034	20.7325	21.8993
5	-451.069	56.04	9	0.000	53621.4	19.2856	20.1434	21.5161*
6	-438.66	24.819	9	0.003	50421.2	19.157	20.1434	21.7221
7	-420.999	35.32*	9	0.000	39893.5*	18.8302*	19.9452*	21.7298

The optimal lag test findings corroborate Sedláček and Sterk's (2017) description of how U.S. start-ups are influenced by macro-level and business cycle conditions at the time of their founding, with effects that persist for years. These findings also match the European Central Bank's (2021) evidence that non-bank financial intermediaries are relatively more responsive to changes in long-term interest rates.

5.5.**Structural Equation Approach**

Table 11 details the relationships among start-up valuation, output gap, and cash-on-market, as a dual partial mediation relationship (Figure 4, Panel A), as defined by Equation 2. Start-up valuation is directly affected by output gap, country risk premium, and cash-on-market; it is indirectly affected too, because country risk premium and cash-on-market are influenced by the output gap. Goodness-of-fit indicators indicate that the total model offers substantially improved explanatory power compared with any direct-effect OLS models or fixed-effects models. The indirect effects through cash-on-market have a more prominent role for explaining start-up valuation than those through country risk premiums. This finding corroborates those we presented in Table 5, in which domestic cash-on-market is the most consistently significant valuation driver, whereas country risk premium loses statistical significance in some regressions in each panel of Table 5.

Table 13: Structural Equation Model Regression

Structural equation model
Estimation method = ml Observations: 1089
Log likelihood = -8064.2694

	Coef.	SE	z	P-Value	[95% Conf.	Interval]
Dependent: Ln_Valuation						
Cash-on-Market	0.0006	0.0001	5.94	0.000***	0.0004	0.0008
Country-Risk-Premium	-9.3936	11.1616	-0.84	0.4000	-31.2700	12.4828
Output-Gap	0.1805	0.0573	3.15	0.002***	0.0683	0.2928
Ln_Revenue	0.5708	0.0295	19.34	0.000***	0.5130	0.6287
Ln_Beta	-1.5794	0.3336	-4.73	0.000***	-2.2332	-0.9257
Constant	8.2520	0.5412	15.25	0.000***	7.1912	9.3127
Dependent: Cash-on-Market						
Country-Risk-Premium	-5257.4110	4748.7620	-1.11	0.2680	-14564.8100	4049.9910
Output-Gap	153.6415	21.5621	7.13	0.000***	111.3807	195.9024
Constant	1405.4680	42.7423	32.88	0.000***	1321.6950	1489.2410
Dependent: Country-Risk-Premium						
Output-Gap	-0.0021	0.0001	-15.53	0.000***	-0.0024	-0.0018
Constant	0.0077	0.0002	37.03	0.000***	0.0073	0.0081
		chi2(7)	21.23		Prob. > chi2	0.0117

Wald tests for equations

observed	chi2	df	p
Ln_Valuation	530.19	5	0.000***
Cash-on-Market	242.74	1	0.000***
Credit-Risk-Premium	90.05	2	0.000***

Equation-level goodness-of-fit

Dependent Variable	Fitted Variance	Predicted Variance	Residual Variance	R-Squared	mc	mc2
Ln_Valuation	7.592008	3.077912	4.514096	0.4054148	0.6367219	0.4054148
Cash-on-Market	0.0000503	9.86E-06	0.0000405	0.195894	0.4425992	0.195894
Credit-Risk-Premium	609226.6	62144.88	547081.7	0.1020062	0.3193841	0.1020062
Overall				0.5240205		

Table 12 presents the estimates of the relationships among start-up valuation, business cycle indicators, and cash-on-market, as another dual partial mediation relationship to capture circular causality (Figure 5, Panel B), according to Equation 3. Although start-up valuation is influenced by the output gap, country risk premium, and cash-on-market, and the country risk premium and cash-on-market are affected by the output gap, cash-on-market is not significantly influenced by start-up valuation.

Table 14: Structural-Equation Model Regression Partial Circular Causality

Structural equation model
Estimation method = ml Observations: 514
Log likelihood = -5469.6096

	Coef.	SE	Z	P-Value	[95% Conf.	Interval]
Dependent: Ln_Valuation						
Cash-on-Market	0.0005	0.0002	2.57	0.010***	0.0001	0.0009
Country-Risk-Premium	-17.6720	17.7988	-0.99	0.3210	-52.5570	17.2130
Output-Gap	0.2065	0.0866	2.39	0.017***	0.0368	0.3762
Ln_Revenue	0.6749	0.0395	17.09	0.000***	0.5975	0.7522
Ln_Beta	-0.6241	0.4285	-1.46	0.1450	-1.4639	0.2157
Constant	6.6992	0.7405	9.05	0.000***	5.2479	8.1505
Dependent: Cash-on-Market						
Ln_Valuation	25.9870	18.9107	1.37	0.1690	-11.0772	63.0513
Country-Risk-Premium	-10355.8800	6041.6010	-1.71	0.0870*	-22197.2000	1485.4420
Output-Gap	108.1019	29.6101	3.65	0.000***	50.0672	166.1366
Constant	981.7159	332.3529	2.95	0.003***	330.3162	1633.1160
Dependent: Country-Risk-Premium						
Output-Gap	-0.0024	0.0002	-13.59	0.000***	-0.0028	-0.0021
Constant	0.0062	0.0003	22.05	0.000***	0.0057	0.0068
		chi2(7)	14.24		Prob. > chi2	0.0471

Wald tests for equations

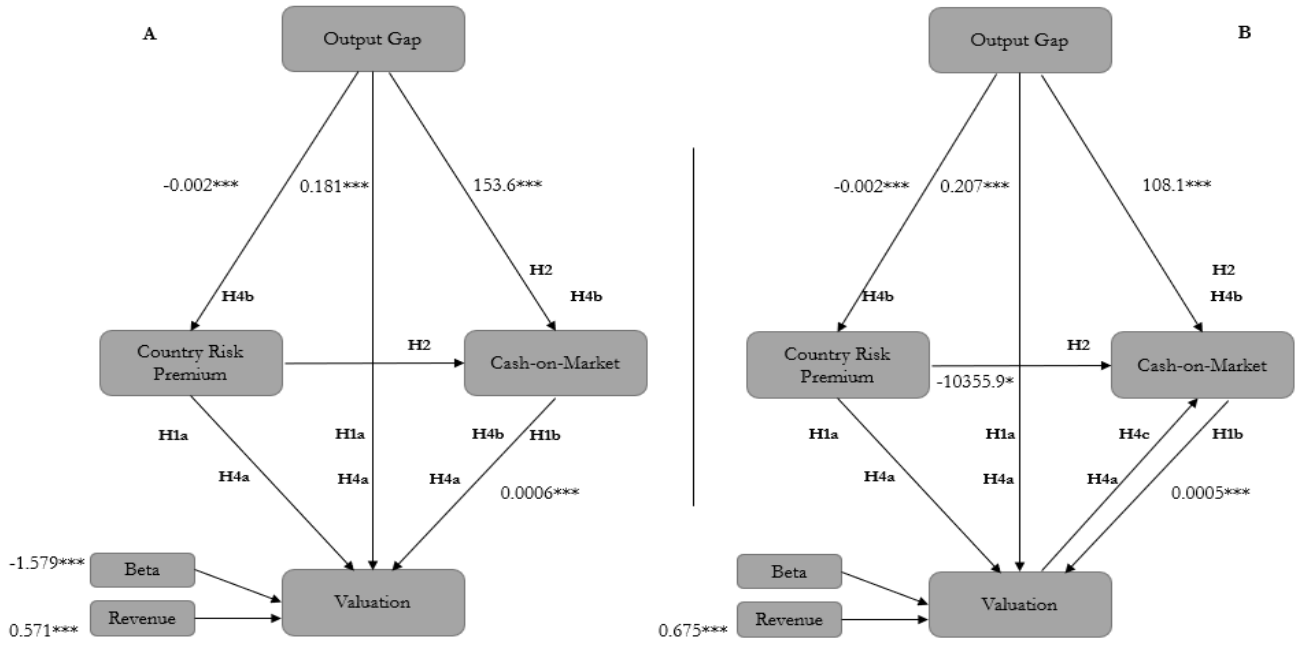
observed	chi2	df	p
Ln_Valuation	425.89	5	0.000***
Cash-on-Market	44.67	3	0.000***
Country-Risk-Premium	184.72	1	0.000***

Equation-level goodness-of-fit

Dependent Variable	Fitted Variance	Predicted Variance	Residual Variance	R-Squared	mc	mc2
Ln_Valuation	9.400332	4.230804	5.029342	0.4649825	0.6819868	0.465106
Cash-on-Market	659319.4	54261.48	588650.1	0.1071852	0.3302521	0.1090664
Credit-Risk-Premium	0.0000438	0.0000116	0.0000322	0.2643713	0.5141705	0.2643713
Overall				0.5910921		

Figure 5 displays the SEM path diagram that summarizes the regression results of Tables 11 and 12. Whereas both SEM regressions demonstrate six statistically significant coefficients, the version in Panel A is more parsimonious, with six of eight coefficients achieving significance, and also lower overall *p*-values for its significant coefficients. The circular components in Panel B do not achieve statistical significance. Altogether, this finding corroborates the goodness-of-fit values in Tables 10 and 11. The non-circular SEM regression offers greater explanatory power.

Figure 4: SEM Path Diagrams for Non-Circular and Partially Circular SEM Regressions



Taking both the Sobel test and regression findings into account, we thus confirm a partial mediation relationship between the output gap and start-up valuation. Business cycles affect start-

up valuation not only directly (revenues, business relationships, consumer demand, and asset values) but also indirectly though cash-on-market and country risk premiums. Furthermore, even if investments significantly drive valuations, valuations do not significantly drive valuations within our data set, though the valuation–cash-on-market-relationship is nearly significant, with a *p*-value of 0.169. Stated another way, our findings confirm the model in Panel A rather than that in Panel B, and endogeneity is driven by the variable structure and hidden variable bias, rather than by the direction of causality. Finally, compared with saturated direct regression models (Gefen et al., 2011) that use OLS and fixed-effects approaches, modeling the relationship between start-up valuation and business cycle as a partial mediation relationship nearly doubles the model's goodness-of-fit, and the partial mediation structure as a whole is both separately and jointly significant. This approach successfully maps direct and indirect causality structures linking business cycles, VC markets, and start-up valuations, and it offers a substantial goodness-of-fit improvement.

6. Findings and Implications

Market conditions influence start-up valuations. Given that effective research designs and generalizability are essential for credible research findings (Wiklund et al. 2019), explicitly addressing multilevel causality structure confers our analysis key advantages (Maula and Stam, 2020). Overall, our findings contribute two major theoretical insights. First, we show that relationships between start-up valuations and macroeconomic market conditions can be modeled as complex, multistep, and partially indirect relationships, in line with similar relationships identified in VC syndication markets (Verwaal et al., 2010), international trade relationships (Trancoso and Gomes, 2020), and small enterprise credit markets (Palazuelos et al., 2018. Such relationships are commonly noted in marketing and psychology research, and in macroeconomic settings, we anticipate that entrepreneurial finance will find similar relationships with increasing frequency. Second, we show that the impacts on start-up valuations primarily are driven by the business cycle; other macroeconomic market conditions, such as country risk premium and cash-

on-market, act as mutually independent business cycle distribution channels rather than valuation drivers in their own right. Therefore, the connections between micro-level start-up markets and entrepreneurial finance, based on macrofinancial and macroeconomic market conditions and market theory—a clear theoretical development need identified by Budhwar et al. (2022)—can be mapped and described as interrelated, whereas market condition valuation drivers are more accurately described as valuation channels rather than valuation factors.

6.1. Functional Form

The business cycle not only drives valuations directly but also drives macroeconomic and macrofinancial factors that exert further, indirect impacts on start-up valuations. In particular, we find that the output gap influences start-up valuations through both direct and indirect effects, namely, through its effect on the credit risk premium and domestic cash-on-market. Our multicollinearity tests demonstrate that each valuation impact behaves as an individual and separate valuation channel, with independent effect magnitudes, but in addition, the valuation process depends on intermediate variables and valuation channels, not just valuation factors in a classical sense.

Our analysis and results, obtained through SEM, also contribute to entrepreneurship literature by establishing an empirically supported model of how business cycles affect start-up valuations both directly and through multiple independent macro-level valuation channels. By comparing direct with indirect effect models, we determine that partial mediation indirect effect approaches attain substantially greater goodness-of-fit and also explain the start-up valuation impacts of market conditions more accurately. We gain no convincing empirical evidence of circular relationships, but considering the cash-on-market impacts in the SEM model (Table 10), the delayed impacts demonstrated by the impulse response function, and the optimal lag tests (Table 9), we argue for a two-stage causality structure, in line with Wooldridge's (2010) description of endogeneity driven by hidden variable bias. Fundamentally, concrete valuation relationships

exist between start-up markets and the macroeconomic level, but they are demonstrably complex, featuring both direct and indirect valuation channels. This evidence implies that start-up valuations are driven by cyclical and macroeconomic factors but also that the way start-up valuations respond to changes in the business cycle or macrofinancial landscape are complex, interactive, and multistage in nature, transmitted through independent valuation channels and influenced by channel-specific mediating variables.

6.4. Common Threads and Key Variables

Cyclical indicators, country risk premiums, and cash-on-market are the most consistently powerful explanatory factors, reflecting the partial mediation structural relationships among business cycle indicators, financial market conditions, and valuations. In addition, the interaction effects indicate that during booms, valuation discounts due to financial market conditions, sectoral beta, and country risk premium are multiplied, further exacerbating the procyclicality of start-up valuations. Valuations are procyclical. The business cycle indicators are the most influential valuation determinants in our study, due to the combination of their direct and indirect deterministic effect. The influence of the output gap, a key business cycle indicator, gets expressed both directly, (influencing revenues, asset valuations, business relationships, and market demand) and indirectly (through effects on country risk premiums and domestic cash-on-market). Not only are start-up valuations directly driven by output gaps, but as investors and entrepreneurs both enter booming markets, they also reflect domestic financing conditions (Figure 3).

Meanwhile, cash-on-market acts as a moderating variable, directly affecting start-up valuations, even while it is directly influenced by business cycles. In terms of overall direct effects, our results indicate that cash-on-market is the strongest macro-level factor. Global cash-on-market has substantial explanatory power, indicating the presence of cross-border investments in our data set, yet this effect may be specific to the European common market. Domestic cash-on-market, which is nearly as strong an indicator, is influenced by both the output gap and tax rates (Table 5).

Moreover, we demonstrate, using both Sobel tests and SEM regressions, that cash-on-market behaves like a business cycle transmission channel for start-up valuations.

In contrast, the regression results indicate that dry powder, though statistically significant in some cases, has limited explanatory power, due to its extremely small coefficients. Even vast differences in country-level dry powder can account for only small increases in valuation, on average. Its non-significant Sobel test further indicates that, unlike cash-on-market, dry powder is sufficiently far removed from the business cycle that it does not act as a transmission channel.

Similar to domestic cash-on-market, country risk premiums function as moderating variables, directly affecting start-up valuations while also being directly affected by business cycles. The baseline models in Table 2 demonstrate that country risk premiums negatively influence start-up valuations, in line with DCF valuation approaches, and cash-on-market (Table 5), yet Tables 6 and 7 also show that fixed effects eclipse, at least partially, the statistical significance of country risk premiums, depending on the categorical variable being examined. Then Tables 10 and 11 reveal that country risk premiums are influenced by business cycle conditions and mediate the relationship between the business cycle and start-up valuations. In principle, country risk premiums proxy for and signal macro-level market conditions, in line with Fama's (1970) efficient market concept.

6.5. Hypotheses Results

We find clear support for H1 and H2. Valuations are decisively influenced by output gaps (H1a), as well as both domestic and global cash-on-market (H1b). The stronger explanatory power of global cash-on-market indicates that extensive cross-border VC investments drive start-up valuations. Our data set, drawn from the EU and EEA prior to Brexit, makes this result intuitive, but its nuances and contours require further research. For H3 though, we obtain only partial support. The fixed-effect findings tell a slightly different story, but the categorical variables in our data set appear to proxy or substitute for the impact of financial conditions on the business

environment. We cannot identify any pockets or subsets in the data set for which the impact of the business cycle diverges substantially from the general situation.

In support of H4, in its non-circular form, start-up valuations reflect domestic cash-on-market, which depends on the output gap, as corroborated by both regression and Sobel tests. Start-up valuations depend on business cycles not only due to direct effects on the business environment but also through indirect effects that influence the financial landscape, which affects the business environment in turn. Our H4 findings thus add a layer of complexity to explanations of how and why business cycles influence start-up valuations. Domestic cash-on-market levels are both procyclical with and highly deterministic of start-up valuations. Concretely then, if start-up valuations are driven by cyclical and macrofinancial factors, through both direct and indirect effects, and these effects generalize across industries, markets, and deal types, we must challenge classical valuation models as oversimplified and perhaps unsuitable for start-up markets. A staged, segmented valuation model, along the lines of Berre and Le Pendeven's (2022) start-up valuation meta-model, might be more accurate.

6.6. Context Matters

Beyond these key theoretical and empirical findings, this article contributes to entrepreneurial and finance literature by addressing complex questions about start-up and VC market data, which are macroeconomic and multidimensional in nature. It establishes a foundation for related interdisciplinary theoretical and empirical pursuits. In particular, we show that context matters in terms of establishing start-up valuations. This deterministic role of the context is multilayered and subject to external macroeconomic influences. We reject endogeneity due to a circular relationship as a source of contextual valuation though, which establishes a clear direction-of-flow by which market conditions affect start-up valuations. Furthermore, this study contributes to the wider field of economics by considering whether and how financial intermediary markets connect the entrepreneurial landscape to the wider macroeconomy, beyond just unidirectional links. In this

sense, we propose that empirical studies that claim unidirectional nonbank financial intermediary impacts may be oversimplified.

7. Conclusions

This study explores the indirect connections of start-up premoney valuations, business cycles, and intermediate macrofinancial variables, in an effort to capture the indirect role of business cycles on financial intermediary valuation channels. We find that VC markets are complex, procyclical intermediaries that reinforce ongoing macroeconomic trends, and their mechanics occur through complex, partially indirect processes. Building on arguments that describe macrofinancial, macroeconomic, and business cycle determinants start-up and VC markets (Bernoth and Colavecchio, 2014; Trancoso and Gomes 2020), as well as descriptions of indirect deterministic effects in entrepreneurship and small-business studies (Palazuelos et al., 2018; Verwaal et al., 2010), we present the impacts of business cycles on start-up markets through multiple, independent valuation channels. These results further our understanding how startup valuations and startup markets evolve over the course of the business cycle, a finding that has applicable uses for investors, as well as in economic policy circles.

In mapping the nuanced causal relationships of business cycles, VC markets, and start-up valuations, we make a substantial contribution to macrofinancial, entrepreneurial finance, and nonbank financial intermediary research. Furthermore, we respond to identifiable research gaps, such as the need to tie together entrepreneurial finance and macro-level economic theory (Budhwar et al., 2022), the demand for methodological diversification in VC research (Berre and Le Pendeven, 2022), and the need for insights on macro-level transmission roles of nonbank financial intermediation (European Central Bank, 2021). Using an SEM approach, we address these gaps and thereby demonstrate how business cycles, start-up markets, and VC intermediary markets are related, in nuanced detail.

Start-up valuations are consistent with DCF valuation approaches, though both macro-level country risk premiums and VC markets influence start-up valuations too. These factors are driven in turn by business cycles, such that start-up valuations depend on dominant market conditions, as much as revenues and discount rates. Start-up valuations also are extremely procyclical, because business cycles influence them both directly and indirectly. Yet the evidence still points to a non-circular relationship. Crucially, the SEM results indicate that whereas classical economic theory (e.g., DCF, multiples) describes valuation as flowing from firm-level characteristics and financial market conditions, start-up valuations actually might convey multichannel impacts of macro-economic business cycle conditions that determine private equity and VC markets directly and indirectly through multiple, uncorrelated transmission channels. Thus, country risk premium, cash-on-market, and possibly other market conditions essentially proxy for business cycle conditions.

Our findings have implications for both economic policy makers and investors. First, because entrepreneurial finance markets are strongly procyclical, it is possible to influence entrepreneurial valuations at the national level through policy measures that affect the business cycle, such as monetary policy or macro-level fiscal policy. By mapping a business cycle's transmission channels in detail, policy makers could craft bespoke entrepreneurial finance policies. Second, for investors, our findings related to procyclicality and variable interrelatedness offer insights for both international venture finance markets, in which offshore VC investors consider a country's start-up market, and for long-term VC investors who depend on timing the market. The former can leverage our findings to optimize their choices of overseas target market; the latter can apply them to optimize market timing, even with the constraints linked to most VC firms.

Continued VC and entrepreneurial finance research hold the promise for additional contributions. First, considering the substantial valuation impacts of macroeconomic and macrofinancial drivers, continued studies should examine cross-border VC deals by comparing

valuation impacts in the start-up's home market versus those linked to investors' jurisdictions, as well as their differences, to uncover evidence of yield-chasing, stability-chasing, or sectoral cross-border effects, as well as any analyzable fault lines. Second, our findings might inform efforts to construct a VC market model, analogous to the quantity theory of money, by substituting the money supply's macro-level role with that of cash-on-market supply. Such an effort would supplement empirical findings about the role of cash-on-market quantity by providing measures analogous to velocity, such as deals, exits, and investment durations. Third, the fixed-effect findings indicate significant fault lines characterized by data subsets, in which start-up valuation sensitivities to identified market condition drivers diverge. That is, categorical variables offer substantial explanatory power, so further research possibilities exist, to explore categorical variable valuation impacts using novel empirical approaches, such as non-parametric statistical techniques, qualitative methods, or hybrid methodologies. The city fixed-effects findings also indicate that municipal-level market conditions might yield detailed findings about the valuation impacts of local drivers.

