The impact of leverage on firm performance: Evidence from start-ups in Sweden

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Ayrton da Silva

DSLAYR001

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Supervisor: Professor Mikael Samuelsson

Abstract

This study investigates the impact of leverage on the performance of start-ups within Sweden's dynamic entrepreneurial ecosystem. Given that fewer than 16% of Swedish start-ups survive beyond their first decade, the challenges of early-stage financing are particularly acute. Drawing on classical frameworks—namely the trade-off theory, pecking order theory, and signalling theory—the research situates the role of debt in the context of firms that operate under high uncertainty and limited internal resources.

Using a comprehensive population dataset from the Serrano database, which covers 66,069 firms over a 20-year period (1998–2017), the study employs fixed-effects panel regression to assess the relationship between leverage and key performance metrics. The results reveal that an increase in leverage is associated with statistically significant declines in both sales growth and the industry-adjusted operating income ratio (adjOIR). Specifically, a one-unit increase in lagged leverage corresponds to reductions of approximately 0.280–0.232 percentage points in sales growth and 0.039–0.034 percentage points in adjOIR. Furthermore, the adverse effects are magnified for firms identified as highly leveraged.

Effect size analysis indicates that a one standard deviation increase in leverage (approximately 24.06 percentage points) results in a decrease of nearly 6.93 percentage points in sales growth and 0.96 percentage points in operating income ratio. In Swedish Krona terms, this equates to revenue losses ranging between 125 and 166 million SEK across the population of firms. These findings underscore the necessity for start-ups to maintain moderate debt levels to preserve financial flexibility and long-term growth potential, offering critical insights for entrepreneurs, investors, and policymakers.

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Student number	DSLAYR001
Student name	Ayrton da Silva
Signature of student	Signed by candidate
Date	10 February 2025

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List of acronyms

Term	Definition
CAPEX	Capital expenditure
CAR	Cumulative abnormal returns
CLM	Classical Linear Model
CLV	Customer lifetime
EEC	European Economic Community
ESG	Environmental, social, and governance
EU	European Union
GDP	Gross domestic product
HGF	High-growth firms
ICT	Information and communications technology
IP	Intellectual property
MVP	Minimal viable product
NPV	Net present value
OECD	Organization for Economic Co-operation and Development
OIR	Operating income ratio
R&D	Research and development
RBV	Resource-based view
ROA	Return on assets
ROE	Return on equity
SDG	Sustainable Development Goal
SME	Small and Medium-sized Enterprise
VIF	Variance inflation factor

1. Introduction

The entrepreneurial landscape in Sweden is characterised by a dynamic start-up ecosystem that plays a pivotal role in innovation, job creation, and economic growth. Start-ups, as nascent businesses, are integral to fostering competitive markets and introducing novel technologies (Hisrich & Peters, 2002; Audretsch, 2007). Sweden, often acclaimed for its innovative capacity and supportive regulatory framework, is a leading nation for start-up activity per capita, and has produced globally recognised unicorns such as Spotify and Klarna (Dutta, Lanvin & Wunsch-Vincent, 2017; Porter, Stern & Green, 2017; Schwab, Sala-i-Martin & Samans, 2017). Notwithstanding these successes, the challenges faced by start-ups, in particular in terms of sustainability and long-term survival, remain significant, with fewer than 16% of Swedish start-ups survive beyond 10 years, which reflects broader global trends in start-up mortality (Klaesson & Karlsson, 2014).

This low survival rate illustrates the importance of understanding the factors that determine start-up performance and survival. Central to this discussion is the role of capital structure and leverage. Start-ups often operate in resource-constrained environments, which makes decisions about financing critical to their ability to scale operations, compete effectively, and withstand market volatility (Brush, Greene & Hart, 2001).

Capital structure decisions can make or break start-ups (Opler & Titman, 1994). Utilizing debt can amplify growth opportunities by providing access to capital, but this also introduces financial risk, in particular for firms with uncertain revenue streams (Berger & Udell, 1998).

Sweden's economic environment provides a compelling context for such an enquiry. The Swedish economy is characterised by its combination of market-oriented policies and a robust welfare state, often referred to as the "Swedish model" (Steinmo, 2013). This model has fostered an ecosystem conducive to entrepreneurship, with government initiatives aimed at reducing barriers to entry, facilitating access to venture capital, and encouraging collaboration between start-ups and larger firms or research institutions. Start-ups are particularly active in high-growth sectors such as biotechnology, cleantech, and information and communications technology (ICT), where Sweden has established itself as a global leader (OECD, 2018a).

Despite this supportive ecosystem, structural challenges do persist. The relatively small domestic market in Sweden limits scalability, often compelling start-ups to seek growth opportunities abroad at earlier stages than their counterparts in larger economies (Bosma & Kelley, 2018). This early internationalisation introduces complexities such as navigating regulatory differences and managing cross-border operations. In addition, while Sweden boasts a diversified funding landscape, including angel investors, venture capital, and public grants, early-stage start-ups in less traditional sectors often face difficulties in securing financing (Mason & Brown, 2013). These structural challenges, compounded by the inherent volatility of start-ups, create an urgent need for nuanced insights into the factors that drive start-up success and longevity.

The broader societal impact of start-ups further emphasises the importance of this research. In addition to their economic contributions, start-ups are often at the forefront of addressing pressing social and environmental issues. Many Swedish start-ups align their business models with sustainability goals, so reflecting the country's strong commitment to green growth and climate action (OECD, 2019a). Understanding the determinants of their success is not only critical for enhancing economic outcomes but also for maximising their potential to contribute to societal well-being.

1.1. Problem statement

Swedish start-ups play an essential role in driving innovation, fostering economic growth, and generating employment, as discussed further in Section 2.1. Despite substantial public and private investments—estimated at around $7 billion annually (Glasner, 2021)—these ventures face alarmingly high failure rates (Klaesson & Karlsson, 2014). The persistent financial fragility of start-ups poses significant economic and social costs, underscoring the need to understand the underlying causes of their vulnerability, particularly in relation to their financing decisions.

One of the central challenges confronting start-ups is the management of debt (Robb & Robinson, 2014). Traditional models of capital structure have long argued that debt can confer benefits such as tax advantages and improved managerial discipline (Modigliani & Miller, 1958; Jensen, 1986). However, these benefits come at a cost. Fixed debt repayments can restrict a firm's ability to invest in growth and innovation, a drawback that is especially problematic for start-ups with unpredictable cash flows and limited internal resources (Warner, 1977). Moreover, many conventional capital structure theories were developed with mature firms in mind and do not fully capture the unique financial constraints and operational dynamics of early-stage ventures (Myers & Majiuf, 1981; Berger & Udell, 1998). In Sweden's competitive but relatively small domestic market—where early internationalisation is often a necessity (Bosma & Kelley, 2018)—the adverse effects of high leverage are likely to be even more pronounced.

Empirical research on the relationship between debt and firm performance further illustrates the complexity of this issue. On one hand, some studies have reported that moderate levels of debt can improve performance (Ahn, Denis & Denis, 2006) - measured in growth or returns - by instilling discipline and enabling access to capital, as observed in research on SMEs in Japan (Tsuruta, 2015, 2017) and on young private firms in the United States (Cole & Sokolyk, 2018a). These studies suggest that, under certain conditions, debt may contribute to improved operational efficiency and profitability. On the other hand, several researchers have documented that excessive leverage is associated with heightened financial distress, reduced investment capacity, and lower growth rates (Opler & Titman, 1994; Lang, Ofekb & Stulz, 1996; Aivazian, Ge & Qiu, 2005a; Agostino & Trivieri, 2010; Cai & Zhang, 2011). This contradictory body of evidence indicates that the relationship between debt and performance is not linear but is highly contingent on contextual factors such as industry characteristics, economic cycles and firm-specific attributes.

In addition to these mixed findings, a significant gap exists in the empirical literature on the effect of leverage on start-ups firm performance. Most previous research has focused on established firms, leaving the unique challenges of start-up financing underexplored (Berger & Udell, 1998). This scarcity of up-to-date empirical work, particularly in the Swedish context, hampers the ability to draw definitive conclusions about the optimal use of debt in early-stage firms. The limitations in available data, combined with the diverse and dynamic nature of start-up environments, call for a dedicated investigation that can provide clearer insights into how debt levels influence performance.

1.2. Study rationale and objectives

Swedish start-ups occupy a pivotal role in driving innovation, creating employment and contributing to societal progress (Hisrich & Peters, 2002; Audretsch & Keilbach, 2007; Bosma & Kelley, 2018). As detailed further in Section 2.1, these new ventures are vital components of the nation's economic dynamism, yet they frequently suffer from high failure rates attributable to financial fragility (Stinchcombe, 1965). By focusing on leverage, rather than the broader capital structure or strategic considerations, this research seeks to isolate the precise impact that varying degrees of financial leverage have on start-up performance.

The rationale for this research is underpinned by both theoretical and empirical gaps identified in the literature. Theoretical models such as the trade-off theory (Kraus & Litzenberger, 1973a) and the pecking order theory (Myers & Majiuf, 1981) have predominantly been applied to mature firms with stable cash flows, leaving the nuanced effects of debt on early-stage companies largely underexplored (Berger & Udell, 1998). As Chapter 2 outlines, start-ups face unique challenges—limited internal resources, volatile revenues and heightened uncertainty—that make their response to debt fundamentally different. This study argues that the adverse impact of debt on operational flexibility and profitability may be more pronounced in start-ups, and that excessive leverage could constrain growth to a degree that outweighs any potential benefits such as tax shields. Moreover, the scarcity of research addressing these issues in the specific context of start-ups provides an impetus to refine existing theories and supply practitioners and policymakers with focused, empirically grounded insights.

Against this background, the study is guided by three primary objectives. First, the research aims to assess the financial performance effects of debt by quantifying how variations in leverage influence key financial indicators such as profitability and revenue growth. This objective is designed to provide a precise measurement of debt's cost in financial terms, thereby enabling a clearer understanding of its impact on start-up viability.

A second objective is to analyse the effects of high leverage. Specifically, this study examines whether start-ups in the highest quintile of debt exhibit disproportionately negative outcomes compared to those operating with moderate debt levels. Empirical evidence suggests that high leverage can lead to a debt overhang, where the burden of fixed repayments stifles further investment and restricts operational flexibility (Tsuruta, 2015, 2017). By isolating this subgroup, the study seeks to determine if there exists a critical tipping point beyond which the risks of debt become markedly severe.

The final objective is to integrate theory with empirical evidence by situating the analysis within debt-focused frameworks. In doing so, this research refines traditional models, assessing how well theory captures the specific dynamics observed in start-ups. The empirical findings will be interpreted in light of these theoretical perspectives, thus contributing to both the academic literature and practical recommendations for optimal debt utilisation in early-stage firms.

In summary, this study narrows its focus from the broad domain of capital structure to the specific influence of debt on start-up performance. By addressing the identified gap in the literature and using a robust empirical framework, the research aims to furnish actionable insights that are pertinent for entrepreneurs, investors and policymakers. The combined rationale and objectives thus provide a clear roadmap for understanding how debt levels affect both financial and operational outcomes, ultimately supporting more informed decision-making in high-risk, innovation-driven environments.

1.3. Research question

The research seeks to answer the question:

What is the impact of leverage on the firm performance of start-ups in Sweden?

Leverage as a critical component of capital structure has long been recognised as a complex factor in corporate finance literature (Cassar & Holmes, 2003; O'Brien, 2003). It can provide firms with the necessary resources to scale rapidly and compete effectively but can also expose them to significant financial risks (Robb & Robinson, 2014). The inherent uncertainty related to leverage is amplified in the context of start-ups, where operating histories are short, revenue streams are volatile, and the competitive landscape is dynamic (Cassar, 2004).

The importance of the research question lies in the distinct characteristics of start-ups. Unlike established firms, start-ups face more substantial challenges that are described as a 'liability of newness' (Stinchcombe, 1965), are typically resource-constrained, and face substantial barriers to accessing financing. They often operate in fast-evolving markets where speed and agility are crucial (Bruderl & Schussler, 1990), so making access to external capital a determinant of survival and growth (Zacharakis, Meyer & Decastro, 1999; Shane, 2009). Leverage, by providing immediate access to capital, can enable start-ups to seize opportunities and expand their operations (Cassar & Holmes, 2003; Cassar, 2004). However, the obligation to service debt can strain cash flows, limit strategic flexibility, and increase the likelihood of financial distress (Colombo & Grilli, 2007). This trade-off makes the study of leverage particularly relevant to start-ups, where decision-making about financing carries disproportionate risks and rewards.

Sweden is a compelling context for exploring this question. The country's entrepreneurial ecosystem, marked by a combination of free-market dynamics and state support (Steinmo, 2013), is internationally recognised for fostering innovation and also start-up success (Bosma & Kelley, 2018). Yet, as discussed in Section 2.1.2, Swedish start-ups face unique challenges, including the limited scale of the domestic market and the consequent need for early

internationalisation (Balawi & Ayoub, 2022). These factors complicate the role of leverage in firm performance, as start-ups may face higher costs and risks associated with cross-border operations (Demir, Wennberg & McKelvie, 2017; Cole & Sokolyk, 2018b). For example, accessing foreign markets requires substantial upfront investments in marketing, logistics, and regulatory compliance – all of which may necessitate external financing. The implications of leveraging debt to meet these demands remain underexplored in the academic literature, in particular in Sweden (Coad et al., 2014).

The research question also reflects gaps in theoretical understanding. Established frameworks such as the trade-off theory (Kraus & Litzenberger, 1973b) and the pecking order theory (Myers & Majiuf, 1981) offer valuable insights into the relationship between leverage and firm performance because they explain why management and shareholders choose the capital structures they do – and the proportion capitalized by debt or equity. However, these theories often rest on assumptions that do not align with the realities of start-ups (Cassar, 2004). For example, the trade-off theory emphasises tax benefits, presupposing that firms are generating taxable profits – a condition not typically met by start-ups in their initial stages (Carpenter & Petersen, 2002; Robb & Robinson, 2014). Similarly, the pecking order theory suggests that companies prefer internal financing over debt, which is less applicable to start-ups that usually lack substantial internal resources and must turn to external equity or debt financing (Carpenter & Petersen, 2002). Consequently, the research aims to adapt these theoretical frameworks to the specific circumstances of Swedish start-ups, bridging the gap between general financial theories and the intricate dynamics of entrepreneurial finance.

A key focus is the multidimensional nature of firm performance. While traditional metrics such as profitability, revenue growth and return on assets are central to assessing firm success, this study also considers the use of broader societal outcomes (Mair & Marti, 2006; Hall, Daneke & Lenox, 2010; Zahra & Nambisan, 2012). Swedish start-ups are often celebrated not just for their financial achievements but also for their contributions to sustainability, inclusivity, and technological advancement (Wendling et al., 2018; OECD, 2019a; Hollanders et al., 2020). This research question could extend beyond narrow financial metrics to explore whether and how leverage influences a start-up's ability to create societal value. For example, do heavily leveraged start-ups prioritise short-term financial needs over long-term innovation and societal impact? Or can access to debt financing enable start-ups to invest in sustainable practices and inclusive business models that may otherwise be unattainable?

The research has practical relevance. Entrepreneurs frequently face difficult decisions about how to structure their financing, in particular when weighing the benefits and risks of debt (Berger & Udell, 1998; Cassar, 2004; Robb & Robinson, 2014). Insights into how leverage affects firm performance can help founders make more informed choices, so balancing growth ambitions with financial prudence (Tsuruta, 2015). Similarly, the findings can inform investors who are evaluating the risks and potential returns of lending to or investing in start-ups. For policymakers, understanding the role of leverage in start-up performance is crucial for designing initiatives that support entrepreneurial success. This is particularly true in Sweden, where public policy plays a significant role in shaping the start-up ecosystem through mechanisms such as grants, tax incentives, and innovation funding.

In summary, the research question – *What is the impact of leverage on the firm performance of start-ups in Sweden?* – is motivated by the need to address both theoretical and practical gaps in understanding. It seeks to elucidate the complex interplay between leverage and performance, considering the unique challenges and opportunities faced by start-ups in Sweden's dynamic entrepreneurial landscape. By situating this inquiry in the broader context of entrepreneurial finance and societal outcomes, this research aims to make a meaningful contribution to both academic literature and practice. The answers to this question will not only highlight the financial strategies of start-ups but also provide actionable insights for entrepreneurs, investors, and policymakers seeking to foster sustainable and inclusive economic growth.

1.4. Organisation of the research

This paper comprises five chapters:

In *Chapter One*, I introduce the research, frame the research problem and rationale, present the central question, and outline the objectives. This chapter establishes the importance of understanding how leverage influences start-up performance, in particular in the Swedish context.

Chapter Two sets the theoretical and conceptual context of the research, and provides a detailed literature review, while exploring key theories and empirical studies on leverage. The chapter concludes with a synthesis of the literature and development of hypotheses.

Chapter Three outlines the research methodology, including the research design, data sources, variable operationalisation, and analytical techniques of the study. I also discuss scope, limitations, and robustness testing.

Chapter Four presents empirical findings: descriptive statistics, correlations, supplementary analysis, the results of diagnostics and robustness testing, and the results of the empirical model considering the relationship between leverage and key performance metrics such as operating income ratio and sales growth.

Chapter Five integrates the discussion of findings with conclusions, and highlights contributions to the academic literature and practical implications for entrepreneurs, investors, and policymakers. I also identify limitations and suggests directions for future research.

2. Theoretical context and hypothesis development

2.1. Context setting

The focus of this study is on private for-profit firms in Sweden covering the period 1998 to 2017.

In Sweden, fewer than 16% of start-ups will survive 10 or more years, this being a significant cost to public and private sector funders (Klaesson & Karlsson, 2014), with one estimate suggesting that as much as $7 billion is funded into Swedish start-ups each year (Glasner, 2021). Generalising from this finding, these unsuccessful firms are unable to establish or maintain a competitive advantage. To achieve a competitive advantage, start-ups must first set themselves up for success by establishing a sustainable capital structure (Myers, 1984; Stiglitz, 1988; Coleman & Robb, 2012; Robb & Robinson, 2014), building economically viable business and operating models that are appropriate for their target opportunity, and growing their customer base (Demir, Wennberg & McKelvie, 2017; Siepel, Cowling & Coad, 2017; Anderson, Wennberg & McMullen, 2019).