8. References

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9. Appendix I: Variable Definitions

Table A1 describes variables used, as well as their definitions and sources.

Table A1: Variable Definitions

Variable	Description
Valuation	Premoney start-up valuation. EIKON, Early Metrics, Crunchbase
Revenue	Start-up company-revenue: EIKON, Dun & Bradstreet, Zoominfo,
Beta	Unlevered sectoral-beta. NYU-Stern dataset
Country-Risk-Premium	Country-level country risk premium. Moody's, NYU-Stern
Tax-Rate	Tax revenue as % of GDP. World Bank Indicators
Output-gap	Deviations of actual GDP from potential GDP as % of potential GDP. OECD
Dry-powder	Country-level estimate. Amount of committed but unallocated VC capital on hand. Invest Europe
Cash-on-Market	Country-level total VC investments. OECD
World Cash-on-Market	Worldwide total VC investments. OECD

10. Appendix II: Multicollinearity

Are Output Gaps and Cash-on-Market Correlated? Causally Related?

Because the multichannel cyclical valuation impact is a key contribution, we conduct multicollinearity testing to establish statistical non-relatedness across the macro-level variables that influence start-up valuation. In Table A2, we provide variance inflation factors (VIF), calculated subsequent to a multivariate regression using our primary macro-level variables (Table 4). It measures the correlation and strength of correlation between explanatory variables. Table A2 indicates non-correlation among the macro-variables. No variable has a VIF score surpassing 2.00, indicating the mutual independence of direct influences on start-up valuation, as in Figure 1.

Table A2: Multicollinearity-Testing

Source	SS	df MS	Number of obs	514	
			F(5, 508)	90.25	
Model	2283.0547	5 456.610941	Prob > F	0	
Residual	2570.24153	508 5.05953057	R-squared	0.4704	
Total	4853.29624	513 9.46061644	Adj R-squared	0.4652	
			Root MSE	2.2493	
Ln_Valuation	Coef.	Std. Err. T	P>t	[95% Conf.	Interval]
Ln_Revenue	0.6714774	.0395184 16.99	0.000	0.5938378	0.7491171
Ln_Beta	-0.6011327	.4294032 -1.40	0.162	-1.444757	0.242492
Country-Risk-Premium	-15.39393	17.77113 -0.87	0.387	-50.30789	19.52003
Output-Gap	0.181132	.0847502 2.14	0.033	0.0146279	0.3476361
Cash-on-Market	0.0007468	.0001272 5.87	0.000	0.0004969	0.0009967
Constant	6.426215	.7142596 9.00	0.000	5.022948	7.829481

Variable	VIF	1/VIF
Output-Gap	1.45	0.688246
Country-Risk-Premium	1.4	0.712027
Ln_Revenue	1.11	0.897474
Cash-on-Market	1.08	0.921813
Ln_Beta	1.07	0.933796
Mean VIF	1.23	

11. Appendix III: Cyclical Variations in GDP Growth Impact

With regard to the valuation impact of GDP growth, which varies substantially across the business cycle, we note that most of the data set refers to recessionary periods. During recessions, GDP growth is positive, even as start-up valuations are shrinking due to the recession. The regression results, with negative coefficients for GDP, thus should diminish as the recession diminishes. Table A3 reveals the valuation impact of GDP growth across the entire data set, as well as divided into business cycle quartiles. We also control for DCF valuation factors (revenue, beta, country risk premium). In our data set, roughly the top one-fourth of observations take place in a positive output gap macroeconomic environment.

Table A3: Business Cycle Variations in GDP's Valuation Impact

VARIABLES	Whole dataset Ln_Valuation	Lower 50% Ln_Valuation	Upper 50% Ln_Valuation	Upper 25% Ln_Valuation	Upper 10% Ln_Valuation
Ln_Revenue	0.6526***	0.7220***	0.5126***	0.3267***	0.3450***
	[0.034]	[0.049]	[0.044]	[0.066]	[0.073]
Ln_Beta	-1.2703***	-1.9671***	-0.7867	-6.7850***	-7.0156***
	[0.389]	[0.538]	[0.536]	[1.170]	[1.858]

Country-Risk-Premium	-30.1974**	44.8580**	-60.4418***	27.4377	38.4893
	[13.415]	[19.789]	[18.604]	[26.681]	[27.600]
LN_GDP Growth	-0.6103***	-1.0067***	-0.2591	-0.1304	0.3363
	[0.233]	[0.337]	[0.296]	[0.484]	[0.510]
Constant	8.5108***	7.0684***	10.6000***	16.7845***	15.7586***
	[0.655]	[0.954]	[0.836]	[1.384]	[2.000]
Observations	608	291	317	111	80
R-squared	0.43	0.51	0.37	0.40	0.40
Adjusted R-squared	0.431	0.502	0.358	0.375	0.367

Standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Overall, Table A3 demonstrates that the statistical significance of GDP growth occurs only in the most recessionary 50% of observations. The coefficient magnitude of GDP growth increases during boom periods and decreases for recessionary observations.

12. Appendix IV: Growth Cycle Coincident Indicator

Alternate Business Cycle Indicator

This appendix examines the business cycle impact using an alternate indicator: the Eurostat growth cycle coincident indicator (GCCI), which indicates the probability of slowdown in the macroeconomy, signals growth cycle peaks and troughs, and is published for the Eurozone as a whole. In Table A4, the OLS regressions demonstrate that valuation is directly affected by the GCCI indicator, as is cash-on-market, but the SEM models indicate the impact is significant on country risk premium. Thus, GCCI measures would describe business cycles' impact as more indirect than direct.

Table A4: Direct and Indirect Impact of Macro-level Start-Up Valuation-Drivers Using GCCI

GCCI Business-Cycle Regressions

VARIABLES	(1) Ln_Valuation	(2) Ln_Valuation	(3) Ln_Valuation	(4) Ln_Valuation	(5) Ln_Valuation	(6) Ln_Valuation
Ln_Revenue	0.6514***	0.6540***	0.6356***	0.7060***	0.6862***	0.6071***
	[0.034]	[0.034]	[0.035]	[0.037]	[0.036]	[0.034]
Ln_Beta	-1.0886***	-1.3509***	-1.1604***	-0.8804**	-0.9448**	-0.9861***
	[0.388]	[0.383]	[0.387]	[0.406]	[0.390]	[0.374]
Country-Risk-Premium	-38.3685***	-15.3681	-38.587***	-43.2772***	-23.8422*	-41.5507***
	[13.092]	[13.622]	[15.048]	[13.048]	[14.386]	[13.232]
Tax Rate		0.1130***				
		[0.020]				
GCCI			0.49393**			
			[0.213]			
Dry-Powder				0.00000009**		
				[0.000]		
Cash-on-Market					0.0006***	
					[0.000]	
World-Cash-on-Market						0.00003***
						[0.000]
Constant	7.9171***	3.8202***	8.0147***	6.6447***	6.4131***	5.3569***
	[0.615]	[0.933]	[0.615]	[0.687]	[0.648]	[0.639]
Observations	646	636	636	557	578	550
R-squared	0.41	0.44	0.42	0.45	0.48	0.53
Adjusted R-squared	0.408	0.438	0.412	0.447	0.473	0.526

Notes: Standard errors in brackets
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

GCCI Impact on Cash-on-Market

VARIABLES	(1) Cash-on-Market	(2) Cash-on-Market	(3) Cash-on-Market	(4) Cash-on-Market	(5) Cash-on-Market	(6) Cash-on-Market
GCCI	920.1494***	912.9339***	-20.1683	166.6458***	79.9328	3.5830
	[78.825]	[74.102]	[107.487]	[57.253]	[103.135]	[100.413]
Tax-Rate	-14.4339**	-28.7325***	-14.3335**			-27.6117***
	[6.345]	[6.176]	[5.752]			[5.563]
Country-Risk-Premium		-40,519.8447***			-29,451.9786***	-36,781.4116***
		[4,545.210]			[3,980.538]	[4,010.077]
Cash on World Market			0.0176***	0.01398***	0.0160***	0.0168***
			[0.002]	[0.0009]	[0.002]	[0.002]
Constant	1,583.0907***	2,444.4569***	-0.6567	.0139845***	-135.3966	862.4071***
	[231.023]	[237.692]	[244.460]	[83.264]	[160.296]	[246.928]

Observations	599	599	571	786	576	571
R-squared	0.19	0.29	0.27	.28	0.33	0.36
Adjusted R-squared	0.192	0.286	0.264	.279	0.322	0.358

Notes: Standard errors in brackets
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Structural equation model Number of obs: 1089
Estimation method = ml
Log likelihood = -7103.2086

	Coef.	SE	z	P-Value	[95% Conf.	Interval]
Dependent: Ln_Valuation						
Cash-on-Market	0.0006	0.0001	5.7	0.0000	0.0004	0.0008
Country-Risk-Premium	-26.7696	10.3907	-2.58	0.0100	-47.1349	-6.4042
GCCI	-0.0810	0.1817	-0.45	0.6560	-0.4371	0.2752
Ln_Revenue	0.5917	0.0301	19.65	0.0000	0.5327	0.6507
Ln_Beta	-1.3501	0.3361	-4.02	0.0000	-2.0089	-0.6913
Constant	7.9103	0.5429	14.57	0.0000	6.8464	8.9743
Dependent: Cash-on-Market						
Country-Risk-Premium	-22955.9900	3826.5600	-6	0.0000	-30455.9100	-15456.0700
GCCI	550.2820	-	-	-	-	-
Constant	1244.5150	41.5438	29.96	0.0000	1163.0910	1325.9400
Dependent: Country-Risk-Premium						
GCCI	-0.0015	0.0005	-2.99	0.0030	-0.0025	-0.0005
Constant	0.0093	0.0003	33.38	0.0000	0.0087	0.0098
		chi2(10)	21.62		Prob. > chi2	0.0171

CHAPTER 3:

Cross-Border Venture Capital Valuation: Business-Cycle, Institutional Factors, and Distance [11]

Max Berre[12][13]

ABSTRACT

Venture capital investment is a topic-of-interest in trade-investment ecosystems. While several studies explore the VC and start-up ecosystem, relatively-few explore the role of macro-level economic factors in influencing startup deals and valuations. Using 1,089 European venture-capital investments, this study examines the comparative macroeconomic, and macro-institutional influences on the European VC market landscape, finding that while firm-level performance indicators and local DCF factors drive startup valuations, there is also a substantial valuation divergence between domestic and cross-border venture capital deals, with cross-border deals substantially more sensitive to country-risk premiums. For cross-country venture capital deals, comparative international venture capital market-size drives startup valuations, as do business cycle conditions and comparative institutional conditions. Valuation-impacts for international venture capital deals show evidence of cross-border yield-chasing. Institutional-factors meanwhile, also impact valuations as investors seek optimal regulatory self-dealing protection and institutional environments that foster competitiveness and growth. This study also finds that physical distances act as a deal hurdle.

Valuation and venture capital markets driven by investor characteristics, by differences between investor and start-up, and by macro-level differences between the investor's market and the start-up's market.

Keywords Valuation, Start-up, Cross-border investment, Venture Capital, Entrepreneurial Finance, Market Size, Institutional factors.

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1. Introduction

Startup and venture capital markets make dramatic headlines. While valuation of startups has become a key topic-of-interest in entrepreneurial finance literature and startup ecosystem, the cross-border aspect of the venture capital market has received relatively little formal academic attention.

This study focuses on international and cross-border aspect of venture-capital markets, examining not only the cross-border macroeconomic dynamics, but also the institutional aspects of cross-border venture-capital markets to answer questions of how and where specifically cross-border venture-capital deals differ from domestic ones. Understanding these nuances can help both investors and entrepreneurs make sense of the ever-changing international-investment landscape, as well as open the door for substantial future economic, financial and policy-related research in a range of fields.

According to Chemmanur and Fulghieri (2014), globalization and technological innovation are key trends affecting the venture capital industry and entrepreneurial finance in general, with cross-border investment more than doubling its share of all 1991-era VC investments during the early 2000s. In principle, this means that a gap exists in terms of development of empirical cross-border research focusing on entrepreneurial finance, and particularly on venture-capital markets.

Using a dataset of 1,089 venture-capital investments, containing 1,042 unique EU and EEA market deals involving both domestic and cross-border venture-capital investments, this study examines macroeconomic, macro-sectoral, and macro-level institutional influences on the venture capital market landscape in European markets, finding that valuations are driven by cross-border differences in macroeconomic and macrofinancial market-conditions, between those of the startup and those of the VC. Overall, venture-capital cash-on-market drives startup valuations, as do growth and business-cycle conditions, valuation-impacts show evidence of cross-border yield-chasing. Cross-border institutional-factors meanwhile, also impact valuations.

This study's contributions shed light on the dynamics of cross-border venture-capital markets, demonstrating that different factors play key roles driving startup-valuations in domestic venture capital deals than in cross-border deals, with cross-border deal-valuations described as being driven by comparative institutional and legal factors.

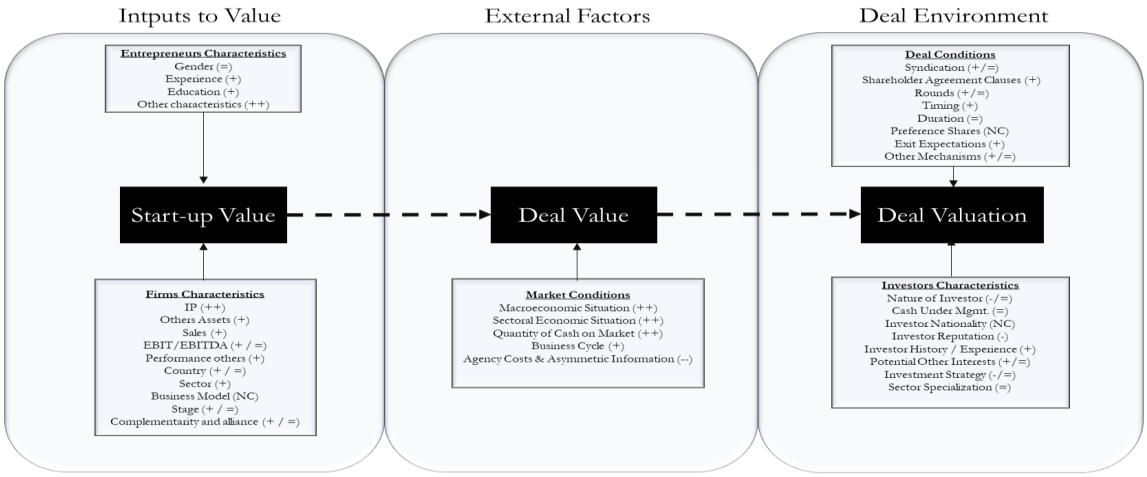
This study develops as follows: Section 2 examines the relevant literature, ranging from firm-specific and industry-specific factors, to country-level economic factors, to country-level institutional and legal factors. Section 3 describes the methodology and dataset used in this study, specifically outlining not only the dataset used, but also the contexts considered in this study's regression structures, comparing domestic and cross-border regressions. Section 4 describes the hypotheses and model-structures used in this study, while Section 5 outlines this study's empirical findings, which are subsequently discussed in detail in Section 6.

1.1: Startup-Valuation Meta-Model

In order to evaluate questions of market-condition valuation-impacts on startups, Berre and Le Pendeven (2021) develop a model outlining the contextually-adjusted startup-valuation-process, taking market-conditions into account. Essentially, startup-value-inputs navigate external market-conditions as part of the valuation-forming process. While the model allows for detail-flexibility for each factor, market-conditions consist, in principle of both sectoral and industry market conditions such as risk-levels, business-models, and market-structure, as well as market-conditions of both macro-financial and macro-institutional nature.

Equation 1: Berre-Le Pendeven Startup-Valuation Meta-Model

$$\boldsymbol{Pre-Money\ Valuation = f(((\sum Startup\ Value) \sum Deal\ Value) \sum Deal\ Valuation)}$$



1.2: Key Questions

Central to understanding the impact of cross-border investment on startup-valuations, are several questions examining the nature of the mechanical impacts of cross-border investment-flows. What details about cross-border-investment, in principle drive investment-behavior and subsequent startup-valuations?

Do cross-border macroeconomic differences drive investments and startup-valuations?

Do differences in macroeconomic performance between investor home-markets and target-markets drive startup-valuations? In principle, international financial investment flows are driven by potential investment yields. Essentially, investors based in low-growth or recessionary-markets are likely to search booming or high-growth markets for higher-yielding investments, thereby potentially driving startup-valuations.

Shaki and Medrano (2012) describe cross-border yield-chasing investment, as can be observed by the causal and interrelated relationship of several financial markets in the Asia-Pacific region. While this serves as evidence of cross-border financial-market investment-relationships, private-equity markets are often driven by similar market-forces.

Do cross-border institutional differences drive investments and startup-valuations?

Do differences in institutional performance between investor home-markets and target-markets drive startup-valuations? Comparative institutional soundness plays a role in driving startup-valuations. As is the case with macroeconomic and macrofinancial environments, financial investors also seek overseas markets which provide stronger investor protection.

La Porta et al. (1998) and La Porta et al. (2006) both find that markets with stronger investor protections, more transparency, and stronger private enforcement possibilities give rise to more investor-confidence, leading to larger, more sophisticated are more diversified financial markets in countries with stronger investor protections. Because some key financial markets such the US, UK, Canada, Netherlands, and Singapore markets have market-capitalizations which are substantially larger than their GDPs, evidence exists that the effect described by La Porta et al. is also at least partially cross-border in nature. Like many other markets, investor confidence is influenced by investor protection from self-dealing and conflicts of interest as well as trade barriers.

Are geographic distances indicative of value?

Do long investment-distances indicate valuable startup deals? Do long investment-distances drive startup-valuation? Long investment-distances can serve as indication of high valuations.

In principle, gravity-models are driven by size and distance, with distance acting as a trade-barrier. Given that Carrère et al. (2020) outlines that research demonstrates that trade falls with distance. Meanwhile, mechanics of gravity-effects within venture-capital markets are known to negatively-impact VC-exit-success in proportion to both physical geographic-distances (Cumming and Dai, 2010), and to travel-times (Chemmanur et al., 2016).

Because it can indeed be observed that both long-distance, high-valuation and short-range, low-valuation startup-deals exist, distance can be described as a hurdle to low-value startup-investments, such that long-range, low-valuation startup-deals are unlikely and relatively-scare.

2: Literature Review

As demonstrated by several systematic literature reviews on pre-money startups valuations published papers in the field mostly investigate impacts of entrepreneurs, investors and deal-related factors on the valuations (Köhn, 2018; Devigne et al., 2019; Wessendorf, 2019; Berre and Le Pendeven, 2022). Meanwhile, macroeconomic, as well as regulatory and governance-related market conditions attract limited attention. In particular, the cross-border aspects of market-condition impacts on startup-valuations are underserved, while the need for further research into cross-border VC research is laid-out clearly by to Chemmanur and Fulghieri (2014), who outline that while cross-border VC investment has been a major driving trend in the VC industry, there has been relatively-little research published on the topic until recently.

In this study, the differences in institutional and market conditions between the home markets of start-ups and their investors play a central role. In this respect, this study draws its intellectual heritage from several key sources. The of examinations of institutional and macroeconomic drivers for their impact on valuations can be traced to two key literature-trends.

2.1: Impacts of country-level economic variables

The role of country-level economic variables and approaches on startup-valuation can be traced to several key authors in the entrepreneurial-finance landscape, going into extensive detail on country-level divergences in both startup-valuations and valuation-approaches, which attribute these divergences to country-level institutional differences as well as differences in country-level valuation-driver-focus.

To begin with, studies comparing the importance to investors and markets of external and internal valuation factors (sometimes referred to as "horse" and "jockey") have traditionally found that external and contextual-factors such as market-conditions matter most (Gompers and Lerner, 2001; Kaplan et al., 2009).

That being said, studies indicate that different markets prioritize different valuation-factors when determining valuations (Lockett et al., 2002; Wright et al., 2004; 2005). For example, both Wright et al. (2004, 2005) and Manigart et al. (1997, 2000), identify differences between sectors, geographic settings, and investor-contexts, finding for example DCF-valuation to be more prominent in German civil-law jurisdictions than common-law jurisdictions, according to Wright et al. (2004). Lockett et al. (2002) meanwhile, reports that firm characteristics such as EBITDA are weighed differently from country to country. This essentially reinforces the Berre and Le Pendeven (2022) argument that the startup valuation process filters value signals through reigning local market conditions.

Relating macrofinancial investment-regulation to startup and VC markets, Gompers & Lerner (1998) find that regulatory changes affecting pension funds, capital gains tax rates, overall economic growth, and research and development expenditures, as well as firm-specific performance and reputation, affect fundraising. The results are potentially important for understanding and promoting venture capital investment.

Several studies take distance into account. Compared to domestic VC investments, international VC investments present additional risks and challenges because of the geographical, cultural and institutional distance between portfolio companies and VC investors increases (Devigne et al., 2016). Furthermore, distances are known to negatively-impact VC-exit-success This refers to both geographic-distances (Cumming and Dai, 2010), as well as travel-times (Chemmanur et al., 2016).

Specifically examining cross-border VC markets, Schertler & Tykvová (2011) make several key points. First, expected growth differences between the PC's and VC firm's country are strongly positively related to the number of international deals between the two countries. Second, expected growth in the VC firm's home country strongly increases the number of domestic deals, while it slightly discourages the number of

international deals. Third, higher market capitalization in the VC firm's home countries leads to more domestic as well as foreign deals. Fourth, the number of deals financed by foreign investors increases when the expected growth and the market capitalization of the PCs' countries increase.

2.2: Impacts of country-level institutional variables

This study is furthermore influenced by several key studies in the economics, finance and entrepreneurial fields. For instance, Devigne et al. (2018), a literature review which examines core literature in the venture capital landscape, as well as drivers which studies have shown to play a deterministic role in international venture capital flows. These include market conditions such as growth rates and growth rate differentials, as well as institutional, and industry-level international differences.

A well-established way to approach information asymmetry as a target of focus is contributed by La Porta et al., who have contributed numerous studies linking corporate governance, valuations, and international financial flows. La Porta et al. (2002) describe that national-level minority shareholder protection and insider concentration has direct impact on valuations, while La Porta et al. (2006) examines the valuation impact of securities laws writ-large, and La Porta et al. (2008) examines shareholder protection against insider self-dealing. Overall, these three studies provide the descriptive statistics which give definition and form to the national-level market conditions by examining national-level juridical differences within financial and company law. The legal view is reinforced by Kaplan et al (2007), who find that startup-valuations vary across legal regimes, finding that weaker outside investor-protection leads to smaller and less-liquid capital markets, more concentrated corporate-ownership, lower corporate-dividends, and lower valuations.

A way to contextualize industry-level and national-level impacts of risks and access to funding further emerges via studies published by policy sources. OECD (2019) outlines that while the growth of alternative finance has driven recent increases in funds and loans available to start-ups and SMEs, several market segments face problems in accessing finance.

Fundamentally, Damodaran (2002) agrees with the outlook presented by La Porta et al. concerning insiders, self-dealing, and minority shareholders. While Damodaran (1993) explicitly finds the effect of insiders, Damodaran also publishes aggregated industry-level figures for insider, CEO, and institutional holdings. In principle therefore, Damodaran, Devigne et al., and La Porta et al. all approach information asymmetry as a driver of investment in start-ups,

3: Methodology and Data

This section presents the methodology, the construction of key variables, and the list of control variables used in the multivariate analysis.

3.1: Startup Deals Dataset

The dataset expressed in EUR consists of both domestic and cross-border startup investment deals in the UK, EU member-nations, EEA member-nations. The startup-valuations, revenues, as well as firm-specific and investor-specific information is drawn from multiple commercially-available and publicly-available sources. Sector-level and national-level data meanwhile, are drawn entirely from publicly available sources. The dataset grants this study numerous strengths, these include not only the large number of observations, but also a wide diversity in terms of macroeconomic environment and of institutional and legal ecosystems. Data from outside the Eurozone were manually converted to EUR using annual-average exchange-rates.

Because each line within our dataset is specific per-investor-per-deal, deals with multiple investors occupy multiple lines within the dataset, identifying data for startup and investor, as well as relevant industry-level, institutional, and macroeconomic data for both parties. Since a start-up can have several investors, it can have multiple observations in the regression analysis, reflecting each unique investor–startup pair. The dataset style is borrowed from Masulis and Nahata (2009).

With 1,089 observations representing 1,042 deals across 675 startups ranging from Q1-2000 to Q1-2020, our dataset-size is substantial, although only 681 observations contain firm-level revenue figures. The dataset includes deal dates and founding dates for both start-ups and investors, expressed as both dates and years.

3.2: Dependent Variable

In principle, startup-valuation is the primary dependent variable. That is, the product of share price before a funding round multiplied by the number of outstanding startup shares. Since the dataset is drawn from EU and EEA data, valuations are expressed in EUR. Data drawn from outside the Eurozone, such as from the UK, Poland, Norway, Sweden, and Switzerland were converted into EUR. Table 1 outlines the summary statistics of this study's pre-money valuations dataset. While the data's time and sectoral distribution is somewhat uneven, it does cover several major events, including the end of the dotcom bubble, the Eurozone crisis, and the start of the Covid-19 Pandemic.

Table 15a: Summary Statistics

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Totals
Mean Valuation	109 000 000	49 700 000	32 900 000	21 800 000	50 800 000	12 000 000	25 700 000	15 200 000	4 181 531	511 000 000	11 900 000	33 300 000	40 100 000	10 300 000	65 400 000	182 000 000	90 100 000	298 000 000	286 000 000	1 130 000 000	1 170 000 000	222 000 000
Std. Dev	239 000 000	155 000 000	29 800 000	15 500 000	29 400 000	7 679 114	32 100 000	9 378 568	3 352 995	690 000 000	.	9 424 469	135 000 000	36 100 000	234 000 000	363 000 000	232 000 000	634 000 000	787 000 000	1 300 000 000	1 420 000 000	602 000 000
Min	795 216	83 579	57 287	6 969 987	30 000 000	762 500	2 970 006	1 708 426	762 500	1 558 441	11 900 000	9 999 972	55 714	53 833	50 000	63 330	63 330	80 000	2 160 000	1 412 881	2 354 802	50 000
Max	1 490 000 000	1 280 000 000	120 000 000	43 700 000	71 500 000	16 500 000	48 400 000	24 000 000	8 899 903	1 270 000 000	11 900 000	36 700 000	556 000 000	229 000 000	1 560 000 000	1 920 000 000	1 920 000 000	2 140 000 000	2 230 000 000	5 380 000 000	5 060 000 000	5 380 000 000
Austria	-	3	-	-	-	-	-	-	2	-	-	-	-	-	1	-	-	-	-	-	-	6
Belgium	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	3	5	-	5	17
Croatia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Czech	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6
Denmark	-	3	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	3	-	8
Finland	1	-	-	-	-	-	-	-	-	-	-	7	-	1	1	5	2	4	1	-	-	22
France	29	11	4	-	-	5	-	-	-	2	-	1	1	4	-	5	27	16	-	1	-	106
Germany	19	11	3	-	1	-	-	-	2	-	-	-	2	3	5	12	14	33	-	31	2	138
Ireland	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	5	8	5	-	-	-	20
Italy	3	-	-	-	1	-	-	-	-	-	-	-	1	1	-	1	2	1	-	-	-	10
Latvia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1
Lithuania	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	-	7
Luxembourg	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	3	-	-	-	-	6
Netherlands	2	1	2	-	-	-	-	-	-	-	-	-	-	-	5	-	-	1	-	-	-	11
Norway	2	4	-	-	-	-	-	2	-	1	-	-	-	-	-	-	-	1	-	-	-	10
Poland	9	8	-	-	-	-	-	-	-	1	-	-	-	-	1	1	2	-	-	-	-	22
Portugal	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	1	2	2	1	-	-	8
Romania	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	6
Spain	5	-	1	-	-	-	-	-	-	-	-	-	-	2	1	2	4	2	-	4	-	21
Sweden	5	3	-	-	-	-	-	-	-	-	-	1	1	-	1	13	-	2	-	1	-	27
Switzerland	4	1	1	-	-	-	-	-	-	-	1	-	-	-	1	-	2	3	-	-	-	13
UK	43	59	6	4	-	2	1	2	1	1	-	-	12	30	89	151	116	54	5	26	21	623

Total	133	108	17	4	2	7	2	5	5	5	1	9	17	42	106	200	182	130	12	73	28	1089
Business / Consumer Services	-	-	-	-	-	-	-	1	-	-	-	-	5	8	30	33	21	12	-	-	-	110
Aerospace	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
Retail	12	9	-	-	-	-	-	-	-	-	-	-	1	3	9	22	31	2	-	7	-	96
Automotive	-	2	-	-	-	-	-	-	-	-	-	-	-	1	1	-	2	9	-	-	-	15
Finance	5	4	2	-	1	-	-	1	-	1	-	-	1	4	5	45	23	23	1	17	4	137
Food/Agro	3	-	-	-	-	-	-	-	-	-	-	-	-	4	16	12	16	16	1	-	1	69
Machinery / Industrial	6	4	1	2	-	-	-	-	-	-	-	-	-	1	-	2	5	3	-	-	-	24
Power	1	1	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	6
ICT / Software	62	45	6	1	-	5	2	2	3	-	-	9	5	9	23	27	35	33	5	36	18	326
Pharma / Healthcare	18	21	7	-	1	2	-	-	2	1	1	-	-	1	-	11	13	3	1	1	5	88
Education	-	1	-	-	-	-	-	-	-	-	-	-	1	-	1	3	4	3	1	-	-	14
Electronics	2	1	-	-	-	-	-	-	-	-	-	-	1	2	-	3	2	1	1	-	-	13
Leisure / Entertain/ Tourism	5	3	1	-	-	-	-	-	-	-	-	-	2	2	10	15	18	5	-	3	-	64
Clean-Tech	-	1	-	-	-	-	-	1	-	-	-	-	1	-	-	1	1	4	2	-	-	11
Home	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	2
Real Estate	1	2	-	-	-	-	-	-	-	-	-	-	-	-	1	11	3	8	-	9	-	35
Office	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	1	-	-	-	3
Fossil	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Transport	1	-	-	-	-	-	-	-	-	2	-	-	-	2	1	11	6	6	-	-	-	29
Media	7	3	-	-	-	-	-	-	-	-	-	-	-	1	8	1	-	-	-	-	-	20
Total	123	98	17	4	2	7	2	5	5	5	1	9	17	42	105	200	180	130	12	73	28	

3.3: Control Variables: Baseline Model: Control Scenario

Classical economic theory gives us the DCF model, whereby valuations are driven by risk-adjusted firm revenues. In principle, the control-scenario draws on the factors used by the DCF valuation approach. These are drawn from Damodaran (2005, 2009, 2010).

In order to approach a clear view on the explanatory power and valuation-impact of macroeconomic factors and macro-financial factors in the startup ecosystem, factors used in classical firm-valuation models – in particular, DCF-related factors –should be included empirical models. The DCF approach can be replicated using ordinary-least-square regressions by regressing valuation against revenue, sectoral-beta and country-risk-premiums.

3.4: Cross-Border Effects

Divergences between explanatory-power of domestic cash-on-market and world cash-on-market are indicative of cross-border investment effects. These cross-border investment-effects would emerge as a result of substantial differences in both the institutional business ecosystem and macroeconomic realities between inter-related open economies.

Macroeconomic and Macrofinancial Market-Conditions

In line with Gompers and Lerner (1998) and Bonini and Alkan (2006), which find valuations to be driven by macroeconomic indicators, cyclical indicators and tax-rates, this study's macroeconomic data consist of macroeconomic output-gap, and total overall tax-rates. To this, we add total venture capital market-cash-on-market available at both county level and on global markets, which likely have direct valuation-impacts on startups. Additionally, comparative cross-country macroeconomic and macrofinancial conditions are able to impact startup valuations as local market-conditions may act as push-factors encouraging investors to look abroad in order to diversify, increase yields, or maximize returns. These are drawn from OECD and IMF figures.

Institutional and Regulatory Market-Conditions

Both venture-capital-specific literature such as Kaplan et al. (2007), as well as wider economic and financial literature, such as La Porta et al. (1997) and Shleifer et al. (2008) indicate that governance at both national-level and firm-level plays a key deterministic role in driving valuation and overall financial-market activity via both investor confidence and business confidence. In line with existing literature, governance indices covering self-dealing, insider-concentration, trade-openness, trade openness, and overall competitiveness. These are drawn from multiple sources, including the World Economic Forum, as well as Shleifer et al. (2008) and La Porta et al. (2006). Additionally, institutional and regulatory conditions that may directly-impact overseas trade and investment flows, such as trade regulation, tariffs rates, and prevalence of non-tariff barriers can directly impact venture capital and private equity investment activity in overseas markets.

Fundamentally, existing economic theory, as outlined in the literature, indicates that comparative institutional soundness plays a role in driving startup-valuations. This is driven by investors seeking overseas markets which provide stronger investor protection. Given that several key financial markets which feature strong investor protection also have market-capitalizations which are substantially larger than their GDPs, evidence exists that the effect described by La Porta et al. is also at least partially cross-border in nature.

3.5: Macro-Level Independent Variables

Macroeconomic and Macrofinancial Market-Conditions

The macroeconomic data consist of country-risk-premium, macroeconomic output-gap, tax-rates and total venture capital cash-on-market available at both domestic county level and on global markets. These are drawn from the NYU-Stern database, the OECD.

Institutional and Regulatory Market-Conditions

Institutional-data are drawn primarily from two sources. La Porta et al. (2006) provide legal-protection indices for self-dealing and investor-protection. The World Economic Forum's World Competitiveness Report, which not only yields a competitiveness index, but also indices for macroeconomic stability, trade-openness, and availability of SME funding. Use of European deals data allow us to draw on a wide range of variation in these indicators. All drivers are captured for both the local-market conditions of the start-up and of the investor.

Definitions of Variables in Dataset

Table 1 outlines the variables used in this study. Included are valuation, this study's key dependent variable, as well as the primary independent variables, ranging from firm-revenues to industry-level variables, including sectoral-beta and sector-level insider-holdings, to macro-level economic variables, including country-risk-premium, cash-on-market, and macroeconomic output-gap, to macro-level institutional variables, such as the LLSV securities law index, and the WEF global competitiveness index, to categorical variables for industry, city, and investor-type. Additionally, kilometer-distance between the investor's city and the target-startup's city is taken into account.

Table 16: Dataset and Variable Definitions

Variable	Description
Valuation	Pre-Money Startup-Valuation. Source: EIKON, Early Metrics, Crunchbase
Revenue	Startup company revenue: Source: Eikon, Dun & Bradstreet, ZoomInfo,
Beta	Unlevered sectoral beta. Source: NYU Stern dataset
Credit Risk Premium	Country-Level Credit Risk Premium. Source: Moody's, NYU Stern
Tax Rate	Tax revenue as % of GDP. Source: World Bank Indicators
Output Gap	Deviations of actual GDP from potential GDP as % of potential GDP. Source: OECD
Cash-on-Market	Country-level total venture capital investments. Source: OECD
World Cash-on-Market	Worldwide total venture capital investments. Source: OECD
LLSV Securities Law Index	Index of security laws covering corporate governance rules, shareholder rights, disclosure, and private-enforceability. Source: LaPorta et al. (2006)
WEF Global Competitiveness Index	The Global Competitiveness Index is made up of over 110 variables, organized into twelve pillars, with each pillar representing an area considered as an important determinant of competitiveness. Source: World Economic Forum
Distance (KM)	Distance in kilometres between city where startup is based and city where investor is based.
Domestic Deal Dummy	Dummy Variable. Takes value of 1 when startup and investor are based in same country.
Sector Categorical Variable	Categorical Variable. Industry sector of startup.
City Categorical Variable	Categorical Variable. City where startup is based.
Investor-type Categorical Variable	Categorical Variable. Types of investors involved in deal.

4: Hypothesis and Analysis

4.1: Functional Form

Discounted-Cashflow Model Approaches

DCF-approaches focused on multi-period risk-adjusted revenue-discounting are the most traditional firm-valuation approaches, are constructed on the basis of revenues, growth-rates, and risk-adjusted discount-rates, as described by Eq. 2.

Equation 2: Discounted-Cashflow Approaches

$$Valuation = \sum_{i=n} \frac{Revenues}{(1 + risk - adj.\ interest\ rate)^n}$$

or

$$Valuation = \frac{Revenues}{(risk-adj.interest\ rate-growth\ rate)} \text{ for stable states}$$

In principle, DCF-model approaches can incorporate cross-border valuation-influences in several ways. These include impacts on revenues, growth-rates, reinvestment-rates, betas, and country-risk-premia.

Scorecard Approaches

Developed by practitioners, scorecard-valuation methods are modular and relatively straightforward valuation-approaches based on summation of key characteristics, market-conditions, and deal-conditions. In industry, the scorecard approach is typically used by business angels. Industry-emergent techniques for scorecard valuation include Berkus (2016) and Payne (2011). Meanwhile, in published economic literature, this same concept appears as summation-based valuation models, such as published by Hand (2005) and Sievers et al. (2013). For example, Eq. 3 outlines the Sievers et al. (2013) summation-based valuation model,

assigning valuation based on summation of financial, and non-financial firm-attributes, as well as deal-characteristics are relevant valuation-coefficients.

Equation 3: Sievers et al. (2013) Summation-based Valuation Model

$$\log(Valuation_{it}) = \sum \Phi Non - financial_{it} + \sum \Delta Financial_{it} + \sum \Psi Deal\ Characteristics_{it}$$

Overall, scorecard approaches can incorporate exogenous cross-border valuation-influences in several ways, ranging from the non-financial and deal-characteristics prevalent in a given market or cross-border ecosystem, to the role of national-level or cross-border linkages and market-conditions in driving the model's factor-coefficients. Additionally, a major advantage to scorecard-approaches is their ability to incorporate data specific to economic geography, which may range from categorial variables to geo-spatial data, to qualitative data and sentiment analysis.

4.2: Hypotheses

Valuations transmit information not just about a firm's revenues and fundamentals, but also about contextual market conditions. At the macro-level, the latter concern macroeconomic indicators such as growth rates (Bernoth and Colavecchio, 2014), cyclical indicators (Fitza et al., 2004; Korteweg and Sorensen, 2010), SME-finance availability and quantity of cash on the private equity market (Inderst and Muller, 2004). Several studies suggest this to be the case: for example, more and more-successful VC deals occur during boom periods (Heughebaert and Manigart, 2012). While there are several ways that business cycles can directly impact valuation, both revenues and discount-factors (i.e., beta, country-risk-premium) are controlled for in this study directly.

Business cycles might directly impact valuations due to potential future revenue-growth, industry-growth, or macroeconomic-growth, all of which may serve to attract investors, influencing both investor selection and startup-valuation (Wessendorf, 2019). Meanwhile, both venture capital cash-on-market and business cycle growth can impact valuations by means of growth of business networks, partnerships, and relationships (Inderst and Muller, 2004; Streletzki and Schulte, 2013). Alternatively, macroeconomic business-cycle conditions can also serve to inflate startup-valuations in the short-run during a boom, albeit on a short-lived based which may later be corrected, as described by Michel (2014). Moreover, macroeconomic differences between the investor's setting vis-à-vis that of the target start-up also play a dominant role in determining startup-valuations. Evidence of this can be found in the cross-border financial-market linkages described by Shaki and Medrano (2012).

In addition, national-level differences in institutional indicators such as investor protection law, trade-openness, or legal protection against self-dealing law can be expected to play a key deterministic role. In particular, transparency and self-dealing regulation is known to influence investor sentiment at an

international and cross-country level (La Porta et al., 1997, 2002, 2006). In terms of regulation, this can be measured via legal and regulatory indices specific to firm-level transparency and self-dealing. Meanwhile, policy-makers uphold that trade-openness contributes to competitiveness (OECD, 2019 and World Economic Forum, 2019) via productivity growth and access to both markets and financing. Because productivity growth and access to finance can impact both national-level competitiveness and firm-level competitiveness, valuations can be impacted. Because these institutional drivers can influence investor-confidence, it is likely value can be detected by contextual differences between the market-conditions in the investor's home market vis-à-vis the market-conditions of the target startup. Fundamentally, investor-startup differences and distances of different types play deterministic roles in cross-border venture-capital investments, including not only geographic distances, but also cultural, and institutional distances (Buchner et al., 2018). According to Wright et al. (2005), an under-researched area of cross-border VC-market research concerns institutional-context influence, especially roles of social networks and cultures.

Fundamentally, a viable reason for engaging in cross-border VC investment would be to chase yield by investing in markets whose growth-rates or business-cycle indicators are stronger than those of the investor's home markets. Accordingly, cross-border differences in cyclical-conditions play a key deterministic role in startup-valuations. Empirically, this would mean cross-border differences in cyclical or macrofinancial indicators would be responsible for substantial startup-valuation premiums or discounts.

On the other hand, yield-possibilities aside, investors also engage in international and cross-border investment in order to seek institutional safe-harbors where investor-protections such as those described by La Porta et al. (2006) are stronger than in the investor's home-market. Additionally, not only are investors interested in low-risk markets from the governance perspective, but also from the credit-risk-premium standpoint. Therefore, cross-border differences in risk-metric-conditions and institutional-conditions play a key deterministic role in startup valuations. Investors seek safer markets. Thus,

> *H1: Macroeconomic differences between the investor's setting vis-à-vis those of the target start-up play a dominant role in determining startup-valuations.*
>
> *H2: Investors seek safer markets. Country-level differences between governance, investor-protection, and country-risk premiums play a dominant role in determining startup-valuations.*

In principle, the veracity of H1 and H2, focusing respectively on economic and institutional-distances described by Buchner (2018) can be evaluated by statistical-significance of cross-border differences in macroeconomic and macrofinancial indicators and of governance-indicators and risk-premia respectively.

5. Empirical Findings

Fundamentally, results are in line with established economic theory, since empirical results are consistent with discounted-cashflow valuation approaches, as well as with both differences in cross-country macrofinancial indicators, including cash-on-market or business-cycle valuation-impacts and with cross-country differences in institutional indicators, including the LLSV Securities Law Index and the WEF Global Competitiveness Index, which measure investor protection regulation and institutional capability to sustain economic growth respectively. Overall, comparative cross-border macroeconomic and institutional indicators consistently demonstrate substantial valuation-impacts within the dataset.

5.1: Discounted Cashflow: The Baseline Scenario

The DCF valuation approach, which discounts revenues, profits, and cashflow figures using a risk-adjusted discount rate, can be used to both establish the soundness of the dataset and as to control-factors by-which to contextualize all other relevant firm-valuation factors.

In principle, a DCF approach can be approximated using OLS models by including revenue or profit figures and discount-factor inputs. Because the free-cashflow-to-equity DCF model applies a cost-of-equity-based discount factor, an FCFE-based DCF approach would include CAPM-related factors in the estimation model.

Table 3 outlines valuation-impact of revenues, sector unlevered-beta, and country-risk-premium and demonstrates that the data are consistent with discounted cash-flow valuation models, and thereby establishes the soundness of the dataset. Panel A displays the overall valuation-impact of firm-revenues, industry-betas, and country-risk-premium, while Panel B displays their valuation-impact in domestic startup-investment deals, and Panel C displays valuation-impact in cross-border deals. Panel A also includes a domestic-deal dummy.