While low start-up success rates are not an uncommon or a new phenomenon, its study is increasingly relevant given the increasing funding of start-ups (OECD, 2018b, 2019b) and their importance in economies (Berger & Udell, 1998; Audretsch, 2007; Audretsch & Keilbach, 2007). Start-ups, as key drivers of innovation and problem-solving (Mawson & Brown, 2017), need to play important social roles in their communities in order to succeed (Pirolo & Presutti, 2010). So, why do so many start-ups not succeed?

In this section, I examine the context of firm competition, the nature of entrepreneurship and start-ups, as well as the Swedish economy and the role of start-ups in it. Finally, I derive the contextual model of this study, the context of which is illustrated in Figure 1 (below).

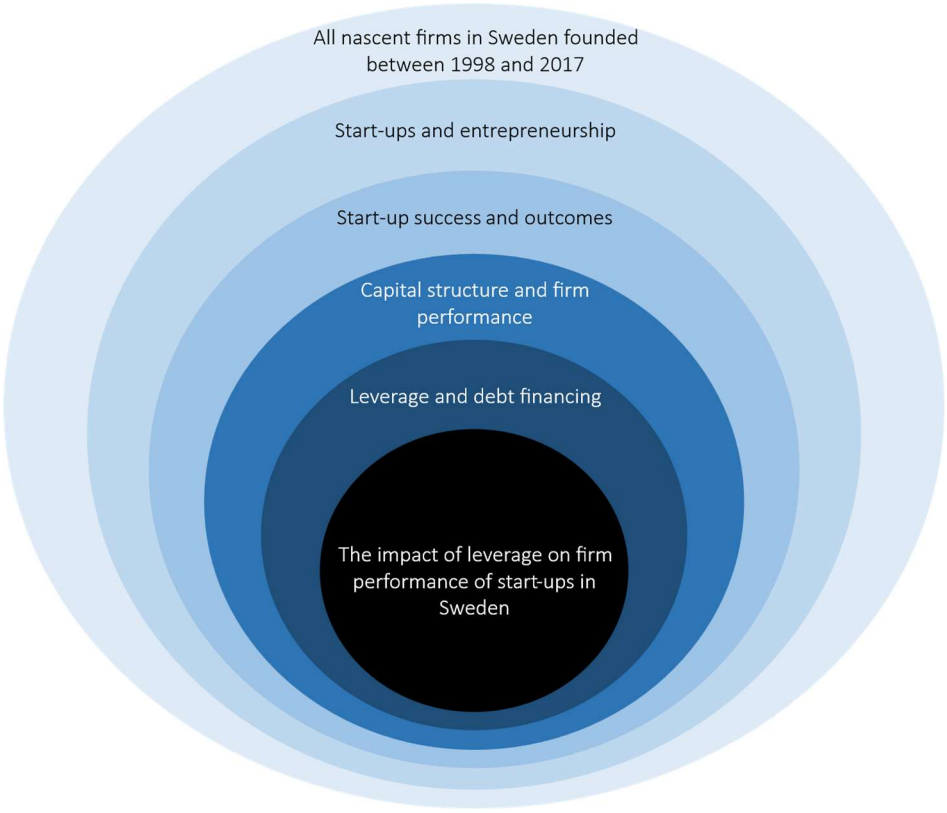

Figure 1: Context setting of the research question

2.1.1. Landscape

In this section, I briefly examine the fundamental theoretical context of this study. I consider the market economy and the implications this may have on entrepreneurship and start-ups, the foundational theories of the firm, and, finally, Schumpeter's work on innovation and creative destruction.

The market economy

The landscape of this study is grounded in foundational theories that elucidate the dynamics influencing start-up firm performance, in particular regarding leverage in Sweden's economic environment. In a market economy, resource allocation is determined by the balance of supply and demand through price mechanisms, so promoting efficient distribution based on consumer preferences (Smith, 1776). This system fosters competition and incentivises firms to innovate and enhance efficiency to meet market demands. Firms act as pivotal agents in this economy, producing goods and services, generating employment, and driving economic growth. Beyond production entities, firms play a critical role in resource allocation and shaping market dynamics (Penrose, 1959).

Sweden's market economy is characterised by a combination of free-market capitalism and a robust welfare state, which is often referred to as the "Swedish model" (Steinmo, 2013). This model emphasises economic efficiency

and social equity, supported by active government policies that encourage innovation and entrepreneurship. The regulatory environment in Sweden is conducive to business creation and growth, with initiatives aimed at reducing barriers to entry, providing access to capital, and fostering a skilled workforce (Henrekson, Johansson & Stenkula, 2010). Such an environment has facilitated the emergence of a dynamic start-up ecosystem, so positioning Sweden as a leader in innovation and start-up success per capita.

Theory of the firm

The theory of the firm offers a framework for understanding why firms exist, their structures, and decision-making processes (Penrose, 1959). Classical theories focused on profit maximisation and production efficiency as primary objectives (Marshall, 1890). Modern theories have expanded on this view. Coase's (1937) transaction cost economics suggests that firms arise to minimise costs associated with market transactions. These costs are numerous, and include information search, contract negotiation, and agreement monitoring and enforcement, among others. By organising activities internally, firms can reduce these costs and operate more efficiently.

The Resource-Based View (RBV) proposed by Wernerfelt (1984) and further developed by Barney (1991) is that a firm's sustainable competitive advantage is due to its unique resources and capabilities that are valuable, rare, inimitable, and non-substitutable. For start-ups, leveraging unique resources like innovative technologies, specialised knowledge, and entrepreneurial talent is crucial for establishing and maintaining a competitive position. Jensen and Meckling's (1976) Agency Theory examines conflicts of interest between principals (owners) and agents (managers), and highlights issues of moral hazard and information asymmetry. This theory is pertinent to start-ups, especially in capital structure decisions where external investors may have objectives differing from entrepreneurs and managers.

Innovation theory and creative destruction[1]

Innovation theory involves mechanisms by which new ideas, products, and processes are developed and commercialised. Schumpeter (1934) emphasised the entrepreneur's role as a catalyst for innovation, introducing "new combinations" that lead to economic development. He later expanded on this with the notion of creative destruction, where incessant innovation by entrepreneurs leads to the displacement of existing products and industries (Schumpeter, 1942). This process is essential for long-term economic growth but can be disruptive in the short term.

One way to conceptualise innovation is to classify it into two types: incremental and radical (Dewar & Dutton, 1986). Incremental innovation is typically marginal improvements to products or processes, while radical innovation leads to significant technological breakthroughs and the creation of entirely new markets (Dewar & Dutton, 1986). Start-ups are often at the forefront of radical innovation owing to their flexibility, risk tolerance,

[1] Additional coverage on entrepreneurship, start-ups and innovation are included in Section 7.1 of the Appendix of this manuscript

and focus on novel ideas. They frequently use methodologies like the lean start-up approach, emphasising iterative product development and customer feedback (Ries, 2011).

Schumpeter's (1942) creative destruction is a fundamental concept explaining how economic structures are revolutionised from within, destroying old ones, and creating new ones (Aghion & Howitt, 1992). This continual process, driven by technological innovation and entrepreneurial activities, leads to productivity improvements and economic growth. Start-ups are central to this process, in particular in industries undergoing rapid technological change (Audretsch, 1995). In Sweden, start-ups have been instrumental in transforming sectors like telecommunications, music streaming, and fintech, exemplified by companies such as Spotify and Klarna (Demir, Wennberg & McKelvie, 2017; Nambisan, 2017).

2.1.2. The Swedish economy and start-ups

Sweden has a highly developed economy, with a population of about 10 million and a GDP of about US$586 billion in 2022 (The World Bank, 2023a). Despite its small population, Sweden's economy is measured by the World Bank (2023b) as the 23rd largest globally. Consequently, the Swedish population is the 16th wealthiest in the world, when measured by GDP per capita (The World Bank, 2023a).

In addition, the Swedish economy repeatedly ranks among the most competitive and innovative economies in the world, ranking 7th out of 137 economies in the Global Competitiveness Index 2017 (Schwab, Sala-i-Martin & Samans, 2017) and 2nd in the Global Innovation Index 2017 (Dutta, Lanvin & Wunsch-Vincent, 2017). Sweden is also one of the most socially progressive and environmentally sustainable economies in the world and is ranked highly by both the Social Progress Index 2017 (8th, globally) (Porter, Stern & Green, 2017) and the Environmental Performance Index 2018 (5th, globally) (Wendling et al., 2018).

As a highly developed economy with a wealth of natural resources, mature industry, and access to a highly skilled workforce, Sweden produces high value-added goods and exports them globally, so contributing significantly to its economic output (National Institute of Economic Research, 2017). Exports accounted for about 46% of Sweden's GDP in 2021 (World Integrated Trade Solution, 2021) and contributed up to 45% of GDP growth in 2017 (National Institute of Economic Research, 2017). Sweden's largest industries contributing to its export economy are petroleum and oil, industrial machinery, automotive, pharmaceutical and life sciences, electrical and electronic equipment, and forestry sectors (World Integrated Trade Solution, 2021). While Sweden is also a major importer of goods and services, it maintains a positive trade balance, with a surplus of about US$11 billion in 2017 (The World Bank, 2023a).

As a result of its highly developed economy and its generally open trading policy, among other factors, Sweden has grown its GDP since 2000 by over 40% in real terms, as seen in Figure 2. Sweden has outpaced the OECD average GDP growth, and achieved 3.1% growth versus the OECD average of 2.4% in 2017 (OECD, 2019a).

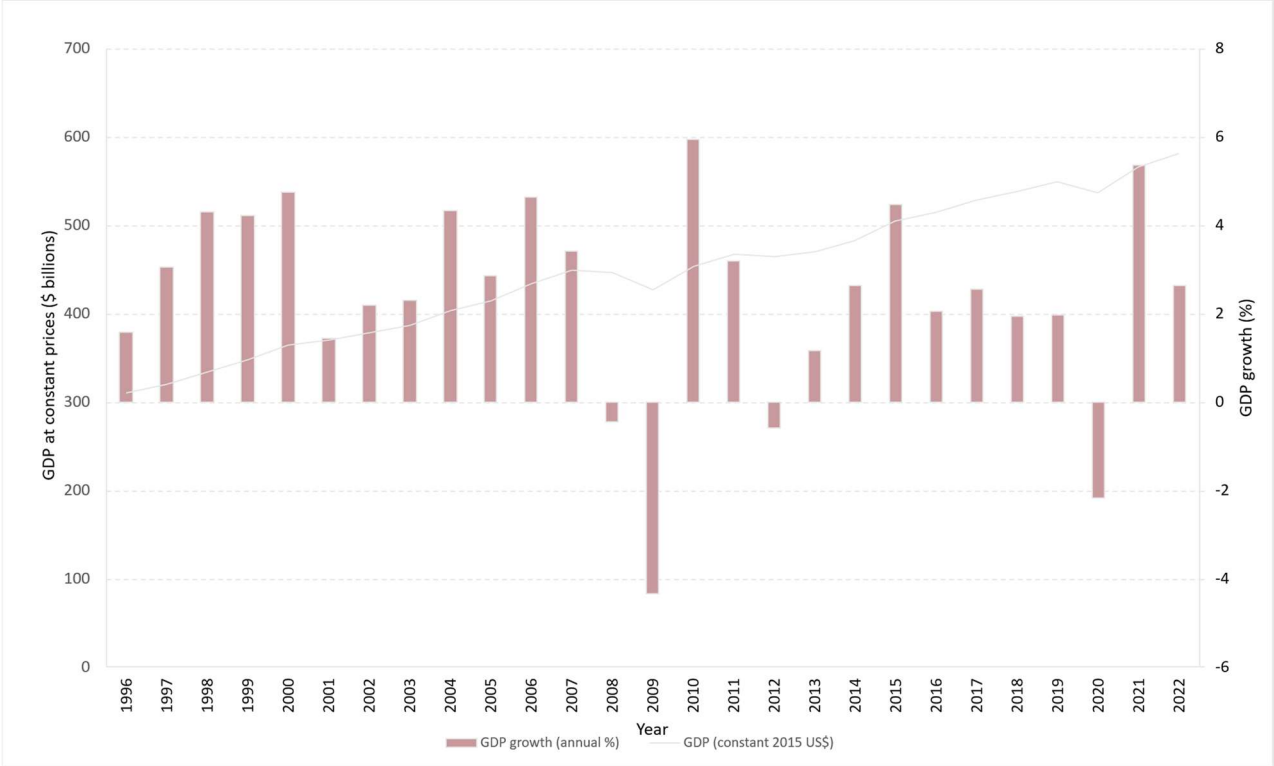

Figure 2: Sweden's GDP and GDP growth, 1996–2022[2]. Data supplied by the World Bank's DataBank (2023a).

Sweden's economy has several strengths that make it competitive and resilient. OECD (2017) economic research into Sweden indicates a high level of innovation, technological development, and extensive research and development (R&D) capabilities. Sweden has the 4th highest R&D spending as a proportion of GDP in the OECD and, similarly, the 4th highest number of researchers per capita. Sweden also possesses a well employed, skilled and educated workforce, with the highest employment rate in the European Union, and low labour shortages (OECD, 2019a). The same OECD (2019a) report further indicates, among Sweden's economic strengths, a collaborative culture and a favourable regulatory framework.

Sweden has a high level of social and environmental sustainability supported by a comprehensive welfare system, a high degree of social trust and cohesion, low level of inequality and poverty, and a strong commitment to green growth and climate action. It also has a high level of macroeconomic stability and fiscal discipline supported by a sound monetary policy, a flexible exchange rate, a low public debt, and a prudent fiscal policy. The favourable regulatory environment is supported by the World Bank's (2017) 'Doing Business' report, which ranks Sweden 10th in the world for ease of doing business.

[2] GDP is in constant 2015 U.S. dollars. Dollar figures for GDP are converted from Swedish Krona using a single year's official exchange rates.

However, Sweden's economy also faces some weaknesses and challenges, such as: a high dependence on external demand and trade which makes it vulnerable to global shocks and uncertainties such as the Covid-19 pandemic; the U.S.–China trade war, the Brexit process, and geopolitical tensions (OECD, 2023). The 'Doing Business 2018' report by the World Bank (2017) indicates that a high tax burden and labour market rigidity may reduce the incentives and flexibility for entrepreneurship, investment, and employment, especially for small and medium-sized enterprises (SMEs). The high cost of living and capital income growth outpacing wage growth are further weaknesses that may affect the affordability and accessibility of goods and services, especially for low-income and vulnerable groups, and this may create social and economic inequalities and exclusion (OECD, 2019a).

Start-ups are an important part of the Swedish economy, as they contribute to innovation, job creation, and competitiveness, with young Swedish firms (five years old or less) accounting for 55% of all firms in the country (Heyman et al., 2019). The OECD's (2018a) country assessment into inclusive entrepreneurship policies found that Sweden has achieved a high rate of total early-stage entrepreneurship activity (a measure of the proportion of the adult population engaged in early-stage entrepreneurship) of 7.3% from 2013 through 2017 – compared to the EU average of 6.7%. Sweden also has a high rate of innovation-driven entrepreneurship, with 32.6% of the early-stage entrepreneurs offering products or services that are new to some or all customers and which face few or no competitors compared to the EU average of 27.6% (OECD, 2018a).

Start-ups are key to driving innovation in the Swedish economy, as progenitors of new products, services, processes, and business models that challenge the existing ones and create value for customers and society. Start-ups also collaborate with other actors in the innovation system, such as universities, research institutes, large firms, and public agencies, in order to access knowledge, resources, and networks (Balawi & Ayoub, 2022). Start-ups are especially active in sectors that are characterised by high technological dynamism and uncertainty, such as biotechnology, ICT, and cleantech. According to the European Innovation Scoreboard 2020 (Hollanders et al., 2020), Sweden is the innovation leader in the EU, with a performance well above the EU average in indicators such as R&D expenditure, patent applications, internal innovations, and sales of new and innovative products and services.

Start-ups are also instrumental in creating jobs in the Swedish economy, and generate employment opportunities directly as a part of the core business of a start-up and indirectly through added demand and supply in the value chains they participate in. Start-ups employ a significant share of the workforce, especially among young people, women, and immigrants, who may face barriers to entering the labour market (OECD, 2018a). Start-ups also create spillover effects for the employment of other firms through their demand for inputs, their supply of outputs, and their knowledge diffusion. Heyman et. al (2019) estimated that from 2001 to 2014, start-ups accounted for 30% of all jobs and 20% of net job creation in Sweden and, with each start-up job created, 0.8 additional employment opportunities are indirectly generated in other firms.

Sweden is a global centre for start-ups; many have grown to international success and attract significant investment. Sweden is second globally in the number of 'Unicorns' – start-ups worth a billion U.S. dollars or more

– its production per capita is second only to Silicon Valley (Hollanders et al., 2020). Spotify, Skype, Klarna, and King are some well-known examples of Swedish start-ups that have achieved global success. According to the Global Startup Ecosystem Index 2023 (StartupBlink, 2023), Sweden ranks 5th worldwide and 2nd in Western Europe for the strength of its start-up ecosystem, which is measured by assessing the investment, support, and success of start-ups in a region or city. The start-up ecosystem in Sweden is best represented in fintech, hardware and IoT, and social and leisure. Sweden attracts and contributes significant capital to start-ups. Crunchbase, an independent venture capital and start-up data platform, reported that, in 2021, Sweden had the fourth highest per capita start-up funding globally, as shown in Table 1 (below) (Glasner, 2021).