Table 17: Baseline Discounted Cashflow Valuation Model

Panel A: DCF-based Regressions

VARIABLES	(1) Ln_Valuation	(2) Ln_Valuation	(3) Ln_Valuation	(4) Ln_Valuation	(5) Ln_Valuation	(6) Ln_Valuation	(7) Ln_Valuation
Ln_Revenue	0.6861***			0.6660***	0.6692***	0.6514***	0.5233***
	[0.034]			[0.034]	[0.034]	[0.034]	[0.034]
Ln_Beta		-2.7738***		-1.1629***		-1.0886***	-1.1329***
		[0.395]		[0.389]		[0.388]	[0.357]
Credit Risk Premium			-70.7055***		-40.7742***	-38.3685***	-32.5285***
			[11.701]		[13.134]	[13.092]	[12.060]
Domestic Deal Dummy							1.9582***
							[0.181]
Constant	6.4565***	17.8453***	16.7791***	7.4278***	7.0425***	7.9171***	9.0059***
	[0.503]	[0.254]	[0.133]	[0.596]	[0.534]	[0.615]	[0.575]
Observations	646	1,045	1,045	646	646	646	646
R-squared	0.394	0.0451	0.0338	0.403	0.403	0.410	0.501
Adjusted R-squared	0.393	0.0442	0.0329	0.401	0.401	0.408	0.498

Panel B: DCF-based Regressions (Domestic)

VARIABLES	(1) Ln_Valuation	(2) Ln_Valuation	(3) Ln_Valuation	(4) Ln_Valuation	(5) Ln_Valuation	(6) Ln_Valuation
Ln_Revenue	0.4921***			0.4813***	0.4875***	0.4780***
	[0.049]			[0.050]	[0.049]	[0.050]
Ln_Beta		-2.2368***		-0.6942		-0.6504
		[0.503]		[0.520]		[0.523]
Credit Risk Premium			-46.5306***		-17.1078	-15.0817
			[13.154]		[17.075]	[17.134]
Constant	10.5840***	19.3016***	18.3499***	11.1457***	10.7845***	11.2871***
	[0.796]	[0.323]	[0.161]	[0.899]	[0.821]	[0.914]
Observations	257	393	393	257	257	257
R-squared	0.282	0.0481	0.0310	0.287	0.285	0.289
Adjusted R-squared	0.279	0.0457	0.0285	0.282	0.279	0.281

Panel C: DCF-based Regressions (Cross-Border)

VARIABLES	(1) Ln_Valuation	(2) Ln_Valuation	(3) Ln_Valuation	(4) Ln_Valuation	(5) Ln_Valuation	(6) Ln_Valuation
Ln_Revenue	0.6082***			0.5766***	0.5844***	0.5547***
	[0.045]			[0.045]	[0.045]	[0.045]
Ln_Beta		-2.7540***		-1.6353***		-1.5833***
		[0.462]		[0.492]		[0.487]
Credit Risk Premium			-79.9106***		-52.4290***	-50.4416***
			[15.858]		[17.201]	[17.003]
Constant	6.8632***	16.7620***	15.7956***	8.2723***	7.6581***	8.9922***
	[0.634]	[0.298]	[0.171]	[0.756]	[0.680]	[0.787]
Observations	389	652	652	389	389	389
R-squared	0.322	0.0517	0.0376	0.341	0.338	0.356
Adjusted R-squared	0.320	0.0503	0.0361	0.338	0.335	0.351

Standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1

Overall, Table 3 corroborate the DCF approach, finding that revenues, industry-betas, and country-risk-premiums are either individually or jointly significant, or both. The regressions displayed in Panel A corroborate the DCF valuation-approach, finding that DCF factors are both individually and jointly significant, impacting firm-valuations as the DCF model indicates, explaining between 39 and 50% of log-variation in startup-valuations according to r-squared, with the domestic deal-dummy indicating that European-market domestic-deals are associated with a significant valuation-markup.

In domestic investment deals meanwhile (as outlined in Panel B), firm-valuation figures, sectoral-beta, and country-risk premium are only individually-significant, with r-squared outlining that DCF-factors explain roughly one-quarter of log-variation in startup-valuations at most. Reduced dataset size and degrees-of-freedom notwithstanding, these regression-results indicate that for domestic-deals in particular, the entire story is not being captured.

Cross-border deals examined in Panel C on the other hand, demonstrate not only higher goodness-of-fit indicators, with DCF-factors explaining as much as 36% of log-variation in startup-valuations according to r-squared, but also that DCF-factor are jointly-significant for cross-border deals.

Inclusion of a domestic-deal dummy increases adjusted-r-squared from .4 08 to 0.498, with the domestic-deal dummy coefficient indicating a valuation-premium for domestic deals. Comparing domestic and cross-border deals indicates that DCF factors play a substantially more deterministic role in cross-border deals than in domestic deals within our dataset. Therefore, while domestic deals may see valuation-markups, this is likely due to factors beyond the standard DCF-model.

5.2: Cross-Border Effects

In addition to simply measuring the valuation-impacts of target-market and investor-country macroeconomic and macro-institutional factors, they must also be contextualized by being compared to one-another, given that cross-border relative differences may drive both investor behavior and subsequent valuations. These coefficients are generated by calculating the differences between target-market and investor-country figures.

Macroeconomic and Macrofinancial Market Differences

Table 4 demonstrates the impact of cross-border macro-level economic and financial valuation-drivers on startup-valuations. In addition to cross-border macroeconomic and macrofinancial variables, we investor-startup kilometer-distances.

Table 4: Valuation-Impact of Cross-Border Macro-Level Drivers

Cross-Border Macro-Regressions

VARIABLES	(1) Ln_Valuation	(2) Ln_Valuation	(3) Ln_Valuation	(4) Ln_Valuation	(5) Ln_Valuation	(6) Ln_Valuation	(7) Ln_Valuation
Ln_Revenue	0.6514***	0.6231***	0.6075***	0.6492***	0.6672***	0.6071***	0.5244***
	[0.034]	[0.034]	[0.034]	[0.036]	[0.038]	[0.034]	[0.033]
Ln_Beta	-1.0886***	-1.1520***	-0.9214**	-0.9370**	-0.8138*	-0.9861***	-1.0201***
	[0.388]	[0.379]	[0.387]	[0.404]	[0.434]	[0.374]	[0.355]
Country Risk Premium	-38.3685***	-75.9348***	-29.6706**	-31.3892**	-38.2335**	-41.5507***	-33.9610***
	[13.092]	[14.517]	[13.303]	[14.024]	[18.268]	[13.232]	[12.185]
Country Risk Premium Difference		-72.3242***					
		[13.242]					
Tax-Rate Difference			0.1107***				
			[0.015]				
Output-Gap Difference				0.1103*			
				[0.066]			
Cash-on-Market Difference					0.0004***		
					[0.000]		
World Cash-on-Market						0.00003***	
						[0.000]	
Ln_Distance (KM)							0.2751***
							[0.024]
Constant	7.9171***	8.6313***	8.1084***	7.7907***	7.1607***	5.3569***	8.5553***
	[0.615]	[0.616]	[0.608]	[0.644]	[0.696]	[0.639]	[0.569]
Observations	646	640	609	610	478	550	633
R-squared	0.41	0.44	0.46	0.42	0.45	0.53	0.51
Adjusted R-Squared	0.408	0.436	0.457	0.412	0.445	0.526	0.506

Standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1

Table 4 demonstrates that cross-border differences in output-gap, tax-rate differences, and world cash-on-market, are associated with higher startup-valuations, while differences in country-risk-premiums are associated with lower startup-valuations. Overall, this indicates that startup-valuations are driven by differences between domestic market-conditions and market-conditions abroad. The statistically-significant near-zero-coefficient of differences in domestic cash-on-market, in conjunction with elevated goodness-of-fit figures indicate that target-market cash-on-market and investor-country cash-on-market may be *equally-impactful*. Country-risk-premiums and country-risk-premium differences meanwhile are jointly-significant and both negative, indicating a compounding-effect. The negative coefficient of country-risk-premium differences indicate that target markets which are substantially riskier than the investor-markets might lead investors of assign unusually-large valuation-discounts. Additionally, log of kilometer-distances are associated with substantial valuation-premiums.

Cross-Border Institutional Differences

In addition to cross-border macro-level economic and financial variables, cross-border differences in institutional and governance-related variables may also drive startup-valuations. Table 5 examines the valuation-impact of cross-border differences in securities law index, competitiveness index, trade-openness,

and non-tariff barriers. As is the case with Table 8, this table also includes investor-startup kilometer-distances.

Table 5: Valuation-Impact of Cross-Border Institutional Drivers

Cross-Border Institutional-based Regressions

VARIABLES	(1) Ln_Valuation	(2) Ln_Valuation	(3) Ln_Valuation	(4) Ln_Valuation	(5) Ln_Valuation	(6) Ln_Valuation
Ln_Revenue	0.6514***	0.5330***	0.6135***	0.6514***	0.6556***	0.5244***
	[0.034]	[0.035]	[0.035]	[0.034]	[0.035]	[0.033]
Ln_Beta	-1.0886***	-1.2091***	-0.8296**	-1.1434***	-1.0745***	-1.0201***
	[0.388]	[0.381]	[0.396]	[0.389]	[0.391]	[0.355]
Country Risk Premium	-38.3685***	-25.2295*	-43.5747***	-41.4604***	-37.0035***	-33.9610***
	[13.092]	[13.579]	[13.660]	[13.425]	[13.404]	[12.185]
Difference in LLSV Securities Law Index		0.3167***				
		[0.034]				
Difference in WEF Global Competitiveness Index			0.1145***			
			[0.024]			
Difference in Trade-Openness				-0.0647***		
				[0.024]		
Difference in Non-Tariff-Barriers					-0.0092	
					[0.022]	
Ln_Distance (KM)						0.2751***
						[0.024]
Constant	7.9171***	9.0853***	8.0781***	7.9631***	7.8493***	8.5553***
	[0.615]	[0.617]	[0.632]	[0.621]	[0.624]	[0.569]
Observations	646	601	603	641	641	633
R-squared	0.410	0.484	0.433	0.418	0.412	0.509
Adjusted R-Squared	0.408	0.481	0.430	0.415	0.408	0.506

Standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1

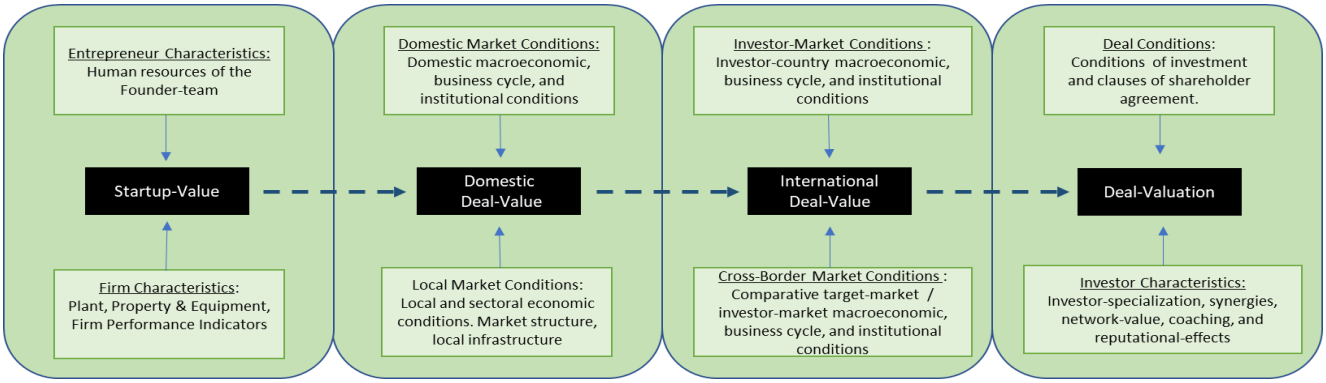
In terms of explanatory-power, goodness-of fit figures indicate that coefficients for differences in competitiveness index and securities law index are the dominant cross-border institutional-governance indicators. Meanwhile, the coefficient for differences in trade-openness is negative, indicating that investor-country trade-openness may have more significant valuation-impact than target-market trade-openness, or that the cross-border differences matter, in favor of investor-country market-conditions. These findings might indicate that while target-markets impact startup-valuations via both competitiveness and securities law standards, investor-country market-conditions influence them via trade-openness.

Market-Conditions Meta-Model

Considering that the empirical findings demonstrate evidence that startup-valuations are affected by both domestic and investor-country market-conditions, as well as comparative cross-border market-conditions, modification of Equation 1 to capture the mechanics of cross-border market-condition valuation-impact may be necessary, as per Equation 4:

Equation 4: Cross-Border Market-Conditions Meta-Model

$$\boldsymbol{Pre-Money\ Valuation} = \boldsymbol{f}((((\sum \boldsymbol{Startup\ Value}) \sum \boldsymbol{Domestic\ Deal\ Value}) \sum \boldsymbol{Internaitonal\ Deal\ Value}) \sum \boldsymbol{Deal\ Valuation})$$



Overall Composite Relationship and Fixed-Effects

Taking Equation 4 into consideration, as well as the findings described in Tables 4, 5, 6, 7, and 8, a composite regression table including those startup-valuation factors with strongest and most theoretically-established explanatory-power, capturing the most likely elements of both domestic and international deal-value. Additionally, the impact of sector, investor-type and city fixed-effects can be included in order to capture the valuation-impact of these categorical variables. Table 6 includes four columns which express this composite relationship in OLS regressions, as well as four columns adding individual and joint fixed-effects.

Table 18: Valuation-Impact of Cross-Border Fixed-Effects

Overall Relationship and Fixed-Effects					Sector FE	Type FE	City FE	Joint FE
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	Ln_Valuation	Ln_Valuation	Ln_Valuation	Ln_Valuation	Ln_Valuation	Ln_Valuation	Ln_Valuation	Ln_Valuation
Ln_Revenue	0.4931***	0.4566***	0.4948***	0.4629***	0.4697***	0.4336***	0.4332***	0.3967***
	[0.035]	[0.035]	[0.035]	[0.036]	[0.036]	[0.040]	[0.036]	[0.041]
Ln_Beta	-1.1315***	-1.3804***	-1.0134***	-1.2282***	0.2597	-1.3505***	-1.3739***	-0.4845
	[0.360]	[0.365]	[0.370]	[0.375]	[0.643]	[0.410]	[0.360]	[0.562]
Country Risk Premium	-64.9092***	-65.6484***	-58.9730***	-58.0412***	-57.7787***	-66.1576***	-48.3461*	-104.3488***
	[15.274]	[15.534]	[16.032]	[16.151]	[15.591]	[18.676]	[24.901]	[26.997]
Cash-on-Market	0.0007***	0.0008***	0.0007***	0.0008***	0.0007***	0.0007***	0.0012***	0.0006***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Investor-Country Tax-rate	0.0581***	0.0627***	0.0532***	0.0578***	0.0520***	0.0688***	-0.0042	0.0295
	[0.016]	[0.017]	[0.017]	[0.017]	[0.017]	[0.021]	[0.018]	[0.019]
Country Risk Premium Difference	-80.9362***	-73.8019***	-75.4332***	-70.1716***	-70.0169***	-87.0900***	-69.1397***	-63.0994***
	[14.589]	[14.998]	[15.455]	[16.083]	[15.399]	[19.056]	[16.900]	[19.305]
Difference in LLSV Securities Law Index		0.1243**		0.1268**	0.1394***	0.1172*	0.0091	0.0961*
		[0.050]		[0.054]	[0.052]	[0.063]	[0.055]	[0.057]
Difference in WEF Global Competitiveness Index			0.0032	0.0076	0.0038	-0.0112	0.0290	0.0172
			[0.038]	[0.045]	[0.043]	[0.051]	[0.045]	[0.044]
Domestic Deal Dummy	2.2461***	1.7591***	2.2203***	1.7331***	1.5975***	2.0447***	1.4960***	1.0408***
	[0.200]	[0.284]	[0.283]	[0.381]	[0.364]	[0.423]	[0.359]	[0.361]
Constant	6.7667***	7.1603***	6.7465***	7.0468***	6.4003***	7.1567***	9.7099***	9.4983***
	[0.800]	[0.808]	[0.827]	[0.836]	[0.906]	[0.959]	[0.883]	[1.034]
Observations	552	533	522	505	502	427	470	393
Within R2	-	-	-	-	0.559	0.349	0.595	0.232
Between R2	-	-	-	-	0.782	0.913	0.467	0.603
Overall R2	0.596	0.602	0.593	0.598	0.587	0.592	0.575	0.600

Standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1

Concretely, Table 6 demonstrates that all valuation-factors of the composite regression are jointly-significant except cross-border differences in WEF Global Competitiveness Index, which is not statistically-significant, while all other factors are either significant or strongly-significant, with R-squared in excess of 0.57 in all regressions. Furthermore, differences in country-risk-premium boasts a negative coefficient, while the domestic deal dummy indicates a valuation-premium associated with domestic deals, with regression 2 boasting the strongest goodness-of-fit indicators.

5.3: Deal-Distance-Taxonomy

In addition to borders, both domestic and international deals contend with distances. Overall, the literature confirms that proximity breeds investment. This is the case on the bank-lending market, given that banks located closer to borrowers are more likely to lend to informationally-obscure borrowers, (Petersen and Rajan 2002; Mian 2006; Sufi 2007), and this is the case at the firm-level, as firms decide where to open new plants and locations (Giroud 2013). According to Giroud (2013), proximity facilitates monitoring, reduces information-asymmetry, therefore increasing the productivity of investments.

Local Deals

Investor and startup are based in same city or nearby city. Examples of this include deals occurring in Greater London, Paris, or Berlin metropolitan areas. Typically, local deals are concentrated in startup and venture-capital hotspots, where the local ecosystem already features high densities of both entrepreneurs and investors. These are driven by the economic dynamics of local economic-clusters as described in detail

by Porter (1990). While both high-valuation and low-valuation startups are involved in local deals, many syndicated deals involve at least one local-investor. Valuations are influenced by local-level economic conditions.

Short-Range Domestic Deals

Investor and startup are based in neighboring regions of the same country. Examples of this generally include deals involving investors located in the Berlin, Greater London, or Greater Paris metropolitan areas, while the startups are located in less than 1000 km away in the same country, in areas such as Cambridge, Glasgow, or Cardiff for London-based investors. These deals typically involve either startup-investor relationships between different local-area startup-clusters, located in different regions of the country, or startup-investor relationships between a venture-capital hotspot and smaller cities.

Short-Range Cross-Border Deals

Investor and startup are based in neighboring countries. Examples of this would include deals involving startups located in Brussels, Amsterdam, or Paris, for investors based in Greater London. While distances involved similar to those of short-range deals, the additional presence of a national border means cross-border differences in both macroeconomic variables such as country-risk premiums, as well as in institutional variables. The latter may be especially-pronounced in the European market, since all legal families are represented across the European common market.

Long-Range Cross-Border Deals

Investor and startup are based in differing countries, at generally between 1000 and 1500 km distance. Examples of this would include deals involving startups located in Barcelona, Stockholm, or Helsinki, for investors based in Greater London. Typically, long-range cross-border deals occur only in cases of extremely high-value startups, which have high valuations and are concentrated in high value-added industries.

The Role of Distance in Valuation

Given the taxonomy of deal-distances present in the dataset, as well as the impact of the cross-border macroeconomic and macro-institutional factors in Tables 4 and 5 (effectively zero in domestic deals, no matter the investor-startup distance), distance is not only a key valuation-signal, but also, its impact is substantially different when combined with non-zero cross-border factor-coefficients. Table 7 outlines the relationship between investor-startup distance and startup-valuation, with columns for domestic deals, cross-border deals, and all investment deals. Panel A adds investor-startup distance to DCF-based regressions. Panel B meanwhile, adds investor-startup distance to macroeconomic regressions and Panel C adds investor-startup distance to institutional regressions.

Table 7: Valuation-Impact Controlling for Distance

Panel A: DCF- Based Regressions	**All Deals**	**Domestic**	**Cross-Border**
	(1)	(2)	(3)
VARIABLES	Ln_Valuation	Ln_Valuation	Ln_Valuation
Ln_Revenue	0.5244***	0.4597***	0.5386***
	[0.033]	[0.048]	[0.046]
Ln_Beta	-1.0201***	-0.5214	-1.5225***
	[0.355]	[0.505]	[0.486]
Country Risk Premium	-33.9610***	-14.8207	-51.1300***
	[12.185]	[17.224]	[16.907]
Ln_KM	0.2751***	0.3966***	0.1408***
	[0.024]	[0.094]	[0.040]
Constant	8.5553***	8.4074***	8.9372***
	[0.569]	[1.105]	[0.786]
Observations	633	256	377
R-squared	0.509	0.337	0.376
Adjusted R-Squared	0.506	0.326	0.369

Panel B: Macro-based Regressions	**All Deals**	**Domestic**	**Cross-Border**
	(1)	(2)	(3)
VARIABLES	Ln_Valuation	Ln_Valuation	Ln_Valuation
Ln_Revenue	0.5254***	0.4169***	0.5117***
	[0.035]	[0.052]	[0.046]
Ln_Beta	-0.9075**	-0.3569	-1.7823***
	[0.370]	[0.535]	[0.465]
Country Risk Premium	-11.9682	10.1261	-12.5339
	[15.220]	[20.333]	[21.086]
Cash-on-Market	0.0005***	0.0005***	0.0007***
	[0.000]	[0.000]	[0.000]
Output-Gap	0.1778**	0.2024**	0.1614
	[0.071]	[0.088]	[0.106]
Investor-Country Tax-rate	0.0262	-0.0269	0.1663***
	[0.016]	[0.022]	[0.026]
Ln_Distance (KM)	0.3036***	0.3429***	0.1289***
	[0.027]	[0.128]	[0.040]
Constant	6.8575***	9.8461***	2.5320**
	[0.852]	[1.729]	[1.166]
Observations	538	188	350
R-squared	0.58	0.46	0.49
Adjusted R-Squared	0.571	0.438	0.484

Panel C: Institutional-based Regressions	**All Deals**	**Domestic**	**Cross-Border**
	(1)	(2)	(3)
VARIABLES	Ln_Valuation	Ln_Valuation	Ln_Valuation
Ln_Revenue	0.4957***	0.4061***	0.5380***
	[0.035]	[0.050]	[0.049]
Ln_Beta	-0.9628b	-0.7284	-1.0048c
	[0.378]	[0.553]	[0.513]
Country Risk Premium	-25.3670c	-1.8235	-45.7709b
	[13.742]	[20.351]	[18.728]
Difference in LLSV Securities Law Index	0.1544***	0.0957c	0.6199
	[0.043]	[0.050]	[0.442]
Difference in WEF Global Competitiveness Index	0.0037	-0.0761b	-0.1931
	[0.034]	[0.038]	[0.480]
Investor-Country Trade-Openness	0.0411	0.0090	0.0179
	[0.025]	[0.029]	[0.061]
Ln_Distance (KM)	0.2082***	0.3849***	0.1072b
	[0.034]	[0.108]	[0.043]
Constant	6.1995***	8.7814***	7.4232c
	[1.762]	[2.183]	[3.995]
Observations	555	201	354
R-squared	0.528	0.399	0.375
Adjusted R-Squared	0.522	0.377	0.362

Standard errors in brackets

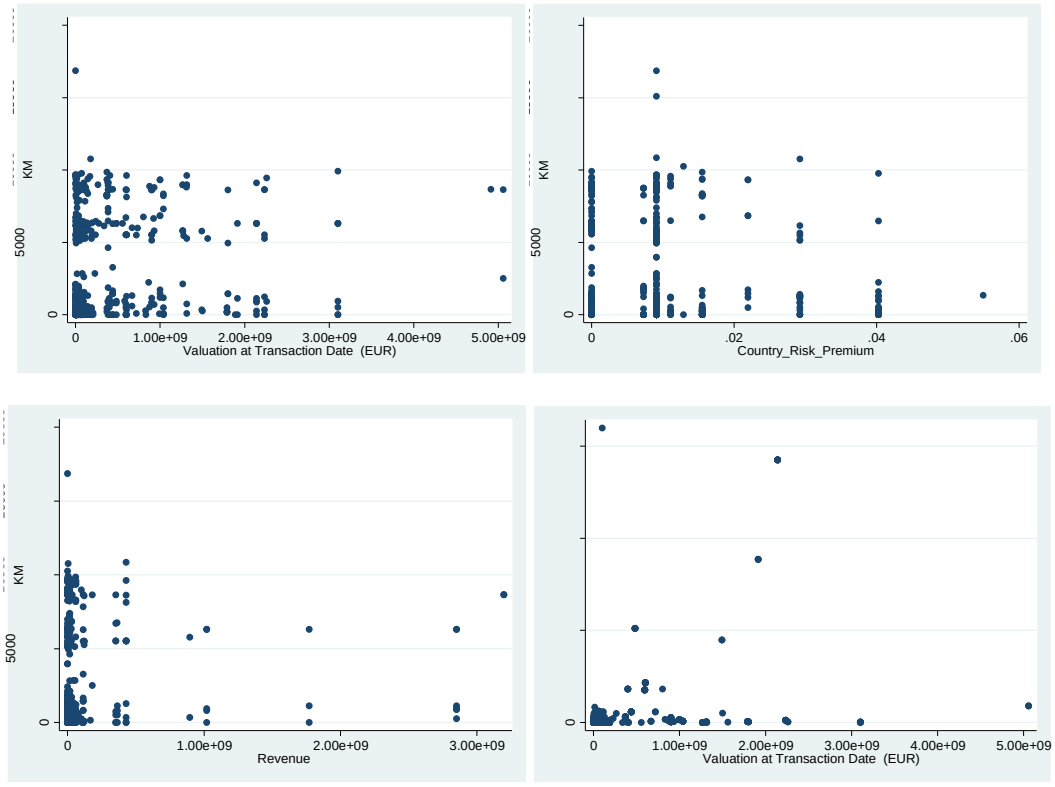
*** p<0.01, ** p<0.05, * p<0.1

Overall, Table 7 demonstrates that investor-startup distance may have stronger explanatory-power in cross-border deals than in domestic deals. This can be seen in higher goodness-of-fit of cross-border regressions in Panels A and B, as well as the significance of log-of-distance coefficient in all panels. Essentially, Table 10 indicates that distances matter more to startup-valuation in cross-border deals than in domestic deals.

Distance-Hurdle

Conceptually, taking into consideration the dataset's positive association between distance and valuation demonstrated in Table 7, what the deal-distance taxonomy describes is a distance-driven hurdle-rate, which serves to filter-out many would-be long-distance, low-valuation deals, while not concretely affecting start-up valuation. Mechanically, any such filter would impact startup-selection rather than valuation, and likely be driven by either trade-barriers or information-asymmetries. Figure 1 captures this visually, demonstrating that high-valuation deals appear proportionally-concentrated at longer deal-distances, while distances also appear substitutable with country-risk-premiums, but not directly impacting revenues.

Figure 2: Distance and Valuation, Revenue, Country-Risk



Accordingly, Equation 4 can be modified to include a distance-driven hurdle-function μ, which captures the apparently distance-tradeoff with country-risk-premiums, and by which $\mu \geq 1$ would mean deal-selection, whereas $\mu < 1$ would mean deal-rejection. Selection would become less-likely as either distance or country-risk-premium increases, but more-likely as firm-revenues increase, essentially adopting the shape of a gravity-model, along lines similar to Carrère et al. (2020). Thus Equation 5 yields:

Equation 5: Cross-Border Market-Conditions Meta-Model

$$\boldsymbol{Pre-Money\ Valuation} = \boldsymbol{f}((((\sum \boldsymbol{Startup\ Value}) \sum \boldsymbol{Domestic\ Deal\ Value}) \sum \boldsymbol{Internaitonal\ Deal\ Value}) \sum \boldsymbol{Deal\ Valuation})$$

$$\boldsymbol{s.t.} \quad \mu = \boldsymbol{f}[\frac{(\boldsymbol{Revenue})}{(\boldsymbol{Distance} * (\boldsymbol{Credit-risk-premium}))}]$$

Whereby, valuations are driven by both domestic and cross-border market-conditions, and subject to μ, a distance-driven hurdle-function. Furthermore, log-transformation would flatten the functional-form, yielding a hypothetical probit-model describing the distance hurdle as follows:

Equation 6: Probit Regression-Model for a Distance-Driven Hurdle-Function

$$\mu = \boldsymbol{\Phi}[\boldsymbol{\beta_1}(\boldsymbol{Revenue}) - \boldsymbol{\beta_2}(\boldsymbol{Credit-Risk-Premium}) - \boldsymbol{\beta_3}(\boldsymbol{Distance})]$$

Testing this empirically, however, would require access to startup deal-selection data, which, at a very minimum would have to include deal-rejections.

6: Discussion and Conclusions

Overall, the empirical findings indicate several insights concerning startup-valuation and pricing, as well as the role of cross-border aspects in determining not only valuation, but also the relative-impact of various valuation-factors. Key differences emerge in terms of which valuation-factors play a dominant role in determining the valuation of domestic deals compared to cross-border deals.

Fundamentally, empirical-evidence indicates that domestic-deals experience valuation-premiums while cross-border deals experience valuation-discounts. Furthermore, investors are more risk-sensitive when faced with cross-border deals, which may indicate that domestic-deal risks are likely more straightforward to foresee, understand, and mitigate. Given findings outlined by Chemmanur et al. (2016) regarding VC-exit-success, valuation-discounts make intuitive sense, as risks to investor-exit-success appear to be priced-in to cross-border deals.

Overall, this study's empirical findings demonstrate that the explanatory-power of deterministic-impacts manifest clearly in cross-border comparative circumstances, as investors follow and act upon differences in business cycles and economic fundamentals between markets. Interestingly, in addition to the valuation-impacts driven by cross-border differences in business-cycle and macrofinancial conditions, cross-border differences in governance-related indicators also drive startup-valuations. Both cross-border competitiveness and securities law demonstrably also have substantial valuation-impacts.

Discussion of Hypotheses

Fundamentally, this study's conclusions are that cross-border-effects on startup-valuation are empirically demonstrable in the international venture capital business environment. Overall, the findings indicate that exogenously-driven cross-border differences between markets drive startup valuations. Specifically, the data indicate that:

H1: Yield-Chasing

Cross-border business cycle conditions play a significant and deterministic role in influencing startup-valuations, as do both domestic and world cash-on-market. This is corroborated by findings in several tables, ranging from the valuation-impacts of world cash-on-market, to valuation-impacts of cross-border differences in business-cycle indicators and cross-border cash-on-market differences, as well as interactions between the domestic-deal dummy and cash-on-market, where the significant-negative coefficient may indicate that valuation-impacts may be stronger for cross-border-deals. Lastly, this is also corroborated by the larger coefficients that macroeconomic and macrofinancial indicators have in cross-border deals than in domestic deals.

H2: Safe-Harbors

The data demonstrate that investors migrate their investments towards markets with relatively-lower country-risk premiums, as well as towards markets with relatively-higher competitiveness and investor-protections enshrined by securities law. While it may seem that this investor-priority may be at-odds with yield-chasing, it can also be taken to be an investment strategy in a similar vein, in the sense that cross-border-investments may offer opportunity to diversify and optimize investments in risk-reward-terms.

Interestingly, valuation-impacts of cross-border differences in competitiveness and investor-protection diverge substantially from those of domestic-market indicators in this area. This may indicate that investors concern themselves questions regarding competitiveness and investor-protection substantially more when dealing with cross-border markets than when dealing with home-markets.

The dramatic valuation-impact of cross-border country-risk-premium differences is also indicative of investor-preferences for even small relative-improvements in country-risk-premiums compared to local market-conditions investors face on home-markets. This is corroborated by the increased significance goodness-of-fit of all risk-factors (and regressions which include them) for cross-border deals.

Further Research

This study's fixed-effects results point to business-environment divergences and fault-lines, which serve as a starting-point to model, capture, and understand further startup-market dynamics. For example, while there has been extensive media and press coverage of the city-level impacts on the startup-and venture capital ecosystem, more formal research is needed examining the actual valuation-impact of various city-level drivers. Concrete factors giving rise to global-level startup-cities deserve further examination, as do the

specifics of intra-city and inter-city investment deals. Meanwhile, industry-level effects could also be further systematically examined. While extensive economic research exists on many key industries, their internal characteristics and their dynamics, their impact and relationship to the venture capital ecosystem and to startup valuations demand further research.

Building on this, city-industry cluster-combinations could also be examined with further studies, using either econometric, data-science, or spatial-economic techniques, – or a combination thereof – as a way to more fully-explore the cross-border entrepreneurial finance landscape. This could for example, uncover critical fault-lines, interactions, or population-subsets for whom impacts diverge substantially. A detailed look into these questions might enrich what is known about cross-border valuations to a substantial level of detail.

Critical fault-lines and subpopulations might also be explored via taxonomy studies, exploring the specific characteristics of not only city-industry cluster-combinations, but also investor-type, business-model, or technological clusters. While Moritz et al. (2016) provide this approach to investigating financing patterns, similar approaches can be employed in approaching startup-valuation, startup-selection, or in other areas of entrepreneurial finance.

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CHAPTER 4:

Can Startups Disrupt the Gender Pay Gap? Disruption of Economic Exclusion

A Two-Tiered Approach[14]

Max Berre[15]

ABSTRACT

Entrepreneurial disruption may mitigate the gender pay gap. Recent research mapping the gender pay gap's details demonstrate the pay-gap's persistence, as well as its nuanced details at the industry-level. While women in the EU earn substantially less per-hour than men, EU-level data indicate that at sectoral level, there is extreme gender pay gap heterogeneity across EU and EEA member-nations. This is particularly concentrated in industries such as finance, characterized by highly concentrated market-structures, and large, well-established firms. With startups and venture capital investment emerging as key topics-of-interest in business ecosystems, research has surfaced concerning significant gender gaps in both startup selection and valuation, as well as founder gender balances. Using an original EU and EEA venture-capital investments database, and a two-tiered empirical approach relying on both OLS and machine-learning techniques, this study examines the impact of valuations and entrepreneurial concentration on the sector level gender pay gap in the EU. Findings indicate that fact it is the emergence of high-valuation startups able to disrupt sector-level market-structure are able to mitigate the gender pay gap and reduce industry-level insider holdings, which proxy economic exclusion in-general. This study contributes to understanding of the role startup disruption plays in mitigating gender-based economic exclusion.

Keywords: Gender Pay Gap, Start-up, Gender Wage Gap, Venture Capital, Entrepreneurship, Disruption, Machine Learning, Economic Exclusion

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1. Introduction

Is the gender pay gap driven by market structure? Is it driven by industry-level factors?

Recent research mapping and contouring the details of the gender pay gap has demonstrated both the persistence of the pay gap, as well as its nuanced details at the industry level. Working women in the EU earn on average 13 to 14% less per hour than men (European Commission 2022; Eurofund, 2021). Furthermore, EU level data indicate that at a sectoral level, there is extreme sectoral heterogeneity of gender pay gap statistics in each EU and EEA member nation. This is particularly concentrated in industries such as finance, which are characterized by highly concentrated market-structures, and by large, well-established firms. Critically, Blau and Kahn (2017) explain that gender differences in occupations and industries continue to play an important role, while Goldin (2014) finds that while industry-concentrations drive earnings-levels overall, within-industry occupation and within-occupation temporal-flexibility are most responsible for recent reductions in gender pay gap.

Whereas occupational-level EU data is difficult to find, EU level data indicate that at a sectoral level, there is extreme sectoral heterogeneity of gender pay gap statistics in each EU and EEA member nation (Eurofund, 2021). This is particularly concentrated in industries such as finance, which are characterized by highly-concentrated market-structures, and by large, well-established firms. While startup markets and their dynamics make dramatic headlines, one of the key topics-of-interest in entrepreneurial finance literature and startup ecosystem has been the disruption-potential represented by startups. Although this typically refers to dominant existing technologies, it also has come to refer to market-structure. Essentially, this may mean that the Blau and Kahn (2017) that explanation that industry-level gender differences drive gender pay gaps can be impacted by the disruption-potential represented by startups.

Meanwhile, the share of female entrepreneurship also lags substantially, with US data indicating that, approximately 20% of US startups have at least one female founder (Silicon Valley Bank, 2020). This notwithstanding, the effect that startups may have in disrupting large established firms, relationships, and market structure, may play a pivotal role in mitigating gender pay gaps going forward.

That being said, it can be broadly understood that economic-exclusion, barriers limiting or blocking the access or participation in economic life, via labor, education, consumption, or economic transactions. (Gorkey, 2019; Williams et al., 2019), can happen also occur along ethnic, racial, regional, generational, or national lines, as well those of sexual orientation, and that discretion and inclination towards discrimination

by firm-insiders can be either taste-based or statistical (i.e., based on membership in an observable and stereotyped group), while the actual exclusion can be described by the Hermalin–Weisbach model of an endogenously determined board (Strom, 2015). While data on all of these may be difficult to gather, particularly with industry-level granularity or finer, industry-level data is available on insider concentration. In parallel with trends on exclusion along gender lines, it is also possible to examine industry-level firm-insiders, their holdings, and whether this too can be disrupted by startups and startup markets.

This study's contribution to the current literature is twofold. First, this study's description of the relationship between entrepreneurial disruption and sector-level gender pay gap, as well as insider concentration represents a substantial theoretical contribution, tying together several threads within existing literature, ranging from literature describing discrimination and insider-power, to literature describing the gender pay gap as being driven at the firm-level and industry-level. This covers an existing literature gap in entrepreneurial finance, which is likely to give rise to future research on the topic. Second, comes this study's methodological contribution. The use of supervised machine-learning in support of this study's OLS findings to examine the impact on sector-level constitutes a two-tiered approach, which is capable of unearthing fine nuanced detail, which either approach alone would have missed, outlining not only the general relationship driving sector-level gender pay gap, but also its key fault-lines and contextual relationships.

1.1: Stylized Facts About the Gender Wage Gap in European Markets

The European Union makes available nuanced data on gendered differences in earnings are available, rendering detailed and highly-nuanced deep-dive into the European Common Market possible. European data on gender pay differences is collected on a per-member nation industry-level basis covering not only EU member nations, but EEA markets such as Switzerland, Iceland, and Norway as well.

The trends at first glance are shocking. While some member nations report national-level statistics to the OECD, which indicate low gender wage gaps, such as Ireland, Norway and Denmark, which report national-level figures in the 4 to 6% range, Estonia, Cyprus, and Latvia report much higher figures in 17 to 21% range, with the EU average falling at 10.8%.[16]

What these figures obscure are between-industry differences in gender pay gaps. While most EU countries have national level figures that resemble neither Denmark nor Latvia, many EU and EEA markets have concentrated industry-level pockets of higher gender pay gap figures and low gender pay gap figure.

[16] OECD Gender Wage Gap Statistics. https://data.oecd.org/earnwage/gender-wage-gap.htm

Additionally, the European economy has a small number of outlier industries reporting consistent gender pay gap figures across the entire common market, with industries such as education and public administration reporting consistently low figures across the EEA, while the banking and finance industry report consistently high figures across the EEA.

1.2: Disruption

In principle, entrepreneurial disruption describes the successful challenge of an incumbent business landscape by smaller market-entrant with relatively fewer resources (Christensen, 1997; Christensen et al. 2015). According to Boucher et al. (2020), disruption is a form of quick and dramatically-occurring change which occurs at all scales, from individuals-level routine to dramatic competition between global superpowers, and which can have both positive and negative effects, although often unevenly distributed across markets and market-players. Essentially, technological development disrupts the economic system by creating (and destroying) certain business models, supply chains and patterns of employment a phenomenon which may affect not only business practices, but also both economic exclusion and productive norms.

Technology has long been seen as a source of disruption to our lives, communities and civilizations, provoking disruptive change at all scales, from individuals' routine daily activities to dramatic competition between global superpowers (Boucher et al., 2020). Given current technological trends, force of innovation-driven disruption has become a central business model feature for many startups.

Overall, disruptive innovations "change the game" according to Assink (2006), attacking an existing business, and offering substantial opportunities for new profit growth. Disruptive innovations lead to growth, exploiting product, service or business models that significantly transforms the demand and needs of an existing market and disrupts its former key players. Markides (2006) elaborates that disruptions may be differentiated into technological and business-model disruptions. While both imply market-structure changes, the latter also implies industry-wide reforms in business-practices.

1.3: Insider Concentration

In principle, controlling insiders typically have power over firms significantly in excess of their cashflow rights (La Porta et al., 1999). This in turn gives rise to both controlling owners and families assuming managerial control (La Porta et al. 1999) and to entrenchment-effects granting management more discretion to pursue their own interest and goals, even at the expense of negative performance-impacts (Gugler et al. 2008).

In terms of economic-exclusion, wherein particular groups are prevented from participating fully and equally in the wider economy overall (Gorkey, 2019), underlying causes and experiences might be similar or at least correlated among various excluded groups.

Associated to this, comes the question of who the non-excluded groups are, and what attributes might in-group members share in an economic landscape. While the might be multidimensional and difficult to model, given that this may differ across countries, industries, and settings (for example, in a particular industry, many of the major industry leaders may share a particular alma mater, regional identity, or other difficult to enumerate shared characteristic), it is possible to measure *company insiders*, and the clout they may hold in their particular industry, as a proxy to approach how well outsiders may fare, even when data might not be available about who specifically they might be.

Mechanically speaking, the functional ability of discrimination by firm-insiders is driven by insiders' power (Strom, 2015). This phenomenon can be measured by various dimensions of firm-level insider-power, ranging from tenure to voting power, to concentration and board-representation.

2: Literature Review

This study is influenced by several key studies in the economics, finance and entrepreneurial fields. Overall, the gender pay gap is understood to be a multifaceted issue, which impacts the national macroeconomic-level, industry-level, and firm-level (Eurofund 2021).

Zooming-in further, studies describe that occupation and industry effects play a clear deterministic role in driving the gender pay gap (Blau and Kahn, 2017), while temporal-flexibility has succeeded in driving change has taken off in some sectors, such as technology, science, and health, but less so in corporate, financial, and legal industries (Goldin, 2014). This view is corroborated by Blau and Kahn (2017), a study examining the evaluation of gender pay gap studies, examining studies using US, UK, Russian, and Dutch data ranging from the 1970s to the 2010s, as well as Goldin (2014), an extensively-cited empirical study which examines recent progress in reduction of the US gender pay gap. Goldin (2014) elaborates that while occupation and industry-differences in employment can drive gender pay gaps. what happens within each occupation is far more important than the occupations in which women wind up. Additionally, although the rise of professional

time-flexibility, has had a mitigating-effect on the gender pay gap, Goldin (2014) outlines that this impact has been uneven across sectors. What the means essentially, is that sectoral differences in the gender pay gap might have their basis in differences in industry-level norms. Both Goldin (2014) and Blau and Kahn (2017) describe the industry-adjusted gender pay gap as generally diminishing over time.

An alternate view meanwhile, describes gender pay gap as being driven by gender-concentration and segregation at both the firm-level and industry level, a tendency which policy sources certainly describe extensively (World Economic Forum 2016; Eurofund 2021). In this vein, Card et al. contribute several studies focusing on both the gender pay gap, for example, Card et al. (2016), as well as Card et al. (2018), which more broadly models labor-market inequalities. In contrast to Goldin (2014), Card et al. (2016) find that gender pay gaps are driven by firm-level gender-concentration differences in firms with premium-remuneration behavior, while Card et al. (2018) describes wage-inequalities as being driven by differences in rent-sharing elasticities.

Disruption on the other hand, is described in several relevant ways in the literature. These include the Christensen definition, which describes disruption as a successful challenge of an incumbent business landscape by smaller market-entrant with relatively fewer resources (Christensen, 1997; Christensen et al. 2015), as well as Damodaran (2019) who describes sectoral-disruption as a five-stage process, which prominently features an imitation phase, and Markides (2006), who describes that disruption may result from either technological innovation or business-model innovation, which may impact both an industry's market-structure, bust also norms and business practices.