Table 1: 2021 venture capital funding per capita by nations with $1B+ in start-up investment (Glasner, 2021)

Rank	Country	Past year funding (Billion$)	Population (Million)	Per capita funding ($)
1	Singapore	8.25	5.9	1,398
2	Israel	8.44	8.8	959
3	Estonia	1.19	1.3	915
4	United States	269	333	808
5	Sweden	7.15	10.2	700
6	United Kingdom	32.1	68	472
7	Netherlands	6.15	17.2	358
8	Denmark	1.97	5.8	340
9	Switzerland	2.75	8.7	316
10	Finland	1.7	5.6	303
11	Canada	10.3	38	271
12	Ireland	1.12	5	224
13	Germany	17	84	202
14	France	11.6	65	178
15	Australia	3.76	25.9	145
16	Austria	1.23	9.1	135
17	South Korea	3.95	51.3	77
18	Belgium	766	11.6	66
19	Spain	2.77	46.7	59
20	Brazil	90.64	214	50

While Sweden may offer an economic environment conducive to start-up success and robust start-up and innovation ecosystems, there are still significant challenges for start-ups. Market size and access, funding

availability and diversity, and regulatory hurdles all still affect the prospects of start-ups in Europe's start-up capital.

Sweden has a relatively small and mature economy, which limits the scalability and growth potential of start-ups, especially in sectors that require network effects or economies of scale. Start-ups may need to expand to other markets earlier than peers in larger or less mature economies. For Swedish start-ups, market expansion into the other EU or EEC countries to achieve higher growth and profitability is more attractive than expanding to the U.S. or emerging markets to achieve higher growth and profitability (Bosma & Kelley, 2018). This may still entail higher transaction costs, risks, and complexities, such as regulatory barriers, cultural differences, and competitive pressures, which are challenging to traverse in a firm's early stages (Autio, Sapienza & Almeida, 2000).

Sweden has a diversified and mature funding landscape for start-ups, which includes various sources of finance, including public grants, crowdfunding, various types of debt financing, angel investors, and venture capitalists (Gompers, Lerner & Scharfstein, 2005; Robb & Robinson, 2014). However, start-ups may still face gaps and challenges in accessing funding, especially in the early stages of development and in some sectors that are less attractive or familiar to investors, such as social and environmental impact start-ups (Mason & Brown, 2013).

The regulatory environment in Sweden is favourable and supportive for start-ups, and enforces low barriers to entry, high protection of property rights, low corruption, and high transparency. Sweden also has a proactive and responsive public sector that supports start-ups through legislation, policy, and special programmes, such as tax incentives, reductions in 'rep tape', innovation agencies, incubators, and accelerators (Isenberg, 2010). However, start-ups may also encounter some regulatory challenges and uncertainties, such as a high tax burden, labour market rigidity, data protection rules, and changing policy in the EU and EEC (Klapper et al., 2007).

2.1.3. Entrepreneurship and start-ups

Entrepreneurship

Entrepreneurship involves creating, launching, and managing a new business endeavour, typically starting as a small company that offers a product, service, or innovative process (Hisrich & Peters, 2002). Entrepreneurs engage in this process to create or extract economic value, and undertake risks with the hope of achieving rewards such as monetary profit, personal satisfaction, and independence (Knight, 1921). In the modern economy, entrepreneurship is a driver of innovation, employment, and economic growth, and shapes societal structures and market dynamics (Audretsch, 2007).

Entrepreneurship, as a concept, has developed over time. Early conceptualisations trace back to Richard Cantillon (1755), who defined an entrepreneur as an individual who purchases goods at certain prices to sell them at uncertain prices, so bearing the risk inherent in enterprise. This is what led Cantillon (1755) to characterise the entrepreneur as a risk-taker, a notion which persisted in subsequent theories (Knight, 1921; Schumpeter, 1934). Joseph Schumpeter (1934) emphasised the entrepreneur's role as an innovator, and introduced the concept of

"creative destruction", where new innovations lead to the demise of outdated industries, so driving economic development.

Israel Kirzner (1973) considered the entrepreneur to be one who identifies and exploits market opportunities, and highlighted "entrepreneurial alertness" as a critical factor in the entrepreneurial process. Frank Knight (1921) distinguished between measurable risks and unmeasurable uncertainties, and posited that entrepreneurs are unique in their willingness to bear the uncertainties inherent in new ventures. Peter Drucker (1986) argued that entrepreneurial opportunities often arise from technological, social, and demographic changes, with the entrepreneur's task being to exploit these changes. Stevenson and Gumpert (1985) shifted the focus to the process of entrepreneurship itself, and described it as "the pursuit of opportunity beyond resources controlled".

Entrepreneurship is mediated or determined by a confluence of individual characteristics and environmental factors. Individual traits such as creativity, motivation, risk tolerance, and resilience are crucial in determining entrepreneurial intent and success (Zhao & Seibert, 2006). According to the Global Entrepreneurship Monitor (2020), the entrepreneurial motivations of an individual can be classified either as opportunity-, improvement-, or necessity-driven. The same report finds that, in Sweden, motivations for starting a business are opportunity-driven 67.5% of the time, necessity-driven 16.9% of the time, and improvement-driven 15.6% of the time (Bosma & Kelley, 2018). Environmental factors, including economic conditions, market dynamics, technological advancements, access to capital, mentorship, and networks, create a landscape in which entrepreneurial ventures arise (Shane & Venkataraman, 2000).

Entrepreneurship is however fraught with challenges and risks (Shane, 2009). One significant concept is the "liability of newness", which suggests that new organisations face a higher risk of failure because of a lack of established processes and procedures, relationships, and legitimacy, among other disadvantages (Stinchcombe, 1965). Start-ups often contend with scarce and underdeveloped resources, including limited financial capital, human resources, and market presence, which can impede their growth and sustainability (Brush, Greene & Hart, 2001). The high failure rates among start-ups underscore the importance of effective resource management and strategic planning. Understanding and managing failure is a critical aspect of entrepreneurship, because not all ventures succeed (McGrath, 1999; Ucbasaran et al., 2010).

The distinction between shareholders and managers introduces additional complexities in entrepreneurial ventures. Agency Theory addresses the conflicts of interest that may arise between owners and managers, in particular when their goals diverge (Jensen & Meckling, 1976). In start-ups, this distinction can affect decision-making processes, governance structures, and ultimately firm performance (Cumming, 2005; Wasserman, 2012). Aligning the interests of managers with those of the owners is essential for mitigating agency problems and ensuring that the firm's objectives are effectively pursued (Jensen & Meckling, 1976; Jensen, 1986; Gompers & Lerner, 2004).

Entrepreneurship manifests in various forms across different contexts (Hisrich & Peters, 2002). Small business entrepreneurship involves owner-managed businesses focused on serving local markets (Hisrich & Peters, 2002). High-tech and innovative start-ups represent entrepreneurship at the cutting edge of technology and innovation, and often seek rapid growth and scalability (OECD, 2010; Coad et al., 2014). Social entrepreneurship focuses on addressing social issues and creating social value, blending economic and social objectives (Mair & Marti, 2006). Corporate entrepreneurship, or intrapreneurship, involves entrepreneurial activities in established companies, and fostering innovation and competitiveness (Antoncic & Hisrich, 2001).

In the modern economy, entrepreneurship contributes significantly to innovation, employment, and economic growth (Acs & Audretsch, 1988; Audretsch, 2007; Van Praag & Versloot, 2007). Entrepreneurs drive technological advancements, introduce new products and services, and stimulate competition (Acs & Audretsch, 1988). In Sweden, the entrepreneurial culture is bolstered by supportive government policies, access to venture capital, and a collaborative ecosystem that includes incubators, accelerators, and networks (Isenberg, 2010; Balawi & Ayoub, 2022; Samuelsson & Jutterström, 2023). The individual characteristics of Swedish entrepreneurs, such as technical skills (76.9%), business skills (69.4%), and management skills (66.8%), play a significant role in the creation and growth of start-ups (Bosma & Kelley, 2018).

Emerging trends such as digitalisation, globalisation, and sustainability are reshaping the entrepreneurial landscape. Technological advancements create new opportunities for innovation and market disruption, while globalisation expands market access and competition (Nambisan, 2017). The prospect of sustainable and inclusive entrepreneurship opens avenues for addressing global challenges like climate change and inequality through entrepreneurial solutions (Hall, Daneke & Lenox, 2010). Technology's impact leading to the creation of new entrepreneurial opportunities is particularly significant, as it lowers barriers to entry and enables scalable business models.

Understanding entrepreneurship's multifaceted nature is crucial for analysing start-up performance and the impact of leverage. The challenges faced by entrepreneurs, including resource constraints and agency issues, can influence strategic decisions related to capital structure and financing. Recognising these factors is a foundation for exploring how leverage affects start-up firms in the context of the Swedish economy.

High-growth firms

High-growth firms (HGF), often known as gazelles, are start-ups distinguished by their rapid expansion and substantial contributions to job creation and economic development (Delmar, Davidsson & Gartner, 2001). Although they represent a small fraction of the total number of businesses, HGF drive a disproportionate share of economic growth, and frequently outpace other firms in terms of revenue generation and employment opportunities (Acs, Parsons & Tracy, 2008). Their significance in entrepreneurship and the broader economy is profound, as they epitomise the pinnacle of entrepreneurial success and innovation.

HGF are characterised by exceptional growth metrics, typically evidenced by significant increases in revenues and employment over a short period. Unlike conventional start-ups, gazelles have a unique ability to rapidly scale operations and expand their market reach. This growth often occurs in waves, and is influenced by industry trends and market demands. These firms predominantly emerge in industries marked by high innovation and growth potential, such as the technology and biotechnology sectors (Henrekson & Johansson, 2010).

The understanding of HGF is grounded in several theoretical frameworks. As previously discussed, Schumpeter's (1934) theory of economic development emphasises the concept of creative destruction, where entrepreneurial activities drive economic advancement through innovation and the displacement of established market players (Schumpeter, 1934). Schumpeter posited that entrepreneurs are agents of change, and introduce new combinations of resources that disrupt existing market structures and propel economic growth.

David Birch's (1979) seminal work further highlighted the impact of gazelles, and revealed their outsized role in job creation compared to larger established firms. Birch (1979) found that a small number of rapidly growing firms were responsible for a significant portion of new jobs, so underscoring the importance of HGF in economic development. The innovation-centric growth model of HGF aligns with the broader concept that technological advancement is a crucial driver of economic progress.

Several factors contribute to the rapid growth of gazelles. Visionary leadership and entrepreneurial capabilities of founders play a central role, and steer these firms through the challenges and opportunities of rapid expansion. Leaders of HGF often have a strong strategic vision and the ability to adapt swiftly to changing market conditions (Barringer, Jones & Neubaum, 2005).

Access to capital is critical for fuelling their growth trajectories. Venture capital, angel investments and, in some cases, public market financing provide the necessary financial resources for scaling operations (Davila, Foster & Gupta, 2003). Market conditions, in particular high demand innovative sectors, facilitate the rapid scaling of HGF. The globalisation of markets expands opportunities for growth beyond domestic boundaries, so allowing gazelles to tap into larger customer bases.

Organisational agility and the ability to swiftly adapt to market changes are key differentiators from more traditional firms (Coad et al., 2014). HGF often have flexible organisational structures that enable rapid decision-making and innovation. Technological innovation is also a significant driver, as these firms leverage cutting-edge technologies to disrupt existing markets and create new ones, so sustaining their competitive advantage.

Despite their successes, HGF face significant challenges. Managing rapid expansion can strain internal resources and necessitate a constant recalibration of strategies. Issues such as scaling operations, maintaining quality, and managing a growing workforce can be daunting (Greiner, 1998). Sustaining innovation and maintaining a competitive edge in fast-evolving industries is a continual struggle, and requires ongoing investment in R&D.

Financial and operational risks are pronounced in HGF. Rapid growth can lead to cash flow challenges, and strategic investment decisions carry higher stakes owing to the scale and speed of operations (Brush, Greene &

Hart, 2001). Human resource management becomes increasingly complex as the firm grows, with challenges in recruiting, training, and retaining talent. Preserving a cohesive organisational culture amid growth is essential – yet challenging (Brush, Greene & Hart, 2001).

Regulatory compliance and navigating complex legal environments can pose significant hurdles. HGF operating in multiple jurisdictions must contend with varying regulations, which can affect operations and profitability (Autio, Sapienza & Almeida, 2000). The liability of newness and smallness also exposes these firms to greater risks of failure because of limited resources and established networks (Stinchcombe, 1965).

The impact of HGF on the economy and society extends beyond their individual success. Their contribution to job creation is substantial, and often accounts for a significant proportion of new employment opportunities in an economy (Henrekson & Johansson, 2010). HGF are at the forefront of technological advancements and drive industry disruption and innovation. By introducing new products, services, and business models, they stimulate competition and efficiency in markets.

Many HGF contribute to social and environmental progress through their innovative products and services, so aligning economic success with societal benefits. For instance, firms focusing on renewable energy, biotechnology, or healthcare innovations address critical global challenges while achieving commercial success (Coad et al., 2014). This dual impact enhances the societal value of HGF beyond mere economic metrics.

Examining successful gazelles provides valuable insights into their growth strategies and challenges (Henrekson & Johansson, 2010; Coad et al., 2014). Tesla, Inc., in the automotive industry, has revolutionised the electric vehicle market through technological innovation and a strong strategic vision under the leadership of Elon Musk (Vance, 2015; Rimmer, 2018). Tesla's focus on sustainable technology and disruption of traditional automotive technologies and business models exemplifies the characteristics of an HGF (Vance, 2015; Demir, Wennberg & McKelvie, 2017).

The future of HGF is likely to be shaped by emerging trends in global entrepreneurship, including digital transformation and globalisation (OECD, 2017). The increasing interconnectivity of markets and the pervasive influence of digital technologies are creating new opportunities for gazelles to scale rapidly and access global customer bases (Zahra & Nambisan, 2012; Nambisan, 2017). The rise of platform-based business models and the sharing economy illustrates how digital technologies enable new forms of high-growth entrepreneurship (Chesbrough, 2003; Botsman & Rogers, 2010; Edelman & Geradin, 2016).

Policy implications are significant, as governmental support mechanisms and regulatory frameworks play crucial roles in nurturing and sustaining HGF (Henrekson, Johansson & Stenkula, 2010; Isenberg, 2010; OECD, 2010; Mason & Brown, 2013). Policies that facilitate access to capital, protect intellectual property, and promote innovation ecosystems are vital (Hanel, 2006; Lerner, 2010; Mason & Brown, 2013). Moreover, incorporating Environmental, Social, and Governance (ESG) criteria into business strategies is gaining significance, with HGF

frequently at the forefront of sustainable and inclusive growth efforts (Hall, Daneke & Lenox, 2010; Zahra & Nambisan, 2012; OECD, 2018a).

HGF represent a dynamic and critical component of the entrepreneurial ecosystem. Their ability to generate significant economic and social value through rapid growth, innovation, and job creation positions them as key drivers in the global economy. Understanding the dynamics of these firms – from their unique characteristics and growth factors to the challenges they face and their broader impacts – is essential for comprehending and fostering entrepreneurial success. Future research in this area will continue to explore the evolving landscape of high-growth entrepreneurship, and offer insights into how these firms can be supported and sustained in an ever-changing economic environment.

Start-ups and the economy

Start-ups play a critical role in enhancing the competitiveness of an economy by increasing productivity, efficiency, and the quality of economic activities (Acs & Audretsch, 1988; Audretsch, 1995). They stimulate market competition and drive structural change by introducing new technologies and processes that reduce costs, increase output, and improve quality (Acs & Audretsch, 1988). By allocating resources to more productive and profitable uses and by exploiting new market opportunities and niches, start-ups enhance economic efficiency (Audretsch & Thurik, 2000). They also offer products and services that meet the evolving needs and preferences of customers and society, and often address social and environmental challenges. According to the Global Competitiveness Report (Schwab et al., 2018), Sweden ranks highly in indicators such as business dynamism, innovation capability, and market size, therefore reflecting the significant contribution of start-ups to its economy.

The relationship between start-ups and the macroeconomy is bidirectional: while start-ups contribute significantly to economic dynamics, they are also profoundly influenced by the overarching macroeconomic environment. Start-ups are pivotal in driving innovation and technological advancement, and often introduce groundbreaking products and services that encourage a culture of innovation that acts as a forcing function to drive innovation forward in industries (Schumpeter, 1934). This innovative capacity is not confined to the technology sector; start-ups across various industries contribute significantly to modernising and diversifying economies.

Moreover, start-ups are crucial for job creation. Despite their size, they contribute a disproportionate number of new jobs compared to established firms (Birch, 1979). The employment they generate often requires new skill sets, which contributes to the evolution of the labour market. Start-ups also add to GDP growth, not only through their direct business activities, but also by stimulating ancillary services and industries.

Broader economic conditions also play a crucial role in the success and failure of start-ups. Economic growth and business cycles influence start-up activity levels; during economic expansions, higher consumer spending, increased business confidence, and easier access to capital encourage entrepreneurial ventures. Conversely, recessions can dampen entrepreneurial activity owing to reduced demand and financial constraints (Klapper et al., 2007). Monetary and fiscal policies also significantly affect start-ups. Interest rate adjustments and inflation

influence the cost of capital and the purchasing power of consumers, which in turn affect start-up revenues and profitability. Government policies, including tax incentives and grants, can encourage or stifle start-up growth.

Market dynamics, including barriers to entry and competitive pressures, shape the start-up landscape. New firms often face significant challenges when entering markets dominated by established players. However, their agility and innovation can disrupt these markets, so forcing traditional firms to adapt (Porter, 1980). Consumer demand and market conditions play crucial roles in determining start-up success or failure. Start-ups that can identify and meet emerging consumer needs are more likely to succeed.

Start-ups often lead in disrupting traditional industries by introducing new business models and technologies. This disruption can lead to the creation of entirely new markets and niches, so contributing to economic resilience and diversification. The role of start-ups in economic resilience becomes particularly evident during economic downturns, where their innovative approaches can lead to new growth areas (Audretsch & Thurik, 2000). By fostering adaptability and innovation, start-ups enhance an economy's capacity to recover from shocks.