Strom (2015) connects firm-level discrimination with insider-power, measured in terms of insider concentration, board-representation, and voting-power. According to Strom (2015), discrimination can be either taste-based or statistical (i.e., stereotyping based on membership in an identifiable group), while discretion and inclination towards discrimination by firm-insiders is described as a Hermalin–Weisbach bargaining process wherein CEOs bargains for board composition, compensation, and freedom of action, preferring little interference from independent directors who have no family or business relations with already-existing insiders.

Focusing on insider-concentration and outsider-exclusion, a well-established way to approach information asymmetry and its relationship to valuations is contributed by La Porta et al., who have contributed numerous studies linking corporate governance, valuations, and international financial

flows. La Porta et al. (2002) describe that national-level minority shareholder protection and insider concentration has direct impact on valuations, while La Porta et al. (2006) examines economic impacts of securities laws overall, and La Porta et al. (2008) examines shareholder protection against insider self-dealing. Overall, these three studies provide a critical firm-level dimension to this paper's analysis. Meanwhile, Cramer and Krueger (2016) describe that institutionalized economic-exclusion effects have already been successfully overturned by disruptive market-entry in the case-study examined.

On the other hand, insider-concentration can also be described as industry-specific (Damodaran 1993, 2009), rather than firm-specific. While Damodaran (2002) agrees with the outlook presented by La Porta et al. (2002, 2006, 2008) concerning insiders, self-dealing, and minority shareholders, Damodaran approaches the landscape with a specifically industry-level outlook. Like La Porta et al. (1997; 1998; 2002; 2006), Damodaran (1993) explicitly finds that insiders are able to appropriate enterprise value, while excluding all others. Damodaran also publishes aggregated industry-level figures for insider, CEO, and institutional holdings.

Meanwhile, zooming-in further on governance of startups and venture capital investors at a granular level, Kaplan and Stromberg (2002) and Kaplan et al. (2007) focus on contracts, shareholder agreements, and their constituent clauses, which can be considered not only sources of valuation, but also responses to market conditions concerning issues such as insider self-dealing, investor-protection, and bankruptcy-protection. In other words, insider-driven economic-exclusion might be a source of concern sufficient to driven overall market behavior among both venture-capital investors and firms.

3: Research Questions

How is gender pay gap driven by sector-level dynamics? Overall, figures indicates that gender pay gap varies widely across both countries and sectors within the EU/EEA, ranging from over 20% in some service sectors, such as financial services, to below 10% in other sectors, such as transportation, mining, construction and water supply (Eurofund, 2021). Indeed, according to Blau and Kahn (2017), industry-level effects play a deterministic role in influencing the gender pay gap.

Can existing industry-level gender pay gaps be disrupted by a more competitive market landscape? Overall, disruptive businesses successfully challenge industry incumbents and established businesses during market-entry, expansion, or growth phases. According to Birnbaum et al. (2005), disruptive innovation occurs when new market-entrants successfully target industry-incumbents by offering new technologies, designs or business models that are more affordable, convenient, or simpler than what existing market-incumbents offer, giving rise to creative destruction.

While the process of disruption has the potential to permanently displace existing incumbents, it also gives rise to fundamental changes in the market's status-quo, which give rise to new norms in terms of technologies, best-practices, firm-and-industry-level culture, business-models, and market-structure. For example, do disruptive startups offer remuneration which would force incumbent firms to align themselves?

Because Goldin (2014), Blau and Kahn (2017), and Card et al. (2018) describe gender pay gap and sector-specific phenomenon driven mechanically by sector-specific and firm-specific cultural-norms ranging from temporal-flexibility (Goldin 2014), to sectoral gender concentration (Card et al. 2018), it might also be the case the new entrants can disrupt these norms as they challenge industry-incumbents while deploying new technologies, designs and business models. This might alter not only the industry status-que in terms of products, approaches, and business model, but also in terms of company-culture on issues ranging from insider-concentration to temporal-flexibility to boardroom-composition. This leads us to question:

3.1: Do Startups Impact Sector-level Gender Pay Gap?

Is the gender pay gap driven by industry-level market-structure? Can it be disrupted by a more competitive market landscape?

According to Markides (2006), sectoral disruption, which can result from technological innovation or business-model innovation, has the potential to alter not only an industry's market-structure, bust also norms and business practices in a given industry. This is particularly the case with disruption driven by business model innovation. Damodaran (2019) elaborates on this phenomenon further, describing in detail a five-stage process of sectoral-disruption, prominently features an imitation phase, whereby the business practices of the disruptor become widely-adopted. In relating to the gender pay gap within an industry, as startup-entry disrupts the status-quo in a market and significantly transforms the demand and needs of an existing market, it may the case that gender-relations within the industry in question are also disrupted,

leading to a smaller gender pay gap. If so, one can expect that sector-level startup-disruption might significantly impact sector-level gender pay gap. Moreover, CART approaches might demonstrate specific niche-situations or sub-populations in which pay-gap-impacts of sector-level startup-disruption are unique or divergent. This leads us to hypothesize that:

H1a: Startup disruption has the potential to generally mitigate sector-level gender pay gap as an industry experiences entrepreneurial disruption.

H1b: There exist specific contextual circumstances under which disruption has potential to mitigate sector-level gender pay gap as an industry experiences entrepreneurial disruption.

3.2: Do Startups Impact Sector-level Governance?

Is the quality of firm-level governance driven by market structure? Can it be disrupted by a more competitive market landscape?

In a similar vein, as startup-entry disrupts the status-quo in a market and significantly transforms the demand and needs of an existing market, it may the case that insider-concentrations within a given industry are also disrupted, leading to reduced sector-level insider-concentration. If so, one can expect that sector-level startup-disruption of the type described by Markides (2006) and Damodaran (2019) might significantly impact sector-level insider-concentration. This leads us to hypothesize that:

H2a: Startup disruption has the potential to generally mitigate sector-level insider concentration as an industry experiences entrepreneurial disruption.

H2b: There exist specific contextual circumstances under which disruption has the potential to mitigate sector-level insider concentration as an industry experiences entrepreneurial disruption.

3.3: Does Sector-level Governance Impact Sector-level Gender Pay Gap?

Does startup-driven sector-level disruption of insider-concentration give rise to the industry-level disruption of the gender pay gap?

Strom (2015) describes that insider-power within the firm can have direct impact on the inclusion or exclusion of women via ease of applying either taste-based discrimination (as described by Becker (1971)) or statistical discrimination (Phelps, 1972; Arrow, 1973). According to Storm (2015) this can occur for example, as insiders concern themselves with questions ranging from loyalty to independent oversight, and can emerge from insider concentration, voting-power, or board-representation. Might it be the case that insider concentration, and the forces and trends which serve to shape industry-level insider-concentration effectively drive industry-level gender pay gaps, whereas their disruption would also lead to the disruption of industry-level gender pay gaps? Because the market entry of startups can disrupt firm-level and industry-level culture, does the disruption of industry-level insider-concentration effectively serve to disrupt industry-level gender pay gap. This leads us to hypothesize that:

H3a: At the sectoral level, insider-power influences the industry's gender pay gap.

H3b: There exist specific contextual circumstances under which at the sectoral level, insider-power influences the industry's gender pay gap.

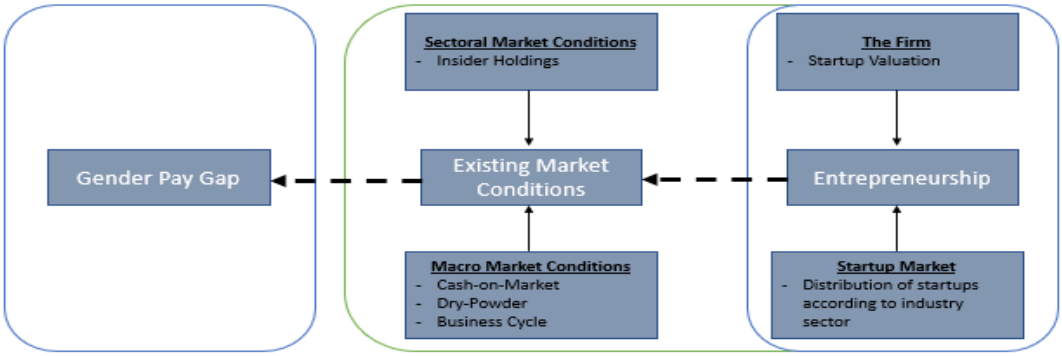
Entrepreneurial Gender Pay Gap Sectoral Disruption Model

To approach these questions, a conceptual model can be elaborated on the basis of sectoral startup distribution, startup valuations, sectoral market conditions, and macro-level market conditions, wherein gender pay gap is driven by existing market-conditions, which in turn may be disrupted by startup markets, as market structure is impacted by startup-disruption. Concretely, Cramer and Krueger (2016) describe that technological disruption brought about by startup market-entry has already succeeded in overturning institutionalized economic-exclusion effects. It is therefore possible to characterize the gender pay gap at the sector-level as being driven by entrepreneurial disruption, which itself can be influenced by valuation, sector-level entrepreneurship rates, and market-conditions, a process which can be modelled by Eq.1 as follows:

Equation 2: Function Influencing Entrepreneurial Disruption and Gender Pay Gap

$$GPG^{17}$$

$$\Leftarrow (Entrepreneurial\ Disrpution) = f(Rate\ of\ Entrpreneruship,\ Valuation,\ Market\ Conditions)$$



In principle, this can give rise to several regression models, which can be used to test the validity of the relationship between startup disruption and gender pay gap. Eq. 2 describes how sector-level entrepreneurial disruption influences the industry's gender pay gap.

Equation 2: Proportionality Function Describing Influencing of Gender Pay Gap

$$GPG \propto (Sectoral\ Disrpution) = \frac{Startup\ Valuation}{(Rate\ of\ Entrpreneruship)}$$

Mechanically, the gender pay gap might be impacted by sectoral disruption, given that Damodaran (2019) describes that disruptive firms tend to be not only younger businesses, but also staffed by younger management and employees, operating according to more recent societal-norms, with relatively little to gain from the establishes status quo, whereas the disrupted industry can more generally be characterized as both being more tied to the status quo and as having greater inertia once status quos are challenged. Eq. 2 uses a proportionality symbol rather than an equal sign to demonstrate that while there is an effect, the entirety of the dynamics of the gender pay gap are not being modeled. Rather, only the disruption impact is modeled. This disruption, in turn can be tracked by the valuation of startups adjusted by the concentration of startups in the sector in question. Further discussion on the specific modelling of sectoral disruption used in this study is provided in the subsequent section.

[17] Author.

In order to examine the matter, this study uses a dataset of industry-level European gender pay gap data, during which 1,089 venture-capital investments, containing 1,042 unique venture capital investments are observed, allowing the examination of the startup market landscape and its possible effect on industry level governance and industry-level gender pay gaps across the EEA.

4: Methodology and Data

This section presents the methodology, the construction of key variables, and the list of control variables on which this study's insights are based. In principle, this study examines the impact of firm and market conditions on the sectoral gender pay gap, as well as industry-level governance.

Primarily, data analysis of the impact of firm and market condition variables on sectoral gender pay gap indicators and industry-level governance indicators depends on Ordinary Least Squares (OLS) regression analysis, deploying key firm and market condition variables, examining primary causality-relationships as well as underlying functional-form, and analysing the resulting findings.

Subsequently, building on these regression results, it is possible to zoom-in on the findings in order to uncover relevant fault-lines in the dataset and further-nuanced statistical relationships via use of regression trees to reinforce regression analysis, shedding light on critical nuances such as relative variable importance and areas in the dataset where trends may behave differently In addition to further insight, model-accuracy may also be improved. Fundamentally, this two-tiered approach can grant detailed insight, adding a layer of nuance where regression results outline a clear general picture, as well as insight where regression results are unclear or inconclusive.

Comparing Goodness-of-Fit

Overall, the accuracy of regression tree models can be compared to those of equivalently-constructed regression models on the basis of their goodness-of-fit indicators. Whereas linear regressions are typically evaluated on the basis of R^2, Sandeep (2014) and Firmin (2021), outline that regression trees are to be evaluated on the basis of root-mean-squared-error (RMSE), with stronger models hosting lower RMSE values. Because RMSE measures average differences between predicted values and observed values, RMSE provides an estimation of model-accuracy and model explanatory power.

4.1: Gender Pay Data

While granular and highly-specific data on gender differences in scare in many markets, the European Union publishes extensive and highly-granular cross-sectional data on gender differences, which includes gender pay gap differences at the sectoral and industry level, for each EU member nation, as well as several EEA member nations such as Switzerland, Iceland, and Norway, and even nations in the European neighborhood such as Macedonia and Turkey, across 29 sectors of each country's labor market.

4.2: Startup Deals Dataset

To examine the impact of startups on Europe's economies, this study uses a dataset of European startup investments, during which 1,089 venture-capital investments, containing 1,042 unique venture capital investments are observed over a 20-year period from 2000 to 2020. The data, collected in March of 2021, are expressed in EUR and consists of startup investments across, EEA member-nations, as well as the UK. Meanwhile, sector-level and national-level data are drawn from publicly available sources. This dataset grants numerous strengths, including not only the large number of observations, but also substantial diversity in terms of institutional and legal ecosystems, as well as macroeconomic environments.

Each line within the dataset is specific per-investor-per-deal, a dataset style is used by Masulis and Nahata (2009).

Accordingly, deals with multiple investors occupy multiple lines within the dataset, identifying data for startup and investor, as well as relevant industry-level, institutional, and macroeconomic data for both parties. Because several investment deals have multiple investors, some deals have multiple observations in the dataset.

4.3: Dependent Variables

In order to approach and understand the impact of firm-level, industry-level, and macro-level market conditions, this study focuses on understand the determinants of industry-level gender pay gap as its primary dependent variable. EU data on the gender pay gap is drawn from Eurostat data on mean annual earnings by sex, economic activity and occupation, and is available by sectoral industry, per country, making the data extremely granular and highly-detailed. This study also employs industry-level insider holdings as its secondary dependent variable, given that similar circumstances may lead to both firm-level management-concentration and firm-level insider ownership-concentration. Data on industry-level insider holdings is drawn from the NYU-Stern database. **Table 1** outlines the summary statistics for sector-level gender pay

gap as well as sector-level insider-holdings available within the dataset on both a per-industry and country-level basis.

Table 19: Summary statistics for sector-level gender pay gap and insider holdings

Gender Pay Gap	Business / Consumer Services	Aerospace	Retail	Automotive	Finance	Food/Agro	Machinery / Industrial	Power	ICT / Software	Pharma / Healthcare	Education	Electronics	Leisure / Ent. / Tourism	Clean-Tech	Home	Real Estate	Office	Fossil	Transport	Media	-	-
Obs.	6	-	95	-	137	69	23	6	316	88	14	-	64	6	-	22	3	-	29	20	-	-
Average	0.2533	-	0.2759	-	0.4469	0.1172	0.2064	0.1877	0.3016	0.3303	0.2019	-	0.2642	0.2035	-	0.2178	0.2306	-	0.2609	0.2098	-	-
Std. Dev	0.1012	-	0.0388	-	0.0919	0.0288	0.0334	0.0865	0.0942	0.0833	0.0441	-	0.0783	0.1026	-	0.0716	0.0000	-	0.0414	0.0525	-	-
Min	0.1013	-	0.1913	-	0.2198	0.0597	0.1588	0.1319	-0.1558	0.1228	0.1155	-	0.0890	0.0478	-	0.0176	0.2306	-	0.1547	0.1517	-	-
Max	0.3770	-	0.3033	-	0.5220	0.1334	0.2309	0.2994	0.3770	0.4187	0.2288	-	0.5739	0.2994	-	0.2765	0.2306	-	0.3295	0.3465	-	-
-	Austria	Belgium	Croatia	Czech	Denmark	Finland	France	Germany	Ireland	Italy	Latvia	Lithuania	Luxembourg	Netherlands	Norway	Poland	Portugal	Romania	Spain	Sweden	Switzerland	UI
Obs.	6	-	1	3	8	17	88	120	20	7	1	7	4	10	7	21	8	5	20	23	12	51
Average	0.2809	-	0.1013	0.2918	0.2097	0.2247	0.2126	0.2625	0.2955	0.2580	0.4396	0.1913	0.2921	0.2956	0.1862	0.1633	0.1796	-0.1211	0.2152	0.2545	0.2790	0.34
Std. Dev	0.0574	-	-	0.0474	0.0293	0.0457	0.0621	0.0611	0.0951	0.1651	-	0.0000	0.0431	0.0776	0.0384	0.0817	0.0257	0.0775	0.0591	0.1062	0.0703	0.11
Min	0.2153	-	0.1013	0.2644	0.1928	0.1489	0.0741	0.0597	0.0775	0.0739	0.4396	0.1913	0.2705	0.1969	0.1115	0.0478	0.1334	-0.1558	0.1155	0.1228	0.2187	0.13
Max	0.3309	-	0.1013	0.3465	0.2607	0.3035	0.4278	0.3099	0.3627	0.5739	0.4396	0.1913	0.3567	0.3813	0.2221	0.3946	0.2198	0.0176	0.3051	0.3455	0.3898	0.52
Insider-Holdings	Business / Consumer Services	Aerospace	Retail	Automotive	Finance	Food/Agro	Machinery / Industrial	Power	ICT / Software	Pharma / Healthcare	Education	Electronics	Leisure / Ent. / Tourism	Clean-Tech	Home	Real Estate	Office	Fossil	Transport	Media	-	-
Obs.	130	1	96	15	137	69	24	6	317	88	14	13	64	11	2	35	3	2	29	20	-	-
Average	0.1791	0.0990	0.1793	0.0994	0.1284	0.1146	0.1002	0.0510	0.1661	0.1169	0.1180	0.1886	0.1941	0.1661	0.2145	0.2301	0.0850	0.0130	0.0633	0.1348	-	-
Std. Dev	0.0233	-	0.0452	0.0070	0.0101	0.0164	0.0106	0.0000	0.0208	0.0317	0.0000	0.0277	0.0199	0.0003	0.0205	0.0449	0.0000	0.0000	0.0040	0.0736	-	-
Min	0.1290	0.0990	0.0660	0.0960	0.0710	0.0870	0.0890	0.0510	0.0940	0.0940	0.1180	0.1440	0.1520	0.1660	0.2000	0.0370	0.0850	0.0130	0.0620	0.0610	-	-
Max	0.2020	0.0990	0.2100	0.1130	0.1540	0.1530	0.1100	0.0510	0.2120	0.1760	0.1180	0.2080	0.2070	0.1670	0.2290	0.2530	0.0850	0.0130	0.0750	0.2420	-	-
-	Austria	Belgium	Croatia	Czech	Denmark	Finland	France	Germany	Ireland	Italy	Latvia	Lithuania	Luxembourg	Netherlands	Norway	Poland	Portugal	Romania	Spain	Sweden	Switzerland	UI
Obs.	6	16	1	6	6	22	98	138	20	10	1	7	6	11	10	22	8	6	21	27	13	62
Average	0.1443	0.1638	0.2020	0.1755	0.1113	0.1800	0.1530	0.1477	0.1358	0.1518	0.1260	0.2100	0.1727	0.1247	0.1787	0.1521	0.1585	0.1872	0.1501	0.1420	0.1145	0.15
Std. Dev	0.0448	0.0138	-	0.0575	0.0374	0.0183	0.0498	0.0503	0.0328	0.0403	-	0.0000	0.0093	0.0319	0.0309	0.0266	0.0400	0.0539	0.0456	0.0245	0.0488	0.04
Min	0.0940	0.1440	0.2020	0.0610	0.0620	0.1570	0.0510	0.0620	0.0620	0.0750	0.1260	0.2100	0.1610	0.0710	0.1570	0.1000	0.0970	0.0940	0.0620	0.1130	0.0620	0.01
Max	0.2120	0.2090	0.2020	0.2120	0.1720	0.2070	0.2420	0.2530	0.1970	0.2100	0.1260	0.2100	0.1800	0.1740	0.2420	0.2120	0.2120	0.2530	0.2120	0.2080	0.2100	0.25

4.4: Deterministic Independent Variables

Startup Valuation

Defined as the product of share price prior to a funding round multiplied by the number of outstanding startup shares, startup valuation is a key indicator of a startup's sectoral disruption. In principle, a high valuation may be indicative of either disruption-potential or already-realized disruption. While startup valuation is a key independent variable, it is necessary to adjust its value according to sectoral trends.

Distribution of Startups According to Industry Sector

Drawn from the 2018 European Startup Monitor, sectoral distribution of startups outlines which startups in Europe belong to according to founders responding to a 2018 survey. Because this figure describes where in the economy startup entrepreneurship is concentrated, it is useful for adjusting startup valuation figures to sectoral trends. This variable is scaled as a percentage between 0 and 1. While mechanically, this figure demonstrates the share of total startup funds invested in a given sector, this figure also proxies the concentration of startups in an industry vis-à-vis more established firms.

Startup Sectoral Disruption Ratio

According to Christensen et al. (2015), disruption in the entrepreneurial space describes a process whereby a smaller market-entrant with relatively fewer resources successfully challenges the incumbent business landscape.

In order to contextualize a startup's value for the purposes of analyzing its sectoral-impact, as well as its potential for economic disruption, which Damodaran (2019) describes as a valuation challenge because of their relatively-recent histories, construction of an analysis ratio may be relevant. Damodaran (2010) describes the objective of analysis ratios as being both highly-relevant for speedy estimation and analysis, and tied to consistent standardizing variables, which are tied to dominant themes of analysis.

Because this study examines impacts on the sector-level gender wage gap, a sectoral-adjustment indicator is most relevant as a standardizing variable. Mechanically speaking, analysis ratios need to be tie underlying fundamentals to their relevant comparable universe (Damodaran, 2010).