Government policies and the regulatory framework significantly influence the start-up ecosystem. Policies that encourage entrepreneurship, such as tax benefits, subsidies, and supportive regulations, can enhance the start-up environment. Conversely, overly restrictive regulations can impede start-up formation and growth. A supportive infrastructure, including legal and financial systems that facilitate business operations, is essential for a thriving start-up ecosystem.

Navigating economic uncertainties is a significant challenge for start-ups. Managing financial and operational risks in a fluctuating economic landscape requires agility and adaptability. Start-ups must stay abreast of technological and market shifts in order to remain competitive and sustainable in the long term. The ability to pivot business models and strategies in response to changing conditions is crucial for survival and success.

In conclusion, start-ups play an important role in the economy by creating jobs, contributing to GDP growth, and driving innovation. The reciprocal relationship between start-ups and the macroeconomy is complex and multifaceted. As the global economy continues to evolve, so will the dynamics of start-ups. Understanding these interactions is crucial for policymakers, investors, and entrepreneurs in order to foster a conducive environment for the growth and sustainability of start-ups. Future research will undoubtedly continue to explore the nuanced interplay between start-ups and the macroeconomic environment.

2.1.4. Economic and social outcomes of start-up performance

Start-ups play a pivotal role in shaping modern economies, and contribute significantly to economic growth and societal transformation. Their influence extends beyond mere business ventures, and effects employment patterns, innovation trajectories, and cultural norms (Audretsch & Thurik, 2000). This section examines the multifaceted economic and societal impacts of start-ups, and draws on empirical studies and theoretical frameworks to elucidate the contributions and challenges of start-ups.

Economic outcomes of start-ups

The economic outcomes of start-ups are most prominently observed in their capacity for job creation and employment. Start-ups are vital engines of employment growth, in particular in economies experiencing structural shifts or technological advancements. Haltiwanger, Jarmin & Miranda (2013) highlight that a disproportionate share of net job creation in the United States is attributable to young firms, and emphasise the role of start-ups in driving employment dynamics. The jobs created by start-ups often encompass a range of skill levels and can stimulate local economies through increased consumption and investment.

However, the employment contributions of start-ups are characterised by volatility. High failure rates and the fluid nature of start-up operations result in significant job turnover (Acs & Armington, 2004). While start-ups generate new employment opportunities, they also contribute to job destruction when they fail or downsize. The net employment effect of start-ups is positive but questions remain regarding the stability and quality of jobs provided.

Innovation and technological advancement are another critical economic outcome of start-ups. Start-ups are instrumental in introducing disruptive technologies and business models that challenge incumbent firms and redefine industries. Audretsch (1995) asserted that small firms, including start-ups, are more likely to engage in radical innovation owing to their flexibility and willingness to take risks. These innovations not only drive technological progress but also lead to the creation of new markets and value propositions.

The spillover effects of start-up innovation extend to other firms and sectors. Through knowledge diffusion and collaboration, start-ups contribute to the broader innovation ecosystem (Zahra & Nambisan, 2012). Their activities stimulate competitive responses from established firms, and foster an environment of continual improvement and adaptation. This dynamic enhances overall industry productivity and efficiency, so reinforcing the competitiveness of the economy on a global scale.

Start-ups also make tangible contributions to GDP and economic growth. By introducing new products and services, they expand consumer choices and stimulate demand. The multiplier effect of start-up activities amplifies their economic impact, as increased employment and innovation lead to higher levels of income and investment (Van Praag & Versloot, 2007). Regional and local economies particularly benefit from start-up activity, with successful start-up ecosystems like Silicon Valley showing how clusters of innovation can drive substantial economic development (Saxenian, 1994).

Societal impacts of start-ups

From a societal perspective, start-ups influence social outcomes through social entrepreneurship and the pursuit of social impact. Many start-ups are founded to address societal challenges such as poverty, healthcare disparities, and environmental degradation (Mair & Marti, 2006). These enterprises prioritise social objectives alongside or even above profitability, and seek to create sustainable solutions to pressing issues. Measuring the social impact of

such start-ups remains complex, but their contributions to societal well-being are increasingly recognised and valued.

Start-ups also engender cultural and behavioural changes by promoting an entrepreneurial mindset and altering consumer behaviours. The proliferation of start-ups has elevated entrepreneurship as a desirable career path, and fostered a culture that values innovation, resilience, and risk-taking (Aldrich & Martinez, 2001). This cultural shift encourages individuals to pursue entrepreneurial endeavours, and contribute to a more dynamic and adaptable economy.

Innovations introduced by start-ups frequently lead to changes in consumer behaviour and lifestyles. The emergence of the sharing economy driven by start-ups like Airbnb and Uber has transformed how people access services and use resources (Botsman & Rogers, 2010). These changes have broader societal implications, including more efficient resource use and shifts in social norms on ownership and consumption.

Technological accessibility and inclusion are further societal outcomes influenced by start-ups. By democratising technology, start-ups make advanced tools and services available to wider populations, including underserved communities (Avgerou, 2011). Initiatives aimed at bridging the digital divide enhance societal inclusion and empower individuals through access to information and opportunities. Start-ups also increasingly emphasise diversity and inclusion in their teams and leadership, and recognise the value of varied perspectives in driving innovation and addressing diverse market needs (Hunt, Layton & Prince, 2015).

Challenges impacting start-ups' societal and economic contributions

Despite these positive impacts, start-ups face challenges and critiques that have tempered their contributions. High failure rates among start-ups result in economic costs for investors, employees, and creditors (Shane, 2009). The resources allocated to unsuccessful ventures are opportunity costs that could have been invested elsewhere. Moreover, the concentration of start-up success in certain regions and among particular demographics raises concerns about inequality and access to opportunities (Fairlie & Robb, 2008). Barriers to entry for under-represented groups, including lack of access to capital and networks, limit the inclusivity of the start-up ecosystem.

Regulatory and ethical considerations are also challenges for start-ups. Disruptive business models often conflict with existing regulatory frameworks, so leading to tensions between innovation and compliance (Edelman & Geradin, 2016). Start-ups must navigate complex legal landscapes while maintaining ethical standards related to data privacy, labour practices, and societal impact. The need for responsible innovation underscores the importance of aligning entrepreneurial activities with broader societal values and norms.

The effects of policy on the outcomes of start-ups

Case studies of start-ups with significant economic and societal impacts illustrate these dynamics. Companies such as Tesla which have increased the rate of adoption of sustainable energy solutions through their disruption of the automotive sector (Rimmer, 2018). Social enterprises such as Warby Parker have combined profitability with social missions, and provided affordable eyewear while contributing to vision-care initiatives globally (Joy, 2016).

These examples highlight the potential for start-ups to achieve both economic success and positive societal outcomes.

The role of government policies and support mechanisms is crucial in enhancing the positive impacts of start-ups, while mitigating challenges. Policies that foster start-up ecosystems, including funding programmes, tax incentives, and infrastructure development, can stimulate entrepreneurial activity (Lerner, 2010). Education and training programmes that promote entrepreneurship equip individuals with the skills and knowledge necessary to launch and sustain successful ventures (Rideout, 2013). Balancing regulatory oversight with flexibility allows start-ups to innovate responsibly within acceptable societal parameters.

In conclusion, start-ups significantly influence economic growth and societal change through job creation, innovation, and cultural transformation. While they offer substantial benefits, the challenges associated with high failure rates, inequality, and regulatory complexities necessitate a balanced approach. Supporting start-ups through conducive policies and responsible practices can maximise their positive outcomes, so contributing to a dynamic and inclusive economy that adapts to emerging needs and opportunities.

2.2. Firm performance determinants and measures

2.2.1. Firm performance and measures

In all for-profit firms the firm must at minimum deliver returns to shareholders above their cost of capital. This can be done through profit distributions – dividends – or through the accretion of the value of the firm and thereby the value of each shareholder's stake in the firm. Therefore, to ensure the performance of shareholders' capital, there is a crude benchmark for firm performance. However, there are many compelling reasons to measure firm performance including to allow managers to evaluate the success and sustainability of the firm, enhance decision-making, attract investment, and benchmark the firm against industry peers. In this section, I explore firm performance and how it is measured, various metrics commonly used in academic literature to measure firm performance, and the advantages and disadvantages associated with each metric.

In the dynamic landscape of entrepreneurship, informed decision-making is paramount. Performance metrics provide essential insights for entrepreneurs and start-up founders. As Barringer, Jones and Neubaum (2005) underscored, such metrics enable entrepreneurs to identify areas that require improvement, adapt their strategies in response to performance data, and effectively allocate resources. These metrics are a compass guiding decision-makers through the complexities of the entrepreneurial journey, with pros and cons associated with each (as illustrated in Table 2).

Securing external funding is often vital for the growth and survival of entrepreneurial ventures. Mason and Brown (2013) highlighted the role of performance measures in attracting investors and stakeholders. Metrics like revenue growth and profitability ratios are powerful indicators of an enterprise's potential returns, thereby making it more

appealing to investors seeking opportunities in the start-up ecosystem. Performance metrics are a persuasive tool for securing financial support.

Entrepreneurs must not only assess their immediate successes but also contemplate the sustainability of their ventures. Wiklund and Shepherd (2003) emphasised that performance metrics offer a means to monitor progress towards long-term objectives. Consistent evaluation of performance helps founders discern whether their business models are viable and whether they will achieve their strategic goals. Sustainability hinges on the ability to sustain and build on early successes.

Entrepreneurs operate in competitive environments, and benchmarking against industry peers is instrumental for gaining a competitive edge. As Porter (1985) emphasised, competitive analysis and benchmarking are crucial for effective strategy formulation. Performance measures provide the foundation for comparing a firm's performance with competitors, so allowing entrepreneurs to identify their relative strengths and weaknesses in the market. This competitive intelligence can guide strategic decisions and foster innovation.

Revenue growth, a fundamental metric for assessing firm performance, quantifies the percentage increase in a company's total revenue over a specified period. Its calculation involves comparing the current revenue to the previous revenue and expressing the change as a percentage. This metric is particularly valuable because it reflects market demand and scalability (Delmar, Davidsson & Gartner, 2001). High revenue growth signals strong demand for the firm's products or services, indicating market traction. Moreover, rapid revenue growth can attract investors and stakeholders, drawing them into the start-up's growth story (Mason & Brown, 2013). However, it is essential to recognise that revenue growth, while promising, may not necessarily indicate profitability, and it can be susceptible to short-term fluctuations (Gompers, 1997).

Net profit margin, another critical measure, evaluates a firm's profitability by expressing net profit as a percentage of total revenue. Calculated as net profit divided by total revenue, this metric provides valuable insights into a company's efficiency in cost management and its capacity to generate profit from its revenue (Penman, 2013). A high net profit margin suggests not only profitability but also effective cost control mechanisms (Hansen & Mowen, 2007) Nevertheless, it is essential to acknowledge that a sole focus on short-term profitability through this metric may neglect long-term investments and sustainability (Bhide, 1992). Net profit margin can also be influenced by accounting practices, which may affect the accuracy of the measurement (Healy & Wahlen, 1999).

The operating income ratio is designed to measure the proportion of a firm's operating income (income generated from core business activities) in relation to its total revenue. It offers insights into a firm's ability to generate profit from its primary operational activities (Penman, 2013). By focusing on core operations, this metric reduces the influence of non-core activities, such as investments or one-time gains (Penman, 2013).

Employee growth, often used to assess a firm's scalability and human capital management, measures the percentage change in a company's workforce size over a specific period. A growing workforce can signify an organisation's ability to scale and manage its human resources effectively (Storey, 2016). It also reflects the

engagement and productivity of the workforce, as a rising number of employees may indicate a productive and engaged workforce (Huselid, 1995). However, crucially, employee growth, in isolation, may not directly correlate with profitability. A firm can expand its workforce without a corresponding increase in revenue or profitability, and excessive hiring can strain resources(Delmar & Shane, 2006). Therefore, the context in which employee growth occurs is essential to its interpretation.

Return on Equity (ROE) measures a firm's profit generated as a proportion of shareholders' equity. This makes it a key metric for assessing financial performance. It is calculated by dividing net profit by shareholders' equity and then expressing the result as a percentage (Hansen & Mowen, 2007; Penman, 2013). ROE offers a direct measure of how efficiently a firm generates profit concerning the equity invested by shareholders. It incorporates both profitability (net profit) and equity utilisation, making it a comprehensive performance metric (Penman, 2013). However, ROE may not adequately account for the associated risk of the investment, so potentially leading to misleading conclusions (Hansen & Mowen, 2007; Penman, 2013). It can also be susceptible to manipulation through leverage, as high financial leverage can artificially boost ROE without a corresponding increase in operational performance (Penman, 2013).

Return on assets (ROA) assesses how efficiently a firm uses its total assets to generate profit. It is calculated by dividing net profit by total assets and expressing the result as a percentage. ROA provides insight into a firm's overall asset use and efficiency, so reflecting profitability concerning the assets employed (Penman, 2013; Holland & Matthews, 2017). It is particularly useful in evaluating the efficiency of asset management, as a higher ROA indicates better asset utilisation. Nonetheless, it does not account for capital structure and financing choices, which can significantly affect a firm's performance. Moreover, ROA may not consider industry-specific nuances, therefore making it less suitable for comparing firms across different sectors (Penman, 2013).

Measuring firm performance in entrepreneurship and start-ups is a critical endeavour that offers valuable insights for decision-making, attracting investors, assessing sustainability, and benchmarking against competitors. The selection of performance metrics, such as revenue growth, net profit margin, operating income ratio, employee growth, ROE, and ROA, depends on the specific goals and context of the analysis. Each metric has its own advantages and limitations, and researchers must consider these factors when evaluating firm performance.

Related to this is the recognition that the utility of different performance measures varies considerably across a start-up's lifecycle. In the early stages, metrics such as revenue growth and employee expansion serve as key indicators of market traction and the potential for rapid scaling (Delmar & Shane, 2006; Coad, Frankish & Storey, 2020). It is also important to note that certain start-ups, particularly those in sectors requiring extensive research and development—such as biotechnology, pharmaceuticals, or deep technology—may remain pre-revenue for prolonged periods due to lengthy development cycles and stringent regulatory demands (Penman, 2013; Coad, Frankish & Storey, 2020). As the firm matures and begins to generate revenue, financial ratios including ROE, ROA, and the operating income ratio become increasingly relevant, offering insight into operational efficiency and capital utilisation (Penman, 2013). This evolution in performance measurement aligns with earlier discussions

regarding the advantages and limitations inherent in each metric. Consequently, selecting appropriate performance indicators should account for the firm's developmental stage as well as its strategic objectives, ensuring that the chosen measures support sound decision-making and long-term sustainability.

In conclusion, the measurement of firm performance in entrepreneurship and start-ups is a complex and dynamic field of study. As researchers continue to study this area, they contribute to a deeper understanding of the factors that drive success and sustainability in the entrepreneurial ecosystem, so ultimately helping entrepreneurs, investors, and policymakers to make informed decisions and foster innovation and growth in this vital sector of the economy.

Table 2: Summary of the pros and cons of various firm performance measures

Metric	Pros	Cons
Revenue growth	Direct measure of market acceptance and growth	May not reflect profitability or cash flow
Net profit margin	Indicates efficiency and profitability	Can be influenced by non-operational factors
Operating income ratio	Measures the operational efficiency of a firm	Dependent on the scaling factor, which could bias results
Survival rate	Reflects the ultimate sustainability of a start-up	Survival indicates existence, and is not a precise metric of performance
Return on Equity (ROE)	Reflects shareholders' return	Affected by leverage and accounting practices
Employee turnover rate	Indicator of organisational health	May not directly reflect performance
Market share	Indicates competitive position	May overlook profitability and efficiency

2.2.2. Determinants of start-up firm performance

Understanding why some start-ups thrive while others fail is a critical question in entrepreneurship research. The contrasting trajectories of companies like Facebook and MySpace illustrate how outcomes can differ drastically

among firms that initially appear similar in terms of resources and market opportunities. In 2007, MySpace reached its peak with 300 million registered users (Garrahan, 2007) but soon began to decline. By 2008, Facebook overtook MySpace in monthly users, and Facebook (now Meta Platforms) grew to become one of the world's largest companies by market capitalisation, while MySpace effectively became defunct, and underwent several acquisitions and maintained only a fraction of its former user base. This stark contrast prompts an examination of the determinants that influence start-up performance (Arrington, 2008).

Firm performance can be measured through various qualitative and quantitative metrics. For this review, the focus is on empirical studies that assess the impact of different factors on the financial performance of start-ups. Both endogenous factors, which are internal to the firm, and exogenous factors, which stem from the external environment, play pivotal roles in shaping start-up outcomes.

Endogenous factors

Among endogenous factors, the skills and characteristics of the founders are paramount. Founders' prior experience, education, and networks significantly influence firm performance. Wasserman (2012) emphasised that founders with industry-specific knowledge and managerial expertise are better equipped to navigate the challenges of early-stage ventures. Ucbasaran et al. (2010) found that prior entrepreneurial experience enhances opportunity recognition and resource mobilisation, so leading to improved performance outcomes.

Strategic decision-making is another critical endogenous determinant. The strategies adopted by start-ups for market positioning, product development, and competitive tactics can significantly affect their growth trajectories. Covin &Slevin (1989) argued that an entrepreneurial strategic orientation, characterised by proactiveness, innovativeness, and risk-taking, is associated with higher performance in dynamic markets. This is supported by Barbero, Casillas and Feldman (2011), who found that strategic planning and clear growth objectives contribute to the success of small and medium-sized enterprises (SMEs).

Human capital in the firm also plays a crucial role. The collective skills, knowledge, and abilities of the firm's employees can enhance innovation and operational efficiency. Becker's (1964) human capital theory posits that investments in employee training and development can lead to higher productivity and firm performance. Coff (2000) highlighted that firms with valuable and unique human capital resources can achieve sustained competitive advantage. The ability to attract and retain talented individuals is particularly important for start-ups, which often rely on specialised skills to innovate and compete against established firms.