Since a startup's ability to disrupt its industry depends on both its value (i.e., its size, revenue, technology, and competitive potential), as well as the share of the startup distribution. In principle, this is because a very high-valuation startup, in an industry with a relatively small share of startup investment, is likely to be a highly disruptive startup. On the other hand, a high-valuation startup in an industry or sector where capital is relatively-abundant might not exactly be a disruption.

Therefore, a startup's sectoral disruption impact can be estimated via a ratio presenting sectoral standardization of the startup's valuation:

$$\frac{Valuation}{Sectoral\ Distribution\ Share}$$

In principle, unicorns and other high-valuation startups which exist is small industries or industries with relatively small levels of investment, likely attain and maintain their size and valuation via substantial sectoral disruption. It is specifically this relationship that is captured by the sectoral disruption ratio, in this functional form.

A risk exists however, as peers in the same industry could be highly distorted due to taxation differences (Ugoani, 2018), as well as other national-level differences that may need to be controlled-for during empirical estimation.

4.5: Control Variables: Market Conditions

Macroeconomic Business Cycle Indicator

This study uses the macroeconomic output-gap as a business cycle indicator. In principle, studies on discrimination in labor-markets describe discrimination to be more severe during recessions, as employment and economic resources become more scarce (Rafferty, 2014; McGinnity et al., 2015; Krosch et al., 2017).

In addition, entrepreneurial finance studies find startups and their valuations to be driven by macroeconomic indicators and cyclical indicators (Gompers and Lerner, 1998; Bonini and Alkan, 2006; Berre and Le Pendeven 2021). This study therefore, uses a business cycle indicator which is composed of macroeconomic indicators. The data are drawn from IMF country-level figures.

Cash-on-Market Venture Capital Market Size

To the macro-level market conditions, total venture capital market-cash-on-market available is added, which likely has direct impacts on the startup market. This figure, drawn from OECD data, estimates the total venture-capital sector size, on the basis of the aggregate valuation of all venture-capital investment, at the national level, within a given country, in a given year. In principle, cash-on-market is understood to impact both startup-valuation and startup investor-selection (Wessendorf, 2019; Berre and Le Pendeven, 2022). As such it is likely that the sectoral-distribution of startup-investment would also be affected.

Dry Powder

In addition to venture capital cash-on-market, dry powder is added. This figure, drawn from Invest Europe, represents the overall amount of committed but unallocated investment-capital available at the national level in a given economy, in a given year. Like cash-on-market, dry powder is known to impact startup-valuations, although dry powder is also understood to separate timings of macroeconomic trends from the timing of startup-investment (OECD, 2015; Berre and Le Pendeven, 2021, Rosenbloom, 2022). Because startup-valuation and startup investor-selection share many of the same determinants (Berre and Le Pendeven,

2022), dry power's inclusion as a control variable may serve to connect-the-dots between macroeconomic market conditions and startup-markets.

4.6: Functional Form

Because research on sector-level impacts require that valuations be sectorally-adjusted, the valuation figure is divided by the sectoral distribution of startups, a figure scaled between 0 and 1. Since mechanically, this produced extremely large figures, and thus regression results would involve extremely small coefficients, it is necessary and appropriate to scale the variables, by z-transformation, allowing regression of the standard deviations, rather than the underlying variables.

5: Empirical Findings

Overall, results are in line with established economic theory, since empirical results are consistent with published literature on governance impacts. In particular, OLS results show evidence that relatively-rare, high-valuation startups are able to disrupt the status quo, which in turn, reduces both sector-level gender pay gap and sector-level insider holdings, although these are somewhat mitigated by VC-industry market-conditions. Subsequently, CART results demonstrate that while high-valuation startup-disruption plays a role during recessions, in lower-risk industries, and in markets with high levels of dry powder, they are also only secondary-importance in terms of gender pay gap impact and insider-holdings impact compared to industry-beta.

Gender Pay Gap Impacts

Because of the otherwise extremely small coefficients resulting essentially from variable's initial construction, consisting of extremely large valuations, divided by percentile denominators, Table 2 describes the impact of the startup sectoral ratio, as well as its component parts (i.e., sectoral distribution and startup valuation) on EU country-wide sector-level gender pay gap. In line with recent entrepreneurial finance studies, such as Faust et al. (2022) and Lukkarinen and Schwienbacher (2023) Table 2, as well as subsequent regression tables make use of z-standardization of the independent variables, whereby the coefficients communicate standard deviations. Essentially, this means that the independent variables would need to increase by several standard-deviations in order for substantial effect on gender pay gap to be observed. Both the disruption ratio and its component parts are significant, indicating that both the ratio and it components contain useful informational content, with the sectoral disruption ratio having a negative and significant impact on sector-level gender pay gap. In principle, this indicates that a one-standard-deviation increase in the sectoral disruption ratio (i.e., the emergence of disruptive startups in a given industry), has

the capability to slightly diminish the sector's gender pay gap. Essentially, the OLS view indicated that it would take the emergence of large, high-valuation startups (i.e., unicorns) in a given industry, with relatively-little pre-existing VC investment, thereby moving the disruption ratio by several standard deviations, to noticeably mitigate the industry's gender pay gap.

Table 2: Gender Pay Gap general standardized regression

Gender Pay Gap Regressions

	(1)	(2)	(3)
VARIABLES	Pay Gap	Pay Gap	Pay Gap
Sectoral distribution of startups	0.0088**		
	[0.004]		
Startup Valuation		0.0104***	
		[0.004]	
Valuation / Distribution of Startups			-0.0071*
			[0.004]
Constant	0.3014***	0.2974***	0.3034***
	[0.004]	[0.004]	[0.004]
Observations	808	870	783
R-squared	0.01	0.01	0.00
Adjusted R-squared	0.00437	0.00749	0.00247

Standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1

Table 3 outlines the gender pay gap, controlled for macro-level market conditions. While Table 3's regressions demonstrate no impact of macroeconomic output gap, a primary business cycle indicator on gender pay gap, indicating that Europe's industry-level gender pay gaps are stable throughout the business cycle. In contrast, the regressions do demonstrate positive relationships between VC-industry funding indicators and the industry-level gender pay gap. Because these indicators are country-level, this may indicate that countries with more active venture-capital industries may be channeling investment towards industries where new disruptions are less likely.

Table 3: Gender Pay Gap and Macro-Level Variables (standardized)

Gender Pay Gap Regressions

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Pay Gap	Pay Gap	Pay Gap	Pay Gap	Pay Gap

Valuation / Distribution of Startups	-0.0071*	-0.0135***	-0.0162***	-0.0083**	-0.0141***
	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]
Country-level dry powder		0.0371***			0.0324***
		[0.004]			[0.008]
Cash on Market			0.0325***		0.0050
			[0.004]		[0.008]
Output Gap				-0.0006	0.0004
				[0.004]	[0.005]
Constant	0.3034***	0.3135***	0.3117***	0.3082***	0.3134***
	[0.004]	[0.005]	[0.005]	[0.004]	[0.005]
Observations	783	533	551	759	532
R-squared	0.00	0.13	0.10	0.01	0.13
Adjusted R-squared	0.00247	0.127	0.0962	0.00323	0.121

Standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1

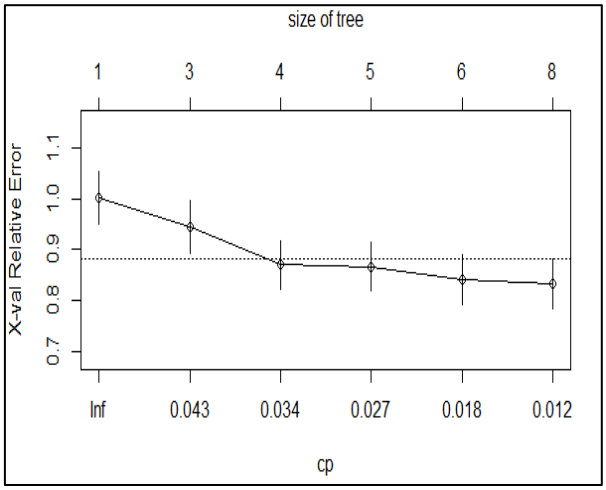
In order to take a second look at the impact, a regression tree approach is used to re-examine the relationship. Not only are regression trees known to be efficient forecasting tools when working on multivariate data (Breiman et al., 1984), but also effectively demonstrate both fault-lines and conditional relationships. While regression trees have the advantage of being highly-detailed, easy-to-understand, and able to incorporate qualitative, ordinal, and categorical data, they have the disadvantage of requiring large datasets in order to give accurate estimates (Hodeghatta and Nayak, 2017).

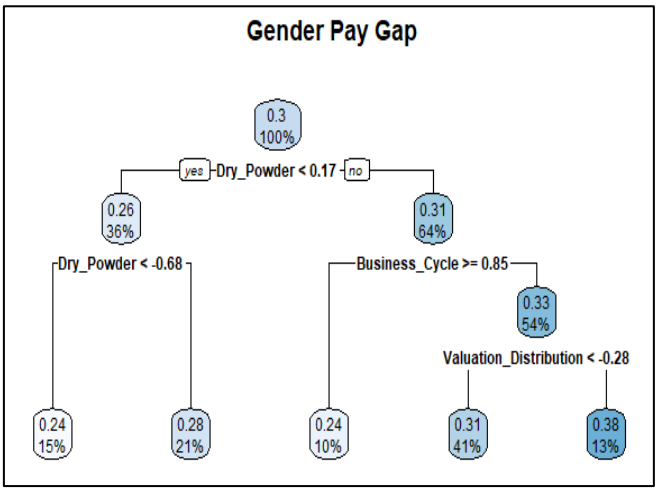
In principle, a CART regression-tree approach, in addition to its own merits, serves to effectively both corroborate general causal relationships described by OLS results, and also to elaborate on OLS findings by means of potentially-enriching factor-hierarchy, which have the potential to detail and describe key fault-lines.

The complexity parameter plot of Figure 1 demonstrates that using the CART approach would maximize value-added with regression trees beyond four end-nodes. The subsequent tree has been pruned to five end-nodes, by limiting the minimum end-node size to 89 observations (i.e., 10% of the CART's observations) in order to approximate the recommendations four to six end-nodes outlined by the complexity parameter graph. In terms of explanatory power, the regression-tree, at its lowest branches has slightly stronger goodness-of-fit indicators than those of the regressions in Table 3. Primarily, the CART-based examination of the gender pay gap and macro-level variables relationship demonstrates that high-valuation startup-

disruption is of relatively-minor importance, behind business cycle and dry powder, playing its primary role during recessions, and in markets with substantial dry-powder.

Figure 3: CART of Macro-level driver impacts on Gender Pay Gap





OBS: 896

End Nodes: 5

Complexity parameter	No. of Split	RMSE	Crossvalidation error	Crossvalidation St. Dev.
0.04609	0	1.0000	1.00080	0.05221
0.04064	2	0.9078	0.96525	0.05176
0.01054	3	0.8672	0.88690	0.05464
0.01000	4	0.8566	0.88922	0.05457

Variable Importance

Business Cycle	Dry Powder	Cash-on-Market	Valuation / Distribution
35	33	20	11

Taken in conjunction with Table 3, the findings indicate that while startup disruption can certainly disrupt the industry-level gender pay gap to a limited extent, the window for these impacts to materialize might be relatively-limited, focusing primarily on high dry-powder markets during recessions. While, goodness-of-fit indicates similar explanatory-power for both models, although the CART model can be considered slightly more accurate. Overall, Figure 1 adds a layer of nuance to the findings outlines in Tables 2 and 3, indicating that while startup-disruption might generally play a small role in driving sector-level gender pay gap, the situation changes substantially as business cycle and financial-market conditions evolve.

Table 4 examines the impact of sector and industry-level variables on Europe's industry-level gender pay gaps, finding that while sector-level insider-holdings are positively-related to sector-level gender pay gap, causality is uncertain. Essentially, sector-level insider-holdings are more likely a parallel side-effect of market conditions leading to inflated sector-level gender pay gaps than a partial cause of them. This can be seen from the negligible goodness-of-fit indicators in regression 3, relating sector-level insider-holdings to sector-level gender pay gap. In contrast, sectoral beta coefficients indicate that high-risk industries experience lower sector-level gender pay gap in the European Union.

Table 4: Gender Pay Gap and Industry-level Variables

Gender Pay Gap Regressions

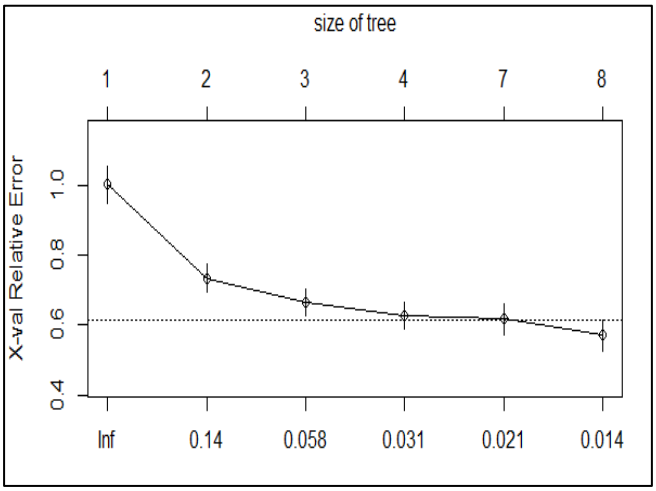
	(1)	(2)	(3)	(4)
VARIABLES	Pay Gap	Pay Gap	Pay Gap	Pay Gap
Valuation / Distribution of Startups	-0.0071*	-0.0183***	-0.0068	-0.0177***
	[0.004]	[0.004]	[0.004]	[0.004]
Sectoral Beta		-0.1249***		-0.1373***
		[0.010]		[0.011]
Sector-Level Insider Holdings			0.0665	0.4279***
			[0.108]	[0.102]
Constant	0.3034***	0.4121***	0.2937***	0.3603***
	[0.004]	[0.010]	[0.016]	[0.016]
Observations	783	783	783	783
R-squared	0.00	0.16	0.00	0.18
Adjusted R-squared	0.00247	0.157	0.00168	0.175

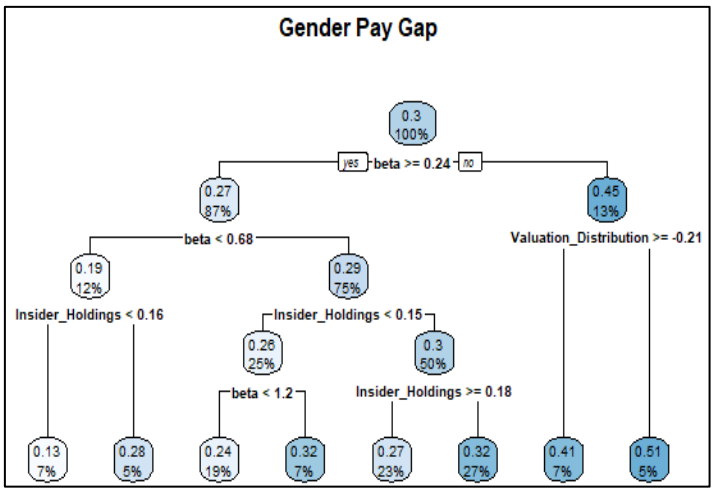
Standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1

Figure 2, pruning the end-nodes to 30 observations (the minimum number for reliable regression results), in approximating the complexity parameter graph's recommendations of seven end-nodes, zooms in on the findings outlined in Table 3 to further elaborate that startup disruption. Figure 2 outlines that while being a driver of secondary-importance compared to that of sectoral beta, startup disruption plays a deterministic primarily in low-risk industries.

Figure 4: CART of Industry-level driver impacts on Gender Pay Gap





OBS: 890

End Nodes: 8

Complexity parameter	No. of Split	RMSE	Crossvalidation error	Crossvalidation St. Dev.
0.27030	0	1.0000	1.00086	0.05216
0.07703	1	0.7297	0.73095	0.04053
0.04323	2	0.6527	0.68206	0.03884
0.02180	3	0.6094	0.64558	0.04675
0.02075	6	0.5440	0.63691	0.04774
0.01000	7	0.5233	0.57499	0.04710

Variable Importance

Beta	Insider Holdings	Valuation / Distribution
78	17	5

Taken in conjunction with Table 4's findings, the findings of Figure 2 outline that while high-risk industries have lower industry-level gender pay gaps in the European Union, the gender pay gap specifically in low-risk industries is more directly impacted by startup disruption.

Insider Holdings Impacts

In addition to measurable impacts on the gender wage gap, startup disruption can be linked to impacts on insider holdings, which may imply exclusion not only on the basis of gender, but also inclusion on the basis of personal insider connections, which may imply exclusion on the basis of not only gender, but also ethnicity, age, or nationality. Table 5 outlines direct regression results of valuations, sectoral distribution, and startup disruption on insider holding, with the third regression demonstrating the impact of sectoral distribution adjusted valuation on industry-level insider holdings. In terms of functional form, the independent variables are transformed via z-standardization and the coefficients communicate standard deviations of the independent variables.

Table 5: Insider Holdings general standardized regression

Insider Holdings Regressions

	(1)	(2)	(3)
VARIABLES	Insider Holdings	Insider Holdings	Insider Holdings
Sectoral distribution of startups	0.0128***		
	[0.001]		
Startup Valuation		-0.0062***	
		[0.001]	
Valuation / Distribution of Startups			-0.0041***
			[0.001]
Constant	0.1473***	0.1527***	0.1468***
	[0.001]	[0.001]	[0.001]
Observations	823	1,044	798
R-squared	0.11	0.02	0.01
Adjusted R-squared	0.108	0.0191	0.00983

Standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1

In corroboration with Table 3's findings, Table 6 outlines that startup disruption causes a statistically-significant impact on insider holdings, reducing insider holdings slightly as disruption proceeds. The small coefficients and small goodness-of-fit indicators demonstrate that similar to the impact of startup disruption on the gender pay gap, the impact of disruption on sector-level insider holdings is only slightly impacted by startup disruption.

Table 6: Insider Holdings and Macro level variables (standardized)

Insider Holdings Regressions

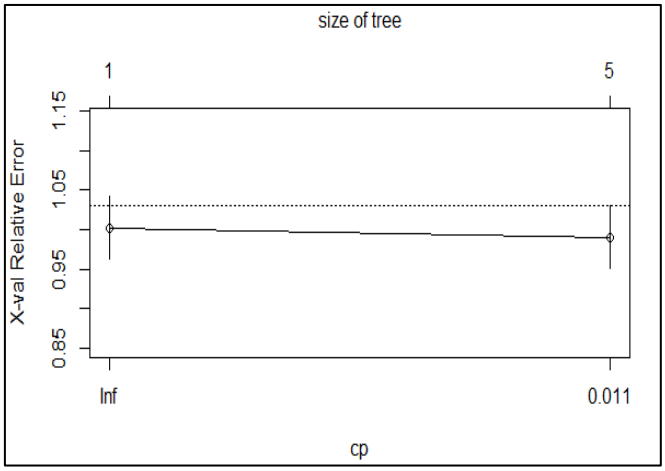
	(1)	(2)	(3)	(4)	(5)
VARIABLES	Insider Holdings	Insider Holdings	Insider Holdings	Insider Holdings	Insider Holdings
Valuation / Distribution of Startups	-0.0041***	-0.0038***	-0.0037***	-0.0041***	-0.0034**
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Country-level dry powder		-0.0001			0.0044
		[0.002]			[0.003]
Cash on Market			-0.0011		-0.0059**
			[0.002]		[0.003]
Output Gap				0.0033**	0.0033*
				[0.001]	[0.002]
Constant	0.1468***	0.1458***	0.1462***	0.1462***	0.1467***
	[0.001]	[0.002]	[0.002]	[0.001]	[0.002]
Observations	798	543	561	774	542
R-squared	0.01	0.01	0.02	0.02	0.02
Adjusted R-squared	0.00983	0.00930	0.0117	0.0152	0.0176

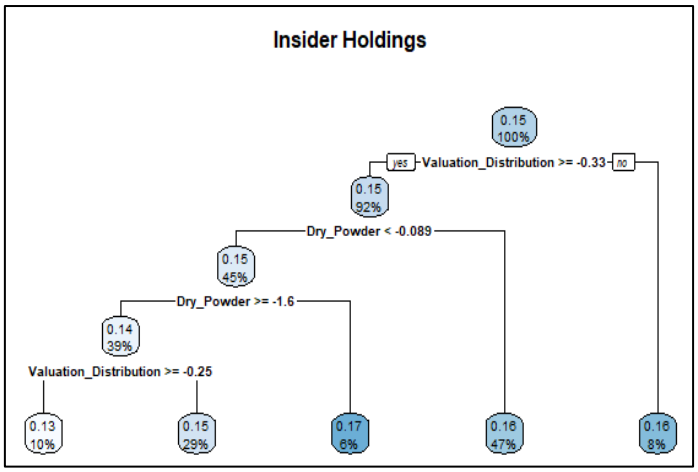
Standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1

Building on Table 6's findings, Figure 3 examines the same relationship using a CART approach, pruning the end-nodes to 30 observations (the minimum number for reliable regression results), in keeping in line with the complexity parameter graph's recommendations, and finds that while Table 6 describes the impact of startup disruption on insider holdings as small, it is also consistent across different states of the business cycle, which is omitted from the regression tree altogether, while VC-industry activity indicators appear to play a secondary deterministic role.

Figure 5: CART of Macro-level driver impacts on Insider Holdings





OBS: 1073

End Nodes: 5

Complexity parameter	No. of Split	RMSE	Crossvalidation error	Crossvalidation St. Dev.
0.01204	0	1.0000	1.00236	0.03926
0.01000	1	0.9519	0.99011	0.03991

Variable Importance

Valuation / Distribution	Dry Powder	Cash-on-Market	Business Cycle
34	34	24	8

Focusing on industry-level indicators, and their impact on industry-level insider-holdings, Table 7 demonstrates that while startup disruption has a mitigating-impact on insider holdings, sectoral beta's coefficient indicates that higher-risk industries have higher insider-holdings. This constitutes a noticeable contrast with Table 4, which demonstrates a negative coefficient for sectoral beta, indicating that higher-risk industries have lower sector-level gender pay gaps, while lower-risk industries have higher gender pay gaps.