Capital structure and access to financial resources are essential endogenous factors affecting start-up performance. Myers and Majluf's (1981) pecking order theory posits that firms prefer internal financing but will seek external funds when necessary. Start-ups often face constraints in accessing capital, making financing decisions critical. Demir, Wennberg and McKelvie (2017) suggested that suboptimal financing can limit a firm's capacity for growth and innovation. Anton (2019) found that high leverage can negatively affect the growth of fast-growing firms,

therefore indicating the importance of managing debt levels to avoid financial distress and to maintain operational flexibility.

Profitability is a fundamental measure of firm performance, and yet its relationship with growth is complex. Davidsson, Steffens and Fitzsimmons (2009) explored the "growth-profitability nexus", and suggested that firms may need to prioritise growth over immediate profitability to achieve long-term success. This perspective aligns with the notion that initial investments and market share acquisition can lead to future profitability. However, some scholars argue that growth may not always be beneficial. Steffens, Davidsson and Fitzsimmons (2009) noted that rapid growth can strain resources and may not translate into improved financial performance if not managed effectively.

Growth itself is often viewed as an indicator and determinant of performance. Penrose's (1959) theory of the growth of the firm posits that managerial capabilities and resource use limit growth. The capacity of management to plan effectively and implement growth strategies is crucial. Steffens et al. (2009) argued that high growth does not always equate with improve

d performance and may not be universally beneficial. Conversely, Siepel, Cowling, and Coad (2017) advocated higher growth levels as drivers of long-term firm performance, in particular in high-tech ventures. The debate suggests that the relationship between growth and performance depends on factors such as industry characteristics and firm-specific strategies.

Exogenous factors

Exogenous factors also significantly influence start-up performance. Macroeconomic conditions, such as economic growth rates and market stability, affect entrepreneurial activity. Klapper, Amit, and Guillén (2007) found that favourable economic environments encourage start-up formation and growth, while recessions can hinder entrepreneurial ventures owing to reduced demand and financial constraints. Lee, Sameen, and Cowling (2015) highlighted that access to finance for innovative SMEs is particularly sensitive to macroeconomic fluctuations, so affecting their ability to invest in R&D.

Regulatory factors, including government policies and legal frameworks, shape the business environment for start-ups. Djankov et al. (2002) highlighted that complex regulations and bureaucratic hurdles can impede business entry and survival. Simplifying regulatory procedures and reducing administrative burdens can enhance the ease of doing business, so promoting start-up performance. The World Bank's "Doing Business" reports (2014) indicated that countries with more business-friendly regulations have higher levels of entrepreneurial activity and start-up success.

Start-up support ecosystems, including incubators, accelerators, and mentorship programmes, provide resources and networks that are essential for start-up success. Samuelsson and Jutterström (2023) demonstrated that participation in accelerator programmes can improve start-up performance by offering access to funding,

expertise, and markets. Such support can mitigate some of the challenges associated with the liability of newness, where start-ups lack established relationships and credibility in the market (Stinchcombe, 1965).

Interest rates and monetary policy influence the cost of capital and access to financing for start-ups. High interest rates can increase borrowing costs, so making it more difficult for start-ups to finance operations and investments. Kashyap, Stein, and Wilcox (1993) discussed how tight monetary conditions can constrain credit availability, so affecting start-up growth. Carpenter and Petersen (2002) noted that financial constraints can limit the growth potential of small firms, and emphasised the importance of favourable credit conditions for entrepreneurial ventures.

Market size and characteristics are critical exogenous factors. Porter's (1980) work considering the strategic implications of industry structure and competitive forces indicated that market attractiveness and competitive intensity influence firm strategies and performance. Start-ups entering large and growing markets with unmet customer needs have greater opportunities for success. Understanding consumer behaviour and market trends is essential for developing products and services that resonate with target audiences (Kotler & Keller, 2012).

The ease of doing business, as measured by factors such as property rights enforcement, contract enforcement, and corruption levels, affects start-up performance. The World Bank's reports (2014) showed that countries with favourable business environments tend to have higher levels of entrepreneurial activity and better start-up performance. Regulatory transparency and efficiency reduce the costs and risks associated with starting and operating a business, thereby encouraging entrepreneurship (Djankov et al., 2002).

Discussion and conclusion

In examining the determinants of start-up firm performance, it is essential to consider the interplay between endogenous and exogenous factors. Founders and managers must focus on developing strategic capabilities, building effective teams, and making sound financial decisions. At the same time, they must also navigate external challenges, such as economic fluctuations, regulatory environments, and market conditions. The divergent paths of Facebook and MySpace can be partially attributed to these determinants (Garrahan, 2007; Arrington, 2008; Gehl, 2012). Facebook's strategic decisions on platform development, user engagement, and scalability, coupled with effective leadership and access to capital, enabled it to outperform MySpace. MySpace faced challenges related to strategic missteps, an inability to innovate effectively, and external competitive pressures, so leading to its decline (Gehl, 2012).

Understanding the determinants of start-up performance has practical implications for various stakeholders. Entrepreneurs can leverage this knowledge to enhance their strategic planning and operational effectiveness. Investors can assess potential ventures more accurately by considering both internal capabilities and external conditions. Policymakers can design supportive environments that foster start-up growth by streamlining regulations and providing resources.

Because the aggregate economic loss of start-up failures can be significant (Coad, Frankish & Storey, 2020), improved understanding of these determinants is crucial. Increasing start-up success rates can contribute to economic growth, job creation, and innovation. Future research should continue to explore how these factors interact in different contexts, industries, and geographies. Longitudinal studies and cross-country analyses can provide deeper insights into the dynamic nature of start-up performance determinants.

In conclusion, start-up firm performance is influenced by a complex array of endogenous and exogenous factors. The skills and decisions of founders, the strategic orientation of the firm, human capital, and financial management are all critical internal determinants. External factors such as economic conditions, regulatory environments, market characteristics, and support ecosystems also play significant roles. A holistic approach that considers both sets of factors provides a more comprehensive understanding of what drives start-up success and failure. Recognising and addressing these determinants can enhance the likelihood of start-up success, benefiting entrepreneurs, investors, and the broader economy.

2.3. Capital structure and leverage

Taking on leverage is fundamentally a capital structure decision, one that reflects the choices made by shareholders and management regarding the mix of debt and equity financing. For start-ups, where resource constraints and volatile cash flows are common, these decisions are particularly critical. Understanding the theoretical underpinnings of capital structure is essential because it illuminates why managers opt for one form of capitalisation over another, thereby shaping the firm's ability to grow, innovate, and withstand market fluctuations (Fischer, Heinkel & Zechner, 1989; Hovakimian, Opler & Titman, 2001; O'Brien, 2003; Robb & Robinson, 2014).

This section draws on established frameworks—including the Modigliani-Miller, trade-off, pecking order, agency, and signalling theories—to explore the trade-offs inherent in leveraging debt, and to provide insight into how these decisions impact overall firm performance. By examining capital structure theory in this context, the analysis builds on the discussions in earlier sections and sets the stage for a deeper empirical investigation into how different financing choices influence the sustainability and competitive positioning of start-ups.

2.3.1. Capital structure theory

Capital structure and leverage are foundational concepts in understanding firm performance and sustainability, especially in the context of start-ups operating in high-risk environments. Capital structure refers to the mix of debt and equity financing that firms use to fund their operations and growth, while leverage describes the use of borrowed capital to amplify potential returns. These financial decisions are critical in shaping a firm's strategic flexibility, cost of capital and, ultimately, its performance outcomes. For start-ups, capital structure and leverage decisions are particularly challenging given limited operating histories, greater market volatility, and constrained access to traditional sources of finance. Understanding these concepts sets a necessary theoretical base for examining start-up performance.

Theoretical perspectives on capital structure have evolved to address both idealised scenarios and the complexities introduced by real-world conditions. A seminal framework is the Modigliani-Miller Theorem (1958), which suggests that in a perfect market without taxes, bankruptcy costs, or information asymmetry, a firm's value is unaffected by its financing choices. However, this theorem's assumptions seldom hold in practice, particularly for start-ups where information asymmetry and market imperfections are pronounced. Consequently, more nuanced theories have been developed to account for these variables, and they offer critical insights into start-up financing choices.

The Trade-Off Theory, for instance, posits that firms will seek an optimal capital structure that optimizes the balance between 1) the tax benefits and, 2) risks of financial distress associated with debt (Kraus & Litzenberger, 1973a). For start-ups, this balance is often skewed owing to limited taxable income in early stages and higher perceived risk, so making extensive debt financing less attractive.

The Pecking Order Theory, on the other hand, emphasises that firms prioritise financing sources based on ease of access and information asymmetry (Myers & Majiuf, 1981). Firms prefer internal funds, then debt, and issue equity as a last resort. Start-ups, however, typically lack substantial internal funds and may struggle to secure debt because of insufficient collateral, so leading them to rely on external equity from venture capital or angel investors.

Agency Theory provides an additional perspective by examining conflicts of interest between various stakeholders, especially between debt holders and equity holders. High leverage can lead to risk-shifting behaviour, where equity holders favour riskier projects to the detriment of debt holders (Jensen & Meckling, 1976). In start-ups, where managers often hold significant ownership stakes, agency conflicts are less about owner–management dynamics and more about aligning investor and management interests – a theme that is revisited in Section 2.4.

Finally, Signalling Theory addresses how financing decisions convey information about a firm's quality. Issuing equity, for instance, may signal overvaluation, whereas obtaining debt can indicate confidence in future cash flows owing to fixed repayment obligations (Ross, 1977). However, start-ups often have limited access to debt markets, son complicating the signalling mechanism in comparison to established firms.

In the start-up context, access to capital and financing choices evolve as firms progress through different life-cycle stages. Initial reliance on personal savings and informal sources of finance may give way to formal venture capital or debt as the firm establishes creditworthiness. This progression aligns with the Life Cycle Theory, which frames capital structure as dynamic, and changing with a firm's growth and financial maturity (Berger & Udell, 1998). Start-ups' capital structure decisions are therefore shaped by unique challenges such as high uncertainty, a lack of collateral, and the critical importance of growth opportunities.

This high-level exploration emphasises why capital structure and leverage are foundational to the study of start-up performance. Later sections provide a more in-depth examination of these theories, their empirical implications, and their integration into the conceptual model, which informs the hypotheses and analyses in this study.

2.3.2. Capital structure of start-ups

Prevalence and patterns of debt financing in start-ups

Debt financing is a significant component of the capital structure for many start-ups, although its prevalence varies widely depending on factors such as industry, geographic location, and firm-specific characteristics. Understanding the patterns of debt usage among start-ups is essential for comprehending their financial strategies and the challenges they face in accessing external capital.

Empirical studies indicate that debt financing is a common funding source for start-ups, and often complements or even surpasses equity financing in certain contexts. Robb and Robinson (2014), analysing data from the Kauffman Firm Survey, found that debt accounts for a substantial portion of initial financing for new firms in the United States. Their research revealed that approximately 40% of start-up capital comes from debt sources, including bank loans, credit lines, and personal loans undertaken by the entrepreneurs themselves. This reliance on debt underscores its importance in the early stages of firm development.

The types of debt financing used by start-ups encompass formal and informal sources. Formal debt includes bank loans, government-backed loans, and credit facilities from financial institutions. However, due to the challenges associated with securing traditional bank financing, such as stringent collateral requirements and perceived high risk, start-ups often resort to informal debt sources. These may involve loans from family and friends, personal credit cards, and peer-to-peer lending platforms (Cassar, 2004). The advent of fintech solutions has also expanded access to alternative debt financing options, such as online lenders offering quicker approval processes with less emphasis on collateral (Mills & Mccarthy, 2014).

The industry sector significantly influences the prevalence of debt financing among start-ups. Capital-intensive industries, such as manufacturing and real estate, tend to exhibit higher levels of debt usage owing to the availability of tangible assets that can serve as collateral (Cassar & Holmes, 2003). In contrast, technology-based start-ups, which often have intangible assets and higher uncertainty, may find it more challenging to secure debt financing and therefore rely heavily on equity funding (Colombo & Grilli, 2007). This disparity reflects lenders' preferences for asset-backed securities and the difficulties in valuing intangible assets.

Geographical variations also play a role in debt financing patterns. Start-ups operating in countries with well-developed financial markets and supportive regulatory environments have greater access to debt financing. For instance, European start-ups benefit from government programmes and policies aimed at facilitating small business lending, so leading to higher use of debt compared to start-ups in regions with less developed financial infrastructure (Beck, Demirgüç-Kunt & Maksimovic, 2008). In emerging markets, limited access to formal debt channels often forces start-ups to rely on informal lending or microfinance institutions (Ayyagari, Demirgüç-Kunt & Maksimovic, 2010).

Temporal trends reveal that the prevalence of debt financing among start-ups is influenced by macroeconomic conditions. During periods of economic growth and low interest rates, lenders are more willing to extend credit,

and start-ups may find debt financing more accessible and affordable (Cowling, Liu & Zhang, 2016). Conversely, in times of economic downturn or financial crises lending standards tighten and access to debt financing becomes more constrained, so disproportionately affecting start-ups owing to their higher risk profiles (Lee, Sameen & Cowling, 2015).

Firm-specific characteristics further affect debt financing patterns. Start-ups with strong business plans, experienced management teams, and positive cash flow projections are more likely to secure debt financing (Coleman, 2004). Also, entrepreneurs with established credit histories and personal assets may leverage these to obtain loans, albeit often with personal guarantees (Ang, 1992). The stage of the start-up also matters; as firms mature and demonstrate viability, they may gain better access to debt markets and more favourable loan terms (Berger & Udell, 1998).

Despite the notable prevalence of debt financing, start-ups frequently encounter barriers that limit their ability to use debt effectively. Information asymmetry, lack of collateral, and high default risk contribute to credit rationing by lenders (Stiglitz & Weiss, 1981). Consequently, many start-ups remain under-leveraged relative to their optimal capital structure, which can potentially constrain their growth and operational capacity (Robb & Robinson, 2014). This under-use of debt underscores the need for policies and financial innovations that can enhance start-ups' access to debt capital.

In summary, debt financing is a prevalent and vital component of start-up financing, and is characterised by diverse patterns influenced by industry, geography, economic conditions, and firm-specific factors. Recognising these patterns is crucial for understanding the financial dynamics of start-ups and for developing strategies to improve their access to debt financing, thereby supporting their growth and contribution to the economy.

Theoretical perspectives on capital structure in start-ups

The capital structure of firms has long been a focus in corporate finance, with several theories attempting to explain how companies decide between debt and equity financing. For start-ups, these decisions are particularly critical because of their unique characteristics, such as high uncertainty, limited operational history, and constrained access to capital markets. Traditional capital structure theories provide a foundational framework for understanding these decisions, but their applicability to start-ups requires careful consideration.

The Modigliani-Miller Theorem (Modigliani & Miller, 1958) is the cornerstone of capital structure theory, positing that in a perfect market without taxes, bankruptcy costs, or information asymmetry, a firm's value is unaffected by its financing mix. However, the stringent assumptions underlying this theorem seldom hold in practice, especially for start-ups. The absence of taxes and transaction costs is unrealistic, and information asymmetry is particularly pronounced in start-ups given their lack of a track record (Stiglitz, 1969). Consequently, while the theorem provides a baseline, it offers limited practical guidance for start-ups' capital structure decisions.

Recognising market imperfections, the trade-off theory introduces the concept of balancing the tax benefits of debt against the costs of financial distress (Kraus & Litzenberger, 1973a). According to this theory, firms aim for

an optimal capital structure that minimises the weighted average cost of capital. For start-ups, the tax shield provided by debt is often less valuable owing to initial losses or minimal taxable income (Bradley, Jarrell & Kim, 1984a). Moreover, the high risk of financial distress and bankruptcy costs weigh more heavily on start-ups, making excessive debt less attractive (Warner, 1977). Therefore, while the trade-off theory acknowledges market imperfections, its practical application to start-ups is constrained by their unique risk profiles.

The pecking order theory offers an alternative perspective, and suggests that firms prioritise financing sources based on the principle of least effort or resistance (Myers & Majiuf, 1981). Firms prefer internal financing, then debt, and issue equity as a last resort owing to information asymmetry between managers and investors. Start-ups, however, typically lack substantial internal funds and may find it challenging to secure debt because of insufficient collateral and credit history (Berger & Udell, 1998). As a result, they may resort to equity financing earlier than established firms, often through venture capital or angel investors. The pecking order theory partially explains start-ups' financing behaviour but may not fully capture their reliance on external equity.

The Agency Theory addresses conflicts of interest between various stakeholders, in particular between owners and managers, and between debt holders and equity holders (Jensen & Meckling, 1976). In the context of start-ups, where owners and managers are often the same individuals, agency conflicts between owners and managers are less pronounced. However, conflicts between debt holders and equity holders can be significant. High leverage can lead to risk-shifting behaviour, where equity holders undertake risky projects to the detriment of debt holders (Jensen & Meckling, 1976). Start-ups may face restrictive covenants and increased monitoring from lenders to mitigate these agency costs, so influencing their capital structure decisions.

The signalling theory posits that a firm's financing decisions send signals to the market about its quality and prospects (Ross, 1977). For start-ups, issuing equity may signal overvaluation or desperation, while obtaining debt can signal confidence in future cash flows owing to the obligation of fixed repayments. However, the applicability of signalling theory is complicated by the fact that start-ups often have limited access to debt markets, and their signals may not be interpreted in the same way as those from established firms (Leland & Pyle, 1977). The high levels of uncertainty and information asymmetry in start-ups can also distort the signalling mechanism.

Furthermore, the Resource-Based View (RBV) from the strategic management literature emphasises the importance of firm-specific resources and capabilities in achieving competitive advantage (Barney, 1991). Financial resources, including capital structure, are considered critical for acquiring and developing other resources. For start-ups, securing adequate financing is essential for investing in innovation, marketing, and talent acquisition. The RBV suggests that start-ups need to strategically manage their capital structure to support their growth objectives, so balancing the benefits and costs of different financing sources.

The Life Cycle Theory of capital structure also offers insights, and proposes that a firm's financing choices evolve over its life cycle (Berger & Udell, 1998). Start-ups initially rely on internal funds and informal external equity, and progress to formal external equity and eventually to debt as they establish creditworthiness. This progression

reflects changes in information asymmetry, asset tangibility and risk over time. The Life Cycle Theory aligns with empirical observations of start-ups' financing patterns and underscores the dynamic nature of capital structure decisions.

In summary, while traditional capital structure theories provide valuable frameworks, their direct application to start-ups is limited by the unique characteristics of these firms. High uncertainty, information asymmetry, lack of collateral, and the critical importance of growth opportunities necessitate adaptations of these theories, or the development of new models tailored to start-ups. Understanding the nuances of how these theories apply or fail to apply to start-ups is essential for researchers and practitioners aiming to optimise financing strategies in the entrepreneurial context.

Access to capital for start-ups

Access to capital is a critical challenge for start-ups, which often operate under conditions of high uncertainty, limited collateral, and minimal operating history. These factors exacerbate information asymmetries between entrepreneurs and potential financiers, so making external financing both costly and difficult to obtain (Berger & Udell, 1998). The unique financial constraints faced by start-ups necessitate a deeper understanding of their financing options and the mechanisms through which they can secure necessary funds.

Berger and Udell (1998) provided a comprehensive framework for analysing the capital acquisition process of small firms, and emphasised the importance of the firm's life cycle in determining access to different financing sources. Some the sources of finance across the firm lifecycle is shown in Figure 3. In the initial stages, start-ups typically rely on internal funds, personal savings, and informal external equity from family and friends. This reliance stems from the lack of tangible assets and proven track records, which are essential for securing traditional bank financing.

As start-ups progress and accumulate assets and reputational capital, they may gain access to external debt and equity markets. However, the high degree of information opacity associated with start-ups poses significant challenges. Financial institutions often struggle to assess the creditworthiness of start-ups owing to inadequate financial statements and limited historical performance data (Berger & Udell, 1998). Consequently, banks may be reluctant to extend credit or may offer loans at prohibitively high interest rates to compensate for the perceived risk.

To mitigate these challenges, relationship lending is a vital mechanism. Through close interactions between entrepreneurs and lenders, information asymmetries can be reduced, so enabling lenders to make more informed decisions (Petersen & Rajan, 1994). Such relationships can facilitate access to capital by leveraging the lender's familiarity with the entrepreneur's capabilities and business prospects.

Alternative financing sources are also crucial in addressing the capital needs of start-ups. Venture capital firms and angel investors provide equity financing, which is often coupled with managerial expertise and industry connections (Gompers & Lerner, 2004). These investors are typically more willing to accept the higher risks

associated with start-ups in exchange for the potential of substantial returns. The emergence of crowdfunding platforms has also expanded opportunities for start-ups to access funds from a broader investor base (Belleflamme, Lambert & Schwienbacher, 2014).

Government programmes and policy interventions can further alleviate financing constraints. Initiatives such as loan guarantees, grants, and tax incentives can bridge the financing gap by reducing the risk to lenders and encouraging investment in start-ups (Lerner, 1999). However, the effectiveness of such programmes depends on their design and the extent to which they address the underlying information and risk issues inherent in start-up financing.

In summary, start-ups face significant hurdles in accessing capital owing to information asymmetries, lack of collateral, and high-risk profiles. Berger and Udell (1998) highlighted the importance of the firm's life cycle in shaping financing options, with access to different sources evolving as the firm matures. Relationship lending, alternative financing sources, and supportive government policies are essential for overcoming the barriers to capital access. Understanding these dynamics is crucial for entrepreneurs seeking financing and for policymakers aiming to foster entrepreneurial activity.

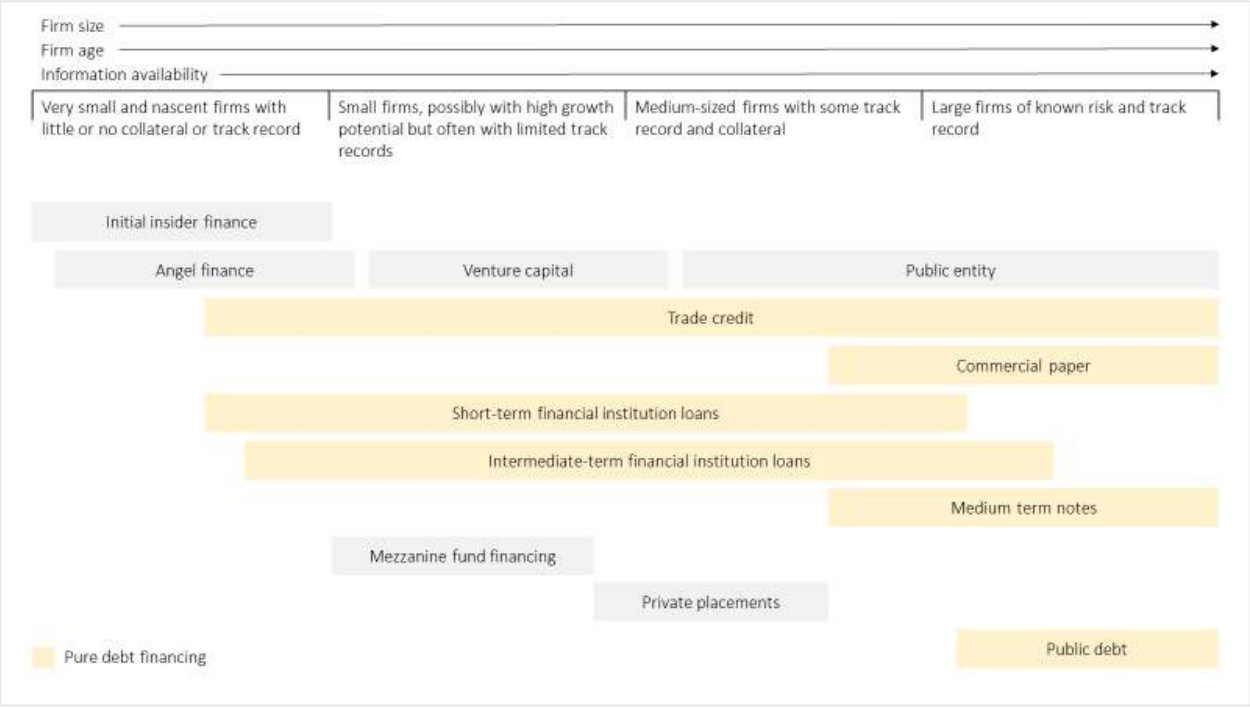

Figure 3: The firm continuum and sources of finance. Adapted from **(Berger & Udell, 1998: 623)**

Use of leverage in start-ups

Leverage, defined as using debt financing to fund a firm's operations and investments, plays a pivotal role in shaping the financial strategies of start-ups. For start-ups, the decision to use leverage involves weighing the potential benefits against the inherent risks associated with debt obligations. The unique characteristics of start-

ups, such as high growth potential, limited internal funds and significant uncertainty, make the role of leverage particularly complex and consequential.

One of the primary motivations for start-ups to use debt financing is to access the necessary capital for growth without diluting ownership stakes. Equity financing, while providing funds without immediate repayment obligations, often requires entrepreneurs to relinquish substantial control and future earnings (Cassar, 2004). Debt financing allows start-up founders to maintain greater ownership and decision-making authority, so preserving the entrepreneurial vision and aligning incentives (Robb & Robinson, 2014).

Moreover, leverage can confer tax advantages through the deductibility of interest expenses, which effectively reduces the firm's taxable income and enhances after-tax cash flows (Modigliani & Miller, 1958). For start-ups that generate taxable profits, this tax shield can improve liquidity and support reinvestment in the business. However, many start-ups operate at a loss during their early years, so limiting the immediate benefits of interest deductibility (Bradley, Jarrell & Kim, 1984a).

The use of debt can also impose financial discipline on start-ups. The obligation to meet fixed repayment schedules may encourage managers to prioritise efficient operations and prudent investment decisions (Jensen, 1986). This disciplinary effect can mitigate agency problems by aligning managerial actions with the goal of value maximisation. In the context of start-ups, where resources are scarce and operational efficiency is critical, such discipline may contribute to improved performance (Tsuruta, 2015, 2017).

Despite these potential benefits, leveraging poses significant risks for start-ups. The fixed repayment obligations associated with debt increase the firm's financial risk, in particular in the face of uncertain and volatile cash flows (Cassar & Holmes, 2003). Start-ups often experience uneven revenue streams owing to market fluctuations, developmental delays, or competitive pressures. High leverage magnifies the vulnerability to financial distress and bankruptcy, which can result in asset liquidation, loss of IP, and damage to reputational capital (Warner, 1977).

Furthermore, excessive reliance on debt can limit a start-up's strategic flexibility. Covenants and restrictions imposed by lenders may constrain operational decisions, such as entering new markets, altering product lines, or adjusting business models (Smith & Warner, 1979). These constraints can hinder a start-up's ability to adapt to rapidly changing environments, which is a critical capability for survival and success in dynamic industries (George, 2005).

The availability of debt financing to start-ups is also influenced by information asymmetry and lack of collateral. Lenders may perceive start-ups as high-risk borrowers because of limited financial histories and intangible assets that are difficult to value and secure (Berger & Udell, 1998). As a result, start-ups may face higher interest rates, stringent collateral requirements, or outright denial of credit, so making leverage a less accessible option compared to established firms (Cosh, Cumming & Hughes, 2009).

Studies on the impact of leverage on start-up performance present mixed findings, which I expand on in Sections 2.4.1 and 2.4.2. Some suggest that moderate levels of debt can enhance performance by providing necessary

capital and enforcing managerial discipline (Cole & Sokolyk, 2018a). Other research indicates that high leverage increases the likelihood of financial distress and negatively affects growth and profitability (Aivazian, Ge & Qiu, 2005b). These divergent outcomes underscore the importance of context, such as industry characteristics, economic conditions, and firm-specific factors, in determining the appropriateness of leverage for start-ups.

In conclusion, leverage is a double-edged sword for start-ups. It offers potential advantages in terms of capital access, ownership retention, tax benefits, and managerial discipline, while simultaneously introducing heightened financial risk and operational constraints. The decision to use debt financing requires careful consideration of the start-up's financial health, growth prospects, and risk tolerance. Entrepreneurs must balance the immediate needs for capital against the long-term implications of debt obligations, and recognise that the optimal capital structure depends on the unique circumstances of each start-up.

Varied challenges associated with debt financing

While debt financing can offer start-ups essential capital and potential benefits such as tax advantages and managerial discipline, it also introduces many challenges that can significantly affect start-up performance and survival. These challenges stem from the inherent risks of debt obligations and the unique characteristics of start-ups, including limited resources, high uncertainty, and evolving business models.

A primary challenge is the debt overhang problem, as described by Myers (1977). This situation arises when existing debt discourages new investment because the benefits of such investment accrue mainly to debt holders rather than equity holders. For start-ups reliant on continual investment to drive growth and innovation, the debt overhang can be particularly detrimental. It can lead to under-investment in positive net present value (NPV) projects, so stifling the firm's growth prospects and competitive edge. The reluctance to invest because of excessive debt burdens undermines the start-up's ability to adapt and expand in dynamic markets.

Agency Costs and Financial Distress are another significant challenge associated with debt financing. Jensen and Meckling (1976) highlighted that high leverage amplifies conflicts between debt holders and equity holders. Equity holders may be incentivised to engage in riskier projects – the "asset substitution effect" – since they benefit from the upside potential while debt holders bear more of the downside risk. This misalignment can lead to suboptimal investment decisions, so increasing the likelihood of financial distress or bankruptcy. For start-ups with volatile cash flows and uncertain revenue streams, the heightened risk of insolvency can result in the loss of critical assets, damage to reputation, and erosion of stakeholder confidence (Warner, 1977).

Restrictive Covenants and Loss of Operational Flexibility further complicate debt financing for start-ups. Lenders often impose covenants to protect their interests, which may limit the firm's operational decisions, such as incurring additional debt, so making significant investments or altering business strategies (Smith & Warner, 1979). While these covenants aim to mitigate the risk of default, they can constrain the start-up's agility, which is a vital attribute in rapidly changing markets. The inability to pivot or invest in new opportunities owing to covenant

restrictions can hinder innovation and impede the firm's ability to respond to competitive pressures (George, 2005).

The Burden of Fixed Repayment Obligations is particularly acute for start-ups with unpredictable cash flows. Unlike established firms with stable revenues, start-ups often experience financial volatility because of market acceptance challenges, developmental delays, or operational setbacks (Cassar & Holmes, 2003). The obligation to meet regular interest and principal payments can strain limited financial resources, potentially leading to liquidity crises. Failure to fulfil these obligations may trigger defaults, so accelerating financial distress and jeopardising the firm's existence (Brearly, Myers & Allen, 2014).

High leverage can also create negative signalling effects in the market. According to the signalling theory, a firm's capital structure choices convey information to external stakeholders (Ross, 1977). Excessive debt levels may signal financial instability or an inability to secure equity financing. This can deter potential investors, partners, and customers. For start-ups striving to build credibility and attract investment, such adverse signals can have long-lasting detrimental effects.

Access to debt financing itself is a challenge owing to information asymmetry and lack of collateral. Lenders are often hesitant to extend credit to start-ups without sufficient tangible assets or proven track records, so resulting in higher interest rates or demands for personal guarantees from entrepreneurs (Berger & Udell, 1998). This reluctance limits the availability of debt financing when it may be strategically advantageous, so forcing start-ups to seek alternative potentially more expensive or dilutive financing options.

Lastly, the risk of over-leveraging cannot be overlooked. Excessive debt can lead to an unsustainable capital structure, so increasing the firm's vulnerability to economic downturns and market fluctuations (Altman, 1984). Start-ups with high-leverage ratios may find it challenging to secure additional funding, negotiate favourable terms with suppliers, or retain key talent – all of which are critical for growth and competitiveness.

In conclusion, while debt financing can provide start-ups with necessary resources and potential benefits, it introduces significant challenges that must be carefully managed. The debt overhang problem, agency costs leading to financial distress, restrictive covenants limiting operational flexibility, burdensome repayment obligations, negative market signalling, difficulties in accessing debt, and the risk of over-leveraging collectively underscore the complexity of using debt in start-ups. Entrepreneurs must thoroughly assess these challenges against the potential advantages and tailor their capital structure decisions to align with their firm's specific circumstances, risk tolerance, and strategic objectives.

Conclusion

The capital structure of start-ups is multifaceted and intertwines theoretical paradigms with practical challenges unique to start-ups. Traditional capital structure theories, such as the Modigliani-Miller Theorem, the trade-off theory, the pecking order theory, and the Agency Theory, provide foundational insights but require adaptation

when applied to start-ups owing to their distinct characteristics: high uncertainty, limited collateral, and significant information asymmetry (Myers & Majiuf, 1981; Berger & Udell, 1998).

Access to capital is as a critical hurdle for start-ups, and is influenced by their inability to secure traditional debt financing because of perceived high risks and lack of tangible assets (Cassar, 2004). Alternative financing avenues, including venture capital, angel investors, and crowdfunding, play a pivotal role in bridging the financing gap, although they often come with trade-offs such as ownership dilution and loss of control (Gompers & Lerner, 2004).

Leverage is as both an opportunity and a threat for start-ups. While debt financing can provide necessary capital without diluting ownership and impose managerial discipline through fixed repayment obligations (Jensen, 1986), it also introduces significant risks. These include increased financial distress probability because of volatile cash flows, restrictive covenants limiting operational flexibility, and the potential for the debt overhang problem to stifle investment in growth opportunities (Myers, 1977; Smith & Warner, 1979).

There is a complex relationship between capital structure and firm performance in start-ups. Some studies highlight the positive effects of moderate leverage on performance metrics like profitability and growth (Tsuruta, 2015; Cole & Sokolyk, 2018a), while others caution against the adverse impacts of high leverage, such as heightened financial risk and under-investment (Opler & Titman, 1994; Aivazian, Ge & Qiu, 2005b). These mixed findings underscore the need for a nuanced understanding of how capital structure decisions align with a start-up's specific context and strategic objectives.

The challenges associated with debt financing – such as the debt overhang problem, agency costs, and loss of strategic flexibility – highlight the precarious balance that start-ups must navigate in their financing decisions (Jensen & Meckling, 1976; Myers, 1977). The prevalence and patterns of debt usage among start-ups vary based on industry, geographic location, economic conditions, and firm-specific factors, which reflects the heterogeneity of the start-up landscape (Robb & Robinson, 2014).

Considering these complexities, there is no one-size-fits-all approach to capital structure for start-ups. Entrepreneurs must carefully consider the trade-offs inherent in different financing options, and balance the immediate needs for capital against long-term implications for control, flexibility, and financial stability. Policymakers and financial institutions can provide support by developing instruments and programmes that address the unique challenges faced by start-ups, such as reducing information asymmetry and providing access to capital without overly burdensome terms (Berger & Udell, 1998; Lerner, 1999).

For researchers, the intricate dynamics of start-up capital structures are fertile ground for further investigation. Future studies could explore how emerging financing mechanisms, such as fintech solutions and impact investing, influence start-up performance and growth. In addition, longitudinal analyses examining how capital structure decisions evolve over the life cycle of start-ups could provide deeper insights into optimal financing strategies at different stages of development.

To conclude, the capital structure decisions of start-ups are critical determinants of their performance and survival. A comprehensive understanding of theoretical frameworks, empirical evidence, and the practical challenges associated with debt financing is essential for entrepreneurs, investors, and policymakers who aim to foster successful entrepreneurial ventures in an increasingly competitive and dynamic economic environment.

2.4. Hypothesis development

Leverage, the strategic use of debt in a firm's capital structure, is a fundamental concept in corporate finance with important implications for a firm's operational and financial performance. In the context of start-ups, leverage is critical because of the unique challenges these entities face, such as limited access to capital markets, uncertainty, and scarce internal resources (Berger & Udell, 1998). The decision to use debt financing can significantly influence a start-up's ability to innovate, compete and, ultimately, survive.