Table 7: Insider Holdings and Industry -level variables

Insider Holdings Regressions

VARIABLES	(1) Insider Holdings	(2) Insider Holdings	(3) Insider Holdings
Valuation / Distribution of Startups	-0.0041***		-0.0015
	[0.001]		[0.001]
Sectoral Beta		0.0368***	0.0294***
		[0.004]	[0.004]
Constant	0.1468***	0.1212***	0.1212***
	[0.001]	[0.004]	[0.003]
Observations	798	1,080	798
R-squared	0.01	0.08	0.09
Adjusted R-squared	0.00983	0.0789	0.0848

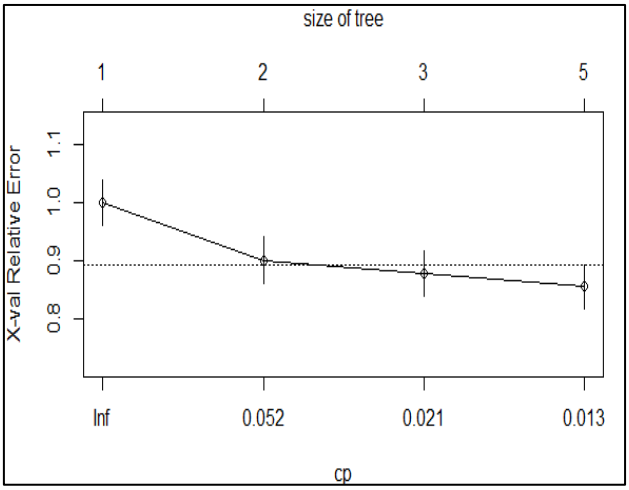
Standard errors in brackets

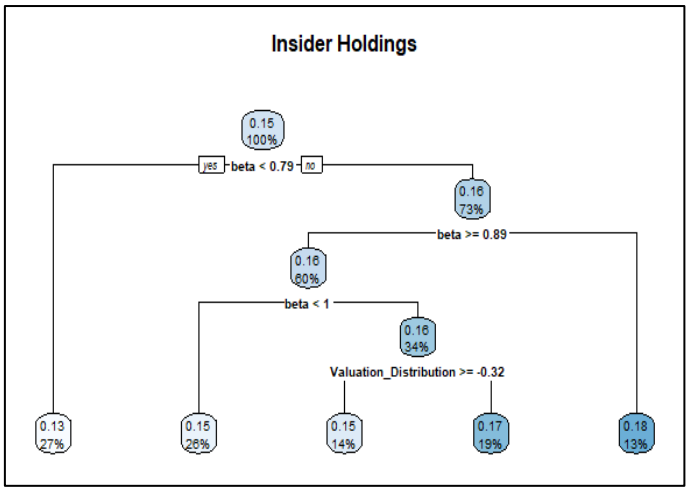
*** p<0.01, ** p<0.05, * p<0.1

Building on Table 7's findings, Figure 4 examines the same relationship using a CART approach, pruning the end-nodes to 108 observations (10% of the CART's observations), in keeping in line with the complexity parameter graph's recommendations limiting end-nodes to between two and five end-nodes.

As is the case with CART findings in Figures 1, 2, and 3, the goodness-of-fit indicators indicate a slightly stronger model-fit compared to the associated regression-model results. The RMSE in this regression tree's lowest branches demonstrate that, while of limited explanatory power, the CART approach explains the insider-holdings and industry-level variables relationship somewhat more than the OLS approach does. Ostensibly, this difference in explanatory power is achieved as a result of the substantial difference in variable-importance between the regression-tree's independent variables, as well as in the value-added from identification of the contextual niche in which startup disruption plays its most influential role. Overall, the CART results find that the impact of sectoral beta far outweighs that of startup disruption in terms of variable-importance, influencing sector-level insider-holdings throughout most of the distribution, but that startup disruption may have a more substantial impact on insider holdings in high-risk industries. As is the relationship between Table 4 and Table 7, Figure 2 and Figure 4 demonstrate contrasting findings as far as the intersection of industry-level beta and startup disruption is concerned.

Figure 6: CART of Industry-level driver impacts on Insider Holding





OBS:	1080
End Nodes:	5

Complexity parameter	No. of Split	RMSE	Crossvalidation error	Crossvalidation St. Dev.
0.10001	0	1.0000	1.00208	0.03917
0.02681	1	0.9000	0.90352	0.04139
0.01585	2	0.8732	0.87830	0.03856
0.01000	4	0.8415	0.85899	0.03880

Variable Importance

Beta	Valuation / Distribution
91	9

Overall, the empirical results find evidence that both gender pay gap and insider holdings can be impacted by macro-level economic market conditions, and by industry-level market conditions. More importantly, the results demonstrate that both can be mitigated by industry-level disruption originating from the entrepreneurial startup market. Essentially, a one standard-deviation increase in sectoral adjusted valuation

appear to be able to cause a reduction in both sectoral gender pay gap and in sector level insider holdings. Using CART to zoom in on the results in detail reveals however, that while sectoral gender pay gap and in sector level insider holdings are correlated, startup disruption impacts each differently, mitigating gender pay gap more decisively in low-risk sectors, but mitigating insider concentration more in high-risk sectors. Furthermore, empirical results demonstrate that startup disruption has stronger impact in mitigating sector-level gender pay gap than in mitigating sector-level insider concentration.

Macro-level indicators meanwhile appear to demonstrate that startup disruption has the largest impact on sector-level gender-pay gap during recessions, in powder-rich markets, while indicators of VC-activity such as dry powder and cash-on-market, which are known to impact startup valuations, may be channeling investment towards industries where disruption is already underway rather than towards new disruptable markets.

6: Discussion and Policy Recommendations

Overall, the findings demonstrate that startup disruption can play a small, but measurable role in mitigating economic exclusion. Although available data is limited to industry-level gender pay gap and industry-level insider-holdings, it may be the case that similar patterns exist across virtually all socio-economic faultlines, ranging from ethno-national, to regional, generational and linguistic fault-lines.

One unexpected finding which resulted from the use of two-tiered empirical methodology is that startup-disruption impacted the status quo in different areas heterogeneously, mitigating gender pay gap and insider-concentration differently, and in different areas of the economy. Overall, this may be indicative that while economic exclusion on the basis of socio-cultural fault-lines is both widespread, and disruptable on the sectoral industry-level, the contours of each type of socio-economic exclusion may be slightly different.

Furthermore, the findings indicate that both sector-level conditions (i.e., industry-level business-risks) and macroeconomic conditions play a role in driving how susceptible sector-level economic exclusion is to entrepreneurial disruption. Because Rafferty (2014), McGinnity et al. (2015) and Krosch et al. (2017), describe that discrimination of various kinds are exacerbated by the business cycle, findings demonstrating that the disruption thereof are also influenced by the business cycle indeed constitutes an intriguing development.

Although the goodness-of-fit indicators attached to this study's findings demonstrate somewhat low explanatory power, an indication of incomplete modelling of the EU's sector-level gender pay gap dynamics, the findings are nevertheless highly relevant, even only able to convey part of the story. While several key deterministic factors remain unknown and outside of the model (which might otherwise serve as relevant control-variables), what we know, is that the findings indicate a clear link between entrepreneurial disruption, insider concentration, and gender pay gap, at the industry level, as well as this relationship's intersectionality with both sectoral and business cycle conditions.

Do Startups Impact Sector-level Gender Pay Gap?

The findings indicate that in fact it is the emergence of prominent, high-valuation startups in hitherto undisrupted industries which are able to impact the gender pay gap. In terms of market-structure impact, the implication of the findings is that market structure in the process of being disrupted is where the effect can be measured and observed most clearly. Specifically, the disruption effect can be detected most clearly in low-beta industries (i.e., stable sectors, which might possibly have monopolistic or oligopolistic market-structure, where sector-levels risks are low), as well as during recessions, while wide economic upheaval is taking place.

Do Startups Impact Sector-level Governance?

In a similar vein, findings also indicate that the emergence of prominent, high-valuation startups in hitherto undisrupted industries which are able to impact the industry-level insider holdings. In terms of market structure impact, the implication is that market structure in the process of being disrupted is where the effect can be measured the most clearly. Because insider concentration proxies insider power more broadly, as demonstrated in Strom (2015), one can presume similar things to be true for the impact on sector-level insider power overall.

That being said, the specific location of the disruptive effect is slightly different than what the findings indicate for the gender pay gap. Specifically, the disruption effect can be detected most clearly in high-beta industries (i.e. high-risk sectors. Additionally, at the macroeconomic-level, the effect of startup-disruption on insider-concentration is considerably more prominent as a deterministic influence, and plays a role across the entire business cycle, during both booms and recessions.

Does Sector-level Governance Impact Sector-level Gender Pay Gap?

Overall, empirical findings demonstrate that sector-level insider-holdings are correlated to gender pay gap. It might be the case that insider holdings play a role in driving industry-level gender pay gap, as well as possibly other types of socio-economic exclusion at the industry-level.

On the other hand, the findings appear to indicate that while sector-level insider-holdings are correlated to gender pay gaps, it might be the case that empirical evidence for this dataset indicate a simple correlation between insider holdings and gender pay gap, rather than a causal relationship. Further research is needed in order to more specifically map the contours and structure of Europe's industry-level economic dynamics in order to be sure.

Contribution to Existing Literature

This study's contribution to the existing literature is both theoretical and methodological. In terms of the relationship between the gender pay gap, insider concentration, and the entrepreneurial landscape, this study's characterization of startup disruption's ability to influence insider concentration, and hence the sector-level gender pay gap is novel. Heretofore, while previous studies have examined and described in detail both sector-level disruption and insider-power, relatively few studies have tied disruption to either the gender pay gap, or discrimination of any kind.

Meanwhile, on the methodological front, the use of a supervised machine-learning approach in support of this study's OLS findings to examine the impact on sector-level has led to nuanced and unique findings. In particular, that the role of startup disruption in mitigating the gender pay gap, while appearing small at first-glance, in concentrated and magnified in specific contextual circumstances, driven by business-cycle, financial-market conditions, and industry risk-levels, among other things. These findings are made possible by the deployment of supervised machine-learning in corroboration with more tradition economic methods.

Policy Recommendation

The implied policy recommendation is clear. If startup-disruption is able to mitigate economic-exclusion, as measured by the gender pay gap or by insider-holdings, policies aimed at expanding, facilitating, or entrenching startup disruption make sense not only from the point of view of economic growth, dynamism, and diversification, but also from the point of view of mitigating socio-economic exclusion at the sectoral industry-level, as well as improving socio-economic cohesion across industries. Upon taking a deeper, more nuanced dive, it may also be prudent to adopt policies aiming to channel investment towards industries which are measurably under-disrupted, in order to maximize this effect across the wider economy. Indeed,

this study may serve to add an industry-level focus to policy initiatives aimed at mitigating both gender pay gaps, and other signs of economic exclusion more broadly.

While it is not wholly likely that startup-disruption will succeed in completely mitigating or undermining gender pay gaps or other forms of economic exclusion, startups can play a role in disrupting the status quo in closed, dynastic, insider-held industries, as well as the socio-economic exclusion effect that these industries may have within the European Common Market's economy. Venture capital and entrepreneurship policy may consider taking economic-exclusion-impact into consideration going forward.

Furthermore, the relationship between business cycle indicators and the gender pay gap, which is in line with Rafferty, (2014), McGinnity et al., (2015), and Krosch et al., (2017) may serve to make gender and economic exclusion a concern of macroeconomic policy dealing with business cycle responses.

Further Research

More can be done going forward. This is particularly the case as broader and more nuanced data become available looking not only at industry and country, but also region, municipality, and network-relationships within startup markets, as well as data on pay gaps involving broader and more diverse socio-economic and demographic fault lines.

Additionally, interactions and intersectionalities between firm level dynamics, industry-level dynamics, and socio-economic outcomes will become increasingly possible as use of machine-learning methodologies becomes more widespread within economics, leading to potentially substantial new emergence of policy-implications in coming years as a result.

Lastly, as methodologies evolve, this question could conceivably be re-examined using increasingly sophisticated methodologies, or indeed multi-tiered combinations of methodologies, making use of both OLS approaches and multiple machine-learning approaches in order to grant new and more-detailed insight into the nuanced details of the issue or issues at hand. With this in mind, it might, in principle be possible to revisit much of not only the established empirical research, but more importantly, to shed light on empirical research which might be heretofore inconclusive given the previously-available empirical approaches.

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To Conclude: What Have We Learned About Startup Valuation?

1. Introduction

The understanding of startup and venture capital markets, the segment of the economy at the core of this dissertation's focus, is notoriously elusive, with many elements and dynamics traditionally considered to be a black box. At the same time, interest in startup markets keeps growing as both valuations, overall investment-deal volumes and numbers of unicorns have reached dramatic new heights in recent years. At the worldwide level, venture capital markets reached records both in terms of resources and capital invested, as well as in terms of number of deals executed in both 2020 and 2021. Subsequently, 2022 saw a substantial cooldown of the world's venture capital markets.

Fundamentally, as a key theme underpinning the understanding of startup and venture capital markets, the valuation of startups bears particular attentionworthiness. As such, startup valuation has become an extensively-covered focal theme within existing and newly-emerging entrepreneurial finance literature.

As a body of knowledge still under construction, novel and diverse research on startup markets and startup valuations emerges each year, broadening our collective understanding of how startup markets, and their underlying valuations work. This implies the systematic discovery of new valuation-factors and the specific valuation-impacts thereof, relationships among factors, downstream effects of valuation dynamics, and causal structures relating to venture capital and startup markets.

Overall, this dissertation's contributions to the entrepreneurial finance field are numerous and varied, with the potential to expand the entrepreneurial finance field, as well as further develop the field's links with other fields of economics and finance literature. This is achieved on the basis of this dissertation's diverse body of works, which explore startup valuation and its relationship to the wider economy, from a number of different angles.

While this dissertation's systematic literature review identifies that valuation-drivers can be classified as entrepreneur and firm characteristics, as market conditions, or as deal conditions and

investor characteristics, the specific way in which these determinants interact with one another in order to impact startup valuations is an issue which is still being debated in the literature. This dissertation's subsequent studies also explore these valuation factors and their relationships in detail.

2. Body of Works

In principle, this dissertation, as well as its component works, are intended to serve as a gateway to emerging research aimed at broadening the entrepreneurial finance field while also providing entrepreneurs, investors, and markets with clear and novel insights on the process and causal structure of startup valuations, as well as the ways in which startup markets interact with the wider economy.

Each of this dissertation's studies addresses key questions surrounding startup valuations, as well as their underlying relationships with general contextual economic conditions, ranging from industry-level to local-level, to macroeconomic and macrofinancial market conditions. This dissertation's body of works includes a systematic literature review, which examines the valuation literature across the entrepreneurial finance field as a whole, concluding with the construction of a valuation meta-model for startups, as well as a prognosis that currently-existing startup valuation literature displays insufficient methodological diversification, although the latter situation has been evolving as time goes on. Subsequent studies in this dissertation's body of work also address this issue. Doing so allows for the examination of diverse and nuanced valuation-factors and causal relationships within entrepreneurial finance.

Next, this dissertation addresses the direct and indirect role of the business cycle in driving startup valuations, explicitly linking startup valuations to the macroeconomic and macrofinancial environment. This study's findings indicate that business cycles impact startup valuations both directly and indirectly via multiple valuation channels, presenting a causality-structure more complex than much of what exists in the entrepreneurial finance literature. In terms of connecting this study to the systematic literature review, as well as to both the valuation meta-model and methodological issues stated in the systematic literature review, this paper uses structural equation modeling to describe that the role of market conditions described in the meta-model in influencing startup valuations is more complex and nuanced than what the meta-model describes, because of causal relationships *among* market conditions.

As a sequel to the examination of macroeconomic marker conditions, the subsequent study included in this dissertation explores the role of international venture capital markets and cross-border investments. Because the literature on cross-border investment examines both the economic and the legal and institutional sides of this issue, as well as distances and differences, drawing from both a gravity-model in the trade-economics literature and from the law-and-finance literature, an examination of cross-border venture capital investment valuation also needs to draw on these factors.

Once the role of various input factors ranging from sectoral, to legal and institutional to macroeconomic and cyclical have been understood and modelled in detail, the impact of startup valuations on specific industry sectors is examined. Specifically, valuations can be used as an indicator of industry-level startup disruption, a phenomenon which impacts not only the industry in question's economic status quo, but also levels of socioeconomic exclusion prevalent in the sector. While this dissertation measures socioeconomic exclusion in terms of sector-level insider concentration and sector-level gender pay gap, other types of economic exclusion, such as along racial, religious, regional or linguistic lines are also worthy of consideration.

3. Going Forward

Because this dissertation is intended to pave the way for both ongoing and future research to broaden the literature and scope of the entrepreneurial finance domain, it has both direct practical applicability and diverse avenues for potential future research. Taken together, this can be taken to mean that the implications of this this dissertation's body of work are both immediate and numerous.

In terms of direct practical applicability, this dissertation's component research examines several aspects of startup valuation which have immediate implications. The systematic literature review's in-detail examination of the process by which startup valuations emerge beginning with firm and entrepreneur characteristics, filtering through market conditions, and finally through investor characteristics and deal-conditions, for example, describe, in detail the relationship between market conditions such as business cycle or industry-level conditions on one hand and a startup's internal valuation drivers such as its assets, founder-team, and performance indicators on the other. These relationship dynamics are immediately useful for both investors and entrepreneurs. In particular, the Berre Le-Pendeven meta-model describes both factor-interaction and the process by which

valuation emerges, potentially strengthening practitioners' awareness of crucial stages and challenges of the evaluation process, and related negotiations and contracting.

Meanwhile, the relationship between and among market conditions, ranging from business cycle conditions to venture capital market dynamics and industry-level conditions, to cross-border governance and institutional conditions have immediate policy relevance, given that they describe specifically how macroeconomic policy, financial regulation, and trade policy influence startup and venture capital markets.

Concerning potential avenues for future research, possibilities are several and diverse. To begin with, the Berre-Le Pendeven meta-model constitutes a flexible, highly-viable framework into which future research into drivers of startup valuation can be juxtaposed. In particular, our model could frame studies examining the valuation-impacts of either newly-discovered and newly-described drivers, or studies examining the interaction of drivers of startup value, as described by the Berre Le Pendeven Meta-Model (i.e., entrepreneur and firm characteristics), with market conditions such as business cycle conditions and sectoral conditions. In addition, studies examining the valuation-impacts of the clauses in the VC contracts negotiated between entrepreneurs and stakeholders, as well as valuation-impacts of the deal negociation process are viable as directions of future research based on this dissertation.

Another key avenue for future research based on this dissertation's research lies in examining complex causalities and complex causal structures within entrepreneurial finance. Whereas this dissertation has uncovered complex causality in terms of valuation-impacts of business cycles and macrofinancial indicators, which impact startup valuation along the lines of multistep valuation channels and valuation and startup disruption impact sectors of the economy along multi-step and conditional lines of causality, it can also be expected that complex and multi-step causal structures influence other key themes within entrepreneurial finance, such as startup selection and startup survival as as well. Additionally, future studies investigating these matters, while making use of complex causal structures are likely going to need to depend on increasingly diverse methodological approaches in order to accurately capture these causal relationships. Examples of this within this dissertation's component studies include the use of hierarchical supervised machine learning to capture otherwise undiscovered conditional relationships, as well as the use of structural equation modelling to capture otherwise undiscovered indirect causal relationships. In principle, the description of complex causal-structure may require methodological innovation within future entrepreneurial finance studies. Furthermore, this avenue for future research may yield studies which successfully bridge the gap between entrepreneurial finance and other branches of

economics and finance, such as macroeconomics in the case of an examination of interaction effects involving business cycle and macrofinancial indicators, microeconomics and industrial organization in the case of interaction-effects involving sectoral and industry-level indicators, or corporate governance in the case where interaction effects involve shareholder agreements of firm-level voting and representation.

A third key avenue for future research lies in the investigation and modelling of the valuation-drivers outlined by the various studies of this dissertation in entrepreneurial finance topics adjacent to valuation, such as startup selection, startup survival, startup volatility, or shareholder agreement clauses. As it currently stands, the existing entrepreneurial finance literature describes that startup selection is driven by many of the same, or at least similar drivers, as those which drive startup valuation, while startup valuation also conveys a firm's long-run survival likelihood, among other things.

A fourth viable avenue for future research exists around downstream effects of startup valuations. Whereas most of this dissertation's studies have focused on modelling and describing the inputs of startup valuations, this dissertation's research has also successfully demonstrated that startup valuation can be used to indicate entrepreneurial disruption, which has measurable industry-level and sector-level socioeconomic impacts. Fundamentally, this is only the beginning. There exist ample grounds along which future studies can examine and investigate the downstream-effects of startup valuations and their dynamics within the wider society and economy.

A fifth and final foreseeable avenue of future research lies in policy-related studies. Because both the interactivity of firm-level startup value indicators with market conditions, as well as the complex causal structures, which this dissertation investigates have clear policy implications (because they imply that startup markets can be influenced by targeted policy actions in a number of specific ways), it is likely that future studies examining the relationship between economic policy aimed at impacting business cycles, financial markets, competition policy, company law, capital structure, or specific sectors of the economy on one hand, and startup and venture capital markets on the other, are forthcoming.

Overall, this dissertation's final message is that a more developed understanding of startup valuations and of startup and venture capital markets can and will translate directly into both a deeper understanding of the economy and financial markets at large, alongside a deeper understanding of the role of startup and venture capital markets within them, and subsequently a

generalized expansion of the scope and importance of the emerging entrepreneurial finance field as a whole.