Start-ups operate under conditions that are different from those of established firms. They typically lack substantial collateral, are unproven, and experience unpredictable cash flows (Cassar, 2004). These characteristics complicate traditional capital structure decisions. For example, while debt can provide the necessary funds to seize market opportunities and achieve economies of scale, it also introduces fixed obligations that may strain a start-up's limited financial flexibility (Myers, 1984). For these reasons, capital structure decisions are critical for the performance and sustainability of start-ups.

Studying the impact of leverage in start-ups extends to theoretical and practical domains. Academically, it tests the applicability of conventional financial theories (such as the trade-off theory, pecking order theory, and others) in the context of emerging firms (Frank & Goyal, 2008). Practically, understanding leverage's impact helps entrepreneurs and investors make informed financing decisions that balance growth ambitions with risk management (Robb & Robinson, 2014). Despite its importance, the literature presents mixed findings on how leverage affects start-up performance, so indicating a need for further empirical investigation.

In this section, I explore the nuanced relationship between leverage and firm performance in start-ups. I analyse how varying levels of leverage and high levels of leverage can influence key performance indicators such as profitability and growth. By reviewing theoretical frameworks and empirical evidence, I propose hypotheses that can be empirically tested and identify gaps that are yet to be tested.

The subsequent analysis begins by examining the theoretical foundations pertinent to leverage in start-ups. This includes a critical evaluation of established theories like the trade-off theory, which suggests that firms balance the tax advantages of debt against bankruptcy costs (Kraus & Litzenberger, 1973a), and the pecking order theory, which posits a preference for internal financing over external debt and equity owing to information asymmetries (Myers & Majiuf, 1981). Agency Theory considerations are also discussed to understand how debt influences managerial incentives and firm behaviour (Jensen & Meckling, 1976).

2.4.1. Theoretical foundations

Effects of leverage on firm performance

Understanding the impact of leverage on firm performance necessitates a thorough examination of the foundational financial theories that explain how and why firms choose specific capital structures. Several influential theories provide insights into the determinants of leverage and its implications for firm value, in particular in the context of start-ups.

The Modigliani-Miller Theorem (Modigliani & Miller, 1958) is the cornerstone of capital structure theory. Assuming a world devoid of taxes, transaction costs, and information asymmetries, Modigliani and Miller posited that a firm's value is independent of its capital structure. This proposition of irrelevance suggests that the mix of debt and equity financing does not affect the overall value of the firm. However, the assumptions underpinning this theorem are unrealistic in practical settings (Stiglitz, 1969). This is especially true for start-ups where imperfect markets, taxes and imperfect information make capital structure decisions important. Recognising the limitations of their initial model, Modigliani and Miller (1963) introduced corporate taxes into the framework, and acknowledged that interest payments on debt are tax-deductible. This Tax Shield Theory suggests that debt financing can enhance firm value by reducing taxable income, thereby increasing after-tax cash flows. For start-ups, the tax benefits of debt could be particularly appealing, so potentially improving cash flow and providing additional resources for growth (DeAngelo & Masulis, 1980). However, start-ups often have limited or negative earnings, which reduces the immediate advantage of interest tax shields (Bradley, Jarrell & Kim, 1984b).

Kraus and Litzenberger's (1973a) Trade-Off Theory further refines the discussion by balancing the tax advantages of debt against the costs of financial distress and bankruptcy. According to this theory, an optimal capital structure exists where the marginal benefit of the tax shield equals the marginal cost of financial distress. For start-ups, the probability of financial distress is inherently higher due to uncertain cash flows and unproven business models (Warner, 1977). Consequently, the costs associated with potential bankruptcy may outweigh the benefits of the tax shield, which suggests that lower levels of leverage may be optimal for these firms (Titman & Wessels, 1988).

In contrast, the pecking order theory proposed by Myers and Majluf (1981) emphasises the role of information asymmetry between firm managers and external investors. It posits that firms prefer internal financing (retained earnings) over external debt and equity because internal funds do not suffer from the adverse selection problems associated with asymmetric information. When external financing is necessary, firms prefer debt over equity since debt issuance is perceived as a less negative signal to the market than equity issuance. For start-ups, which typically have minimal retained earnings and high information asymmetries, the pecking order theory implies a reliance on equity financing, despite its higher costs and potential for ownership dilution (Berger & Udell, 1998).

The Agency Theory introduces another dimension by focusing on conflicts of interest between various stakeholders, such as managers, shareholders, and debt holders (Jensen & Meckling, 1976). Debt can act as a disciplining mechanism on managerial behaviour by reducing free cash flow and obligating managers to meet fixed

repayment schedules (Jensen, 1986). This discipline can potentially enhance firm performance by curbing managerial excesses and aligning interests with those of debt holders. However, for start-ups, the pressure of mandatory debt repayments may constrain managerial flexibility and hinder the ability to invest in positive net NPV projects, so adversely affecting long-term performance (Harris & Raviv, 1991).

Moreover, the signalling theory suggests that capital structure decisions convey information to the market about a firm's future prospects (Ross, 1977). By choosing a higher level of debt, managers signal confidence in the firm's expected cash flows, as they must believe that the firm can meet its debt obligations. In the context of start-ups, this signalling effect may help attract investors and enhance the firm's reputation. However, excessive leverage may also signal overconfidence or desperation for funds, which can potentially deter cautious investors (Leland & Pyle, 1977).

Another relevant framework is the Market Timing Theory, which posits that firms time their financing decisions based on market conditions to minimise the cost of capital (Baker & Wurgler, 2002). Firms may prefer equity financing when stock prices are perceived to be overvalued and debt financing when interest rates are low. Start-ups, however, often lack the flexibility to time the market because of their urgent financing needs and limited access to capital markets, so diminishing the applicability of this theory in their context (Hovakimian, Opler & Titman, 2001).

The Resource-Based View (RBV), although traditionally focused on strategic management, offers insights into how financial resources contribute to a firm's competitive advantage (Barney, 1991). Access to debt financing can enable start-ups to acquire critical resources, invest in innovation, and scale operations – thereby enhancing performance. However, the RBV also underscores the importance of unique, inimitable resources, suggesting that an overreliance on debt – a readily available resource to competitors – may not yield sustained competitive advantages (Peteraf, 1993).

Lastly, the Dynamic trade-off theory acknowledges that firms adjust their capital structures over time in response to changing internal and external conditions (Fischer, Heinkel & Zechner, 1989). This theory recognises the costs associated with adjusting capital structures and suggests that firms may temporarily deviate from their optimal leverage ratios. For start-ups, this implies that leverage decisions are not static and may evolve as the firm matures, gains stability, and accumulates internal funds (Leary & Roberts, 2005).

In synthesising these theories, it becomes evident that leverage can have both positive and negative implications for firm performance. The benefits of debt, such as tax shields and managerial discipline, must be weighed against the costs of financial distress, agency conflicts, and reduced financial flexibility. For start-ups, the balance may tilt differently than for established companies because of their unique characteristics and constraints (Cassar & Holmes, 2003). Theoretical models suggest that while some leverage can enhance firm value, excessive debt increases the risk of financial distress, which can be particularly detrimental for start-ups lacking diversified

revenue streams (O'Brien, 2003). Information asymmetries and agency problems may also be more pronounced in start-ups, so influencing their capital structure decisions differently to mature firms (Colombo & Grilli, 2007).

Understanding these general theories on leverage provides a foundation for analysing how start-ups navigate their financing choices. It highlights the complexity of leverage decisions and the need for start-ups to carefully consider their specific circumstances when determining their optimal capital structures.

Effects of high leverage on firm performance

While general capital structure theories provide a foundational understanding of leverage, specific theoretical frameworks address the nuanced effects of high leverage on firm performance, in particular in start-ups. High leverage introduces unique dynamics that can exacerbate risks, alter managerial incentives, and affect a firm's strategic decisions differently to moderate levels of debt.

The Agency Costs of Debt become more pronounced under high-leverage conditions. Jensen &Meckling (1976) highlighted that as debt levels increase, conflicts between debt holders and equity holders intensify. Equity holders in highly leveraged firms may have incentives to undertake riskier projects – the so-called "asset substitution effect" – because they stand to gain from upside potential while debt holders bear more of the downside risks (Myers, 1977). This misalignment can lead to suboptimal investment decisions, and increase the likelihood of financial distress and negatively affect firm performance.

The debt overhang problem, introduced by Myers (1977), is particularly relevant for firms with high leverage. When a firm carries substantial debt, new investment opportunities may be forgone because the benefits accrue primarily to existing debt holders rather than equity holders. This under-investment hampers growth prospects and is especially detrimental for start-ups that rely heavily on continual investment to develop products, expand operations, and gain market share (Lamont, 1995). The debt overhang therefore impedes the firm's ability to capitalise on NPV projects, so constraining performance and competitive positioning.

High leverage also exacerbates the risk of financial distress and bankruptcy costs. According to the trade-off theory, while debt provides tax shields, excessive debt heightens the probability of financial distress, where costs such as legal fees, asset fire sales, and loss of customers can erode firm value (Kraus & Litzenberger, 1973a; Warner, 1977). Start-ups are particularly vulnerable because of their limited financial buffers and less diversified income streams (Cressy, 2006). The spectre of bankruptcy not only affects current operations but also tarnishes reputation, so making it harder to secure future financing or strategic partnerships.

The Agency Costs of Free Cash Flow concept, as discussed by Jensen (1986), posits that high debt levels can discipline managers by reducing free cash flow available for discretionary spending. However, in highly leveraged start-ups, this constraint may be counterproductive. Limited financial slack can hinder the firm's ability to respond to market opportunities or invest in innovation (George, 2005). The rigidity imposed by high debt obligations reduces managerial flexibility, so potentially stifling growth and adaptability in dynamic market environments.

From a signalling perspective, high leverage can send adverse signals to the market. While moderate debt may indicate management's confidence in future cash flows, excessive debt may be perceived as a sign of desperation or overextension (Ross, 1977). This negative perception can deter investors, suppliers, and customers, and further challenge a start-up's performance and survival (Leland & Pyle, 1977). In markets characterised by information asymmetry, such signals carry significant weight in shaping stakeholder decisions.

The Credit Rationing Theory suggests that lenders become increasingly cautious as a firm's leverage rises. Stiglitz and Weiss (1981) argued that higher interest rates cannot compensate for the increased risk of default associated with high leverage, so leading lenders to ration credit instead. For start-ups, which already face hurdles in accessing external finance because of a lack of collateral and track record, high leverage can exacerbate financing constraints (Carpenter & Petersen, 2002). This limitation impedes the firm's ability to fund operations and invest in growth initiatives, so adversely affecting performance.

High leverage also influences strategic interactions in competitive markets. According to Brander &Lewis (1986), firms may use debt strategically to commit to aggressive market behaviours, so leveraging the limited liability of equity to gain competitive advantages. However, for start-ups, such strategies are risky. The burden of debt reduces financial resilience, making it difficult to withstand competitive retaliation or market downturns (Zingales, 1998). The aggressive posture enabled by high leverage may not be sustainable, and lead to a potential exit from the market.

The Real Options Theory provides further insight into the drawbacks of high leverage. High debt levels can limit a firm's strategic flexibility: the ability to defer, expand, or abandon projects in response to market changes (Myers, 1977; Trigeorgis, 1993). For start-ups operating in volatile environments, preserving flexibility is crucial. High-leverage commitments constrain managerial discretion, and prevent the firm from adapting its strategic course as new information emerges (McGrath, 1999). This rigidity can undermine competitive advantage and long-term viability.

High leverage can also exacerbate behavioural biases among managers. Under significant debt pressure, managers may exhibit risk-averse behaviour to avoid default, even if risk-taking is necessary for the firm's growth (Shefrin, 2007). Conversely, they may engage in reckless strategies hoping for high returns to escape financial distress: a phenomenon known as "gambling for resurrection" (Campbell, Hilscher & Szilagyi, 2011). Both scenarios can lead to suboptimal decisions that harm firm performance.

In summary, theories specific to high leverage underscore the multifaceted risks that excessive debt imposes on start-ups. High leverage amplifies agency conflicts, increases financial distress costs, limits strategic flexibility, and can adversely affect stakeholder perceptions. While debt financing can offer benefits, such as tax advantages and managerial discipline, the negative implications of high leverage often outweigh these benefits in the context of start-ups. Theoretical frameworks suggest that maintaining a balanced capital structure is critical for optimising performance and ensuring the sustainability of young firms.

2.4.2. Empirical evidence

Effects of leverage on firm performance

Empirical studies examining the relationship between leverage and firm performance have produced a spectrum of findings, which reflects the complexity of financial dynamics in different contexts. For start-ups, this relationship is particularly nuanced owing to their distinctive operational characteristics and financial constraints. The following discussion synthesises empirical evidence that highlights both positive and negative impacts of leverage on firm performance, and provides insights into how debt influences the trajectory of emerging firms. I provide a summary of the empirical evidence reviewed in Table 3.

Several studies have documented a positive relationship between leverage and firm performance, and suggest that debt financing can enhance efficiency and profitability. Tsuruta (2015) investigated SMEs in Japan and found that leverage positively affects firm performance, measured by return on assets (ROA). The study posits that debt imposes financial discipline on managers, and aligns their actions with shareholder interests and reducing agency costs. This disciplining effect is consistent with Jensen's (1986) free cash flow hypothesis, where debt limits managerial discretion over free cash flows, so prompting more prudent investment decisions.

Similarly, Cole and Sokolyk (2018a) examined young private firms in the United States and reported that moderate levels of leverage are associated with improved firm performance. Their analysis indicates that access to debt financing enables start-ups to invest in growth opportunities, achieve economies of scale, and enhance operational efficiency. The findings support the Resource-Based View, emphasising that financial resources obtained through debt can be instrumental in building competitive advantages (Barney, 1991). Moreover, the study suggests that the tax benefits of debt contribute to increased after-tax earnings, so bolstering overall performance.

Contrastingly, much research highlights the negative impact of leverage on firm performance, in particular when firms are overleveraged. Opler and Titman (1994) analysed data from U.S. firms during economic downturns and found that highly leveraged firms suffer significantly greater declines in sales and market share compared to their less leveraged counterparts. The study attributes this vulnerability to financial distress costs, where the burden of debt obligations exacerbates the adverse effects of economic contractions. This is particularly detrimental for start-ups, which may lack the resilience and diversification of established firms.

Lang, Ofek, and Stulz (1996) further investigated the relationship between leverage and firm growth, and found that high leverage is negatively correlated with future growth opportunities. Their research suggests that overleveraged firms are constrained in their ability to invest in new projects because of the debt overhang problem (Myers, 1977). For start-ups reliant on continual innovation and market expansion, such constraints can impede performance and hinder long-term success.

Aivazian, Ge and Qiu (2005b) explored Canadian firms and found that increased leverage is associated with reduced corporate investment, in particular in firms with high growth opportunities. The study supports the view that debt can lead to under-investment, as firms may forego positive NPV projects to avoid the additional burden

of financing costs. This phenomenon is especially pronounced in start-ups, where the need for ongoing investment is critical for development and competitive positioning.

Agostino and Trivieri (2010) examined Italian manufacturing SMEs and reported that high leverage negatively affects firm performance measured by productivity levels. The study indicates that excessive debt increases financial distress risks and limits managerial flexibility, so reducing operational efficiency. Similarly, Cai and Zhang (2011) analysed U.S. firms and concluded that leverage has an inverse relationship with future stock returns, and suggested that the market penalises overleveraged firms because of perceived risks.

Some empirical studies present mixed findings, which reflects the complexity of the leverage–performance relationship. Weill (2008) conducted a cross-country analysis of manufacturing firms in seven European countries and found that the impact of leverage on performance varies by country. The study suggests that institutional factors, such as legal frameworks and financial market development, influence how leverage affects firms. In certain contexts, leverage positively correlates with performance, while in others the relationship is negative or insignificant. This variability underscores the importance of contextual factors in understanding financial dynamics.

Ahn, Denis and Denis (2006) investigated U.S. firms undergoing operational restructuring and observed that leverage can both positively and negatively affect performance depending on the firm's situation. For firms with efficient operations, leverage enhances performance by enforcing discipline. However, for firms already experiencing operational difficulties, additional debt exacerbates performance issues because of increased financial strain. This duality suggests that leverage's impact is contingent on firm-specific factors, such as operational efficiency and management effectiveness.

The divergence in empirical findings may be attributed to several factors, including differences in sample selection, measurement of leverage and performance, and contextual variables such as industry characteristics and economic conditions. For instance, studies focusing on SMEs or start-ups may yield different results compared to those examining large established firms because of variations in access to capital markets and susceptibility to financial distress.

Table 3: Summary of the empirical literature on the effects of leverage on firm performance

Effect	Growth[3]	Returns[4]	Survival
Positive	(Tsuruta, 2015) (Cole & Sokolyk, 2018a)	(Tsuruta, 2015)	(Cole & Sokolyk, 2018a)
Negative	(Opler & Titman, 1994) (Lang, Ofekb & Stulz, 1996) (Aivazian, Ge & Qiu, 2005a)	(Opler & Titman, 1994) (Agostino & Trivieri, 2010) (Cai & Zang, 2011)	
Positive or negative	(Weill, 2008)	(Ahn, Denis & Denis, 2006)	

Moreover, the stage of the economic cycle can influence the leverage–performance relationship. During periods of economic growth, leverage may facilitate expansion and profitability, while in downturns it may amplify risks and lead to deterioration in performance (Opler & Titman, 1994). Start-ups, with their limited financial buffers, are particularly sensitive to such cyclical effects.

The conflicting empirical evidence also reflects the theoretical ambivalence regarding leverage. While theories like the trade-off theory suggest an optimal level of debt that balances tax benefits against bankruptcy costs (Kraus & Litzenberger, 1973a), determining this optimal point is challenging in practice – especially for start-ups with volatile earnings and uncertain prospects.

The role of information asymmetry and agency problems also cannot be overlooked. High information asymmetry in start-ups may lead to adverse selection and moral hazard issues, affecting both the availability of debt financing and its impact on performance (Myers & Majiuf, 1981). Agency costs arising from conflicts between debt holders and equity holders may also undermine firm performance when leverage is high (Jensen & Meckling, 1976).

In summary, empirical evidence on the impact of leverage on firm performance in start-ups is mixed, and highlights both potential benefits and risks associated with debt financing. Positive impacts are often linked to moderate leverage levels that provide necessary capital for growth while imposing managerial discipline. Negative impacts tend to emerge when leverage reaches levels that increase financial distress risks, constrain investment opportunities, and exacerbate agency conflicts. These findings suggest that the relationship between leverage and performance is not linear but rather contingent on various factors, including the firm's leverage level, industry context, economic conditions, and internal management capabilities. For start-ups, carefully calibrating debt levels is crucial for harnessing the advantages of leverage without incurring its detrimental effects.

[3] Papers included in the 'growth' category include dependent variables in their regressions such as sales growth or asset growth.
[4] Papers included in the 'returns' category include dependent variables such as operating income ratio, operating margin, EBIT margin, ROE, ROA, and stock returns in their regressions.

Effects of high leverage on firm performance

Empirical research has extensively examined the consequences of high leverage on firm performance, and often highlighted the heightened risks and adverse outcomes associated with excessive debt levels. For start-ups, high leverage can amplify financial vulnerabilities, constrain strategic flexibility, and increase the likelihood of financial distress and bankruptcy. This section explores empirical findings from key studies that elucidate the negative implications of high leverage, while also considering nuanced perspectives that recognise context-specific effects.

Myers (1977) introduced the concept of the debt overhang problem, where firms with substantial debt may under-invest in valuable projects because the benefits accrue primarily to debt holders rather than equity holders. This can stifle growth and impair performance, in particular for start-ups that rely on continual investment to develop and commercialise new products or services. Empirical support for this theory is found in studies like Aivazian, Ge, and Qiu (2005), who observed that highly leveraged Canadian firms exhibit reduced investment levels, especially those with significant growth opportunities.

Opler and Titman (1994) provided empirical evidence on the detrimental effects of high leverage during economic downturns. Analysing U.S. firms in distressed industries, they found that highly leveraged firms experienced greater declines in sales and market share compared to their less leveraged peers. The study suggests that high leverage exacerbates the impact of negative economic shocks, and leads to deeper performance declines and increases the risk of bankruptcy. For start-ups, which often operate with limited financial reserves, such amplified vulnerabilities can be particularly devastating.

Altman (1984) contributed to the understanding of high leverage by developing the Z-Score model, which is a financial distress prediction tool that incorporates leverage ratios as key indicators. His research demonstrated that firms with higher leverage ratios are more likely to experience financial distress and bankruptcy. This finding underscores the risks associated with high leverage, as excessive debt burdens can overwhelm a firm's cash flow capabilities, and lead to insolvency. Start-ups, with their typically volatile earnings and cash flows, are especially susceptible to these risks when carrying high debt loads.

Tsuruta (2015, 2017) examined Japanese SMEs and provided nuanced insights into the impact of high leverage. In his 2015 study, Tsuruta found that while moderate leverage can improve performance through the disciplinary effect of debt, high leverage negatively affects firm survival and profitability. The 2017 study further revealed that overleveraged SMEs face significant constraints in accessing additional external financing, so limiting their ability to invest and grow. These findings highlight that the benefits of leverage have limits and that surpassing an optimal debt threshold can reverse its positive effects.

The negative impact of high leverage on firm performance is also evident in the work of Agostino and Trivieri (2010), who studied Italian manufacturing SMEs. They reported that firms with excessive debt exhibit lower productivity levels owing to the strain of servicing debt obligations and the reduced capacity to invest in efficiency-enhancing technologies or processes. Similarly, Cai and Zhang (2011) found that U.S. firms with high

leverage experience lower future stock returns, which suggests that markets penalise overleveraged firms owing to increased risk perceptions.

Empirical studies have also highlighted the role of high leverage in exacerbating agency problems. As debt levels rise, conflicts between equity holders and debt holders intensify, so potentially leading to asset substitution or risk-shifting behaviours that harm firm value (Jensen & Meckling, 1976). Ahn, Denis, and Denis (2006) observed that in diversified firms, high leverage is associated with reduced investment efficiency, supporting the view that excessive debt can impair managerial decision-making and resource allocation.

However, some studies offer a more nuanced perspective. Tsuruta (2015) noted that the negative effects of high leverage could be mitigated in firms with strong relationships with creditors or in institutional environments that support debt restructuring. Weill (2008) found that the impact of leverage varies across countries because of differences in legal systems and financial market development, suggesting that the adverse effects of high leverage are context-dependent. That said, the overarching empirical evidence indicates that high leverage poses significant risks to firm performance, especially for start-ups. Excessive debt increases the probability of financial distress, limits strategic options, and can deter investment in growth opportunities because of the debt overhang problem (Myers, 1977). Furthermore, high leverage may lead to stricter covenants and increased monitoring by creditors, which can constrain managerial autonomy and hinder swift decision-making in dynamic markets (Smith & Warner, 1979).

In conclusion, empirical studies consistently demonstrate that while leverage can provide benefits up to a certain point, high leverage tends to have a deleterious effect on firm performance. For start-ups, the risks associated with high leverage are amplified because of their inherent financial fragility, uncertain cash flows, and dependence on continual investment for growth. These findings underscore the importance for such firms to carefully manage their capital structures, and avoid excessive debt levels that could jeopardise their performance and viability.

2.4.3. Hypothesis development

Effects of leverage on firm performance

Building on the theoretical frameworks and empirical evidence discussed, I here formulate a hypothesis on the impact of leverage on firm performance in start-ups. The trade-off theory suggests that firms balance the tax advantages of debt against the costs of financial distress, which implies that a moderate level of leverage can enhance firm value by providing tax shields without significantly increasing bankruptcy risk (Kraus & Litzenberger, 1973b). The Agency Theory further posits that debt can act as a disciplining mechanism, and reduce agency costs by constraining managerial discretion and aligning interests between managers and shareholders (Jensen & Meckling, 1976; Jensen, 1986).

Empirical studies provide evidence that supports a positive relationship between leverage and firm performance in start-ups. Tsuruta (2015) found that leverage positively affects the return on assets of Japanese SMEs, and

attributed this to the disciplining effect of debt. Similarly, Cole and Sokolyk (2018a) reported that access to debt financing enables young firms in the United States to invest in growth opportunities and improve operational efficiency, so leading to enhanced performance. However, the relationship is complex, with some studies indicating that the positive effects of leverage depend on maintaining debt levels within an optimal range. Excessive leverage may introduce risks that outweigh the benefits, which is a consideration that is addressed in the next section.

Focusing on the potential advantages of moderate leverage, I propose the following hypothesis:

H_1: There is a positive relationship between leverage and firm performance in start-ups.

This hypothesis suggests that for start-ups, increasing leverage is associated with improved performance metrics, such as profitability and growth rates – up to a certain point. By testing this hypothesis, I aim to contribute to the understanding of how debt financing influences the success of emerging firms and provide insights that can inform capital structure decisions in the entrepreneurial context.

Effects of high leverage on firm performance

Drawing from the theoretical frameworks and empirical findings presented, I formulate a hypothesis on the impact of high leverage on firm performance in start-ups. The Agency Costs of Debt theory posits that excessive debt amplifies conflicts between debt holders and equity holders, which leads to suboptimal investment decisions and increased risk-taking behaviours (Jensen & Meckling, 1976; Myers, 1977). High leverage can result in the debt overhang problem, where firms forgo valuable investment opportunities because the benefits predominantly accrue to debt holders rather than equity holders (Myers, 1977; Lamont, 1995). This under-investment hampers growth and adversely affects performance.

The financial distress and bankruptcy costs associated with high leverage are particularly detrimental for start-ups, which often lack the financial resilience of established firms (Altman, 1984; Opler & Titman, 1994). Excessive debt increases the probability of financial distress, and leads to costs such as asset liquidation at unfavourable prices, loss of customers, and damaged reputation. These costs can erode firm value and hinder operational capabilities.

Empirical studies support these theoretical assertions. Opler and Titman (1994) found that highly leveraged firms experience greater declines in performance during economic downturns. Altman (1984) found that firms with high-leverage ratios have an increased likelihood of bankruptcy. Tsuruta (2015, 2017) observed that overleveraged Japanese SMEs face significant constraints in accessing additional financing and exhibit lower profitability and survival rates.

Given these considerations, I propose the following hypothesis:

H_2: High leverage is negatively associated with firm performance in start-ups.

This hypothesis suggests that excessive debt levels adversely affect key performance indicators such as profitability, growth, and survival probability in start-ups. By empirically testing this hypothesis, I aim to deepen the understanding of how high leverage influences the success of emerging firms and provide insights into optimal capital structure strategies in the entrepreneurial landscape.

2.5. Conceptual model

The conceptual model illustrated in Figure 4 provides a comprehensive framework for understanding the determinants of firm performance, in particular in the context of start-ups. This model emphasises the interplay between exogenous factors, such as financial markets and market characteristics, and endogenous factors, including strategy, resource allocation, capital structure, and firm characteristics, to explain how these elements influence firm outcomes.

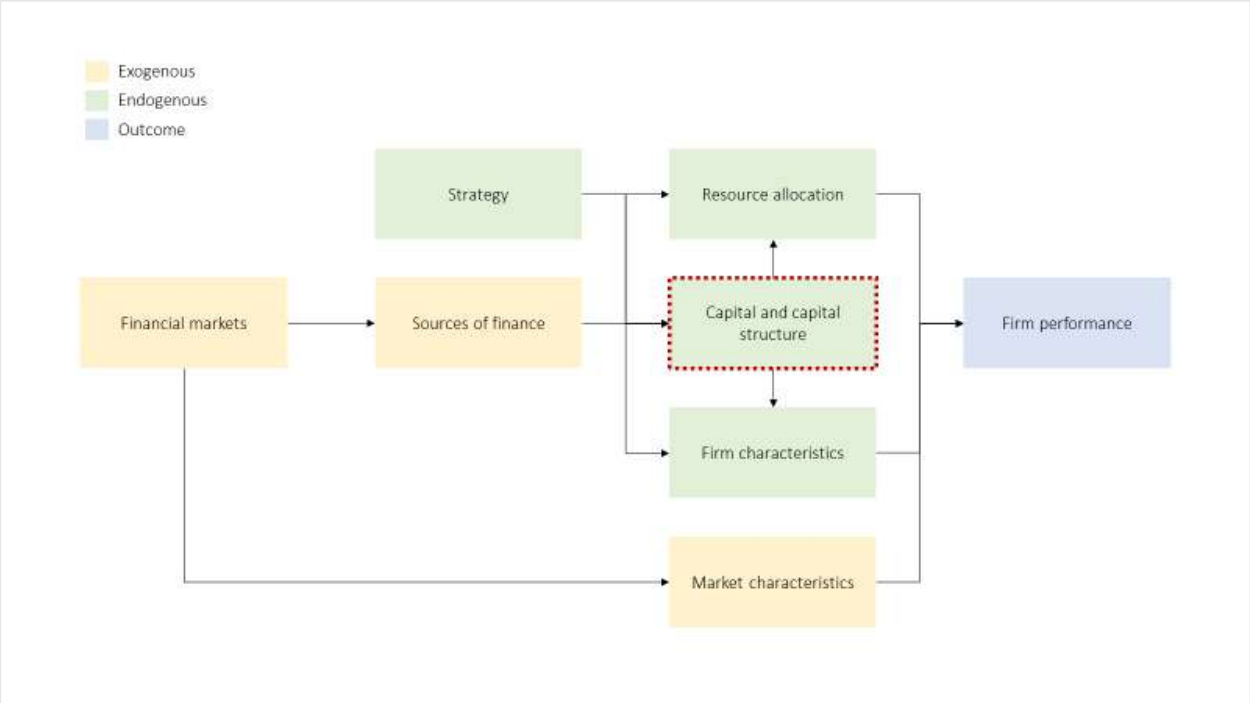

Figure 4: Conceptual model of this study

The model begins with exogenous factors, representing the external environment in which firms operate. Financial markets, as a primary external factor, determine the accessibility and cost of capital, which is crucial for start-up financing. The availability of funding through venture capital, loans, or other financial instruments affects the resources that firms can mobilise. As noted by Berger and Udell (1998), access to external finance is a significant determinant of a start-up's growth potential and competitive positioning. Similarly, market characteristics, such as consumer demand, industry competition, and regulatory frameworks, shape the operational context of start-ups and influence strategic choices and potential growth paths (Porter, 1980).

These exogenous factors feed into the "Sources of Finance" component, which directly affects the capital and capital structure of firms. Start-ups, in particular, must strategically navigate their sources of financing owing to limited internal funds and heightened risk profiles, and often rely on equity financing or alternative funding sources earlier in their life cycle (Myers & Majiuf, 1981). The capital structure then becomes a critical determinant of firm resilience and adaptability, as it influences both the financial stability and operational flexibility of start-ups

(Modigliani & Miller, 1958; Kraus & Litzenberger, 1973a). High leverage, while potentially enhancing returns, can also exacerbate financial distress risks, especially in volatile markets.

Endogenous factors such as strategy, resource allocation and firm characteristics are pivotal in shaping firm performance outcomes. The model illustrates that strategy is informed by both internal firm characteristics and external market dynamics. A firm's strategic approach, whether oriented towards differentiation, cost leadership, or innovation, dictates its competitive position in the industry. Strategic alignment with resource allocation is crucial, as resources are finite and must be optimally deployed to create sustainable competitive advantages (Barney, 1991). Efficient resource allocation, combined with a firm's internal characteristics – such as human capital, organisational culture, and managerial competencies – forms the core capabilities that drive performance (Penrose, 1959; Teece, Pisano & Shuen, 1997).

The central role of capital and capital structure, depicted with a dashed border in Figure 4, signifies its mediating function in the model. Positioned at the intersection of financial markets, sources of finance, and firm-specific factors, capital structure directly influences the allocation of resources and, consequently, overall firm performance. By managing capital efficiently, firms can mitigate financing risks and enhance their strategic capacity to adapt to market fluctuations (Brearly, Myers & Allen, 2014). This dynamic interaction underscores the importance of a balanced capital structure, as excessive debt or equity reliance can impair long-term sustainability (Jensen & Meckling, 1976).

Ultimately, the model posits firm performance as the outcome of these endogenous and exogenous factors. Performance is not solely a product of isolated strategies or resources but rather a cumulative outcome of how well a firm aligns its internal capabilities with external opportunities and constraints. By synthesising these components, the conceptual model provides a holistic perspective on the factors influencing start-up success, and highlights the critical need for strategic alignment between internal resources, financial structures, and market conditions.

3. Empirical approach

3.1. Introduction

In this chapter, I outline the empirical approach used to investigate the impact of leverage on the financial performance of start-ups in Sweden. Leveraging the Serrano database, a comprehensive source of firm-level financial data, I construct a robust dataset that enables examination of the relationship between leverage and performance metrics such as the operating income ratio and sales growth.

The foundation of the empirical approach is guided by the research model presented in Figure 5. This model encapsulates the key variables and hypothesised relationships central to the study, and provides a conceptual framework for the analysis. I begin by detailing the data sources and the rigorous sample selection process used to ensure internal validity. This is followed by a discussion of the operational definitions for the key variables, including leverage, performance metrics, and control variables, which are all grounded in established methodologies.

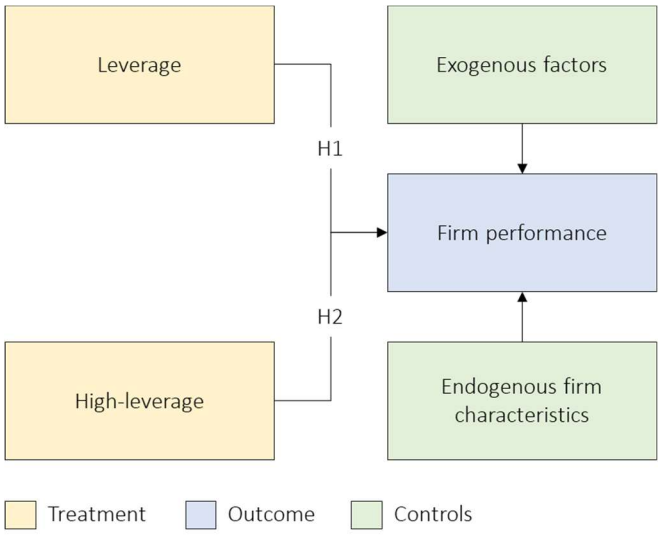

Figure 5: Research model of hypotheses

The choice of a fixed effects panel regression model is then justified in the context of the dataset's large-N, small-T structure, so enabling the accounting for unobserved heterogeneity and time-invariant firm-specific characteristics. I also outline diagnostic tests and robustness checks to ensure statistical validity, and address issues such as multicollinearity, heteroskedasticity, and autocorrelation.

By combining the conceptual insights from Figure 5 with a rigorous empirical approach, this chapter sets the stage for answering the research question: What is the impact of leverage on the performance of Swedish start-ups? This structured analysis aims to provide actionable insights into how financial decisions influence the growth and sustainability of early-stage firms.

3.2. Data

In the following section I detail the data used in this study, including its sources, the criteria I used to construct the sample, and the procedures employed for cleaning and preprocessing variables.

3.2.1. Data sources

For the analysis, I used the Serrano database, a comprehensive population dataset[5] that contains company-level annual financial data for all corporations in Sweden since 1997 (Weidenman, 2016). The data are derived by Bisnode from financial statements and organisational reporting submitted to the Swedish Companies Registration Office and the Swedish Patent and Registration Office, with supplemental information provided by Statistics Sweden.

The Serrano database offers detailed information reported at the level of individual companies, including data on company groups and ownership structures[6]. Each firm in the dataset is assigned a unique identifier, enabling the tracking firm performance over time and facilitating panel data analysis, which is discussed in detail in subsequent sections.

3.2.2. Sample selection

The initial dataset encompassed all firms in Sweden between 1998 and 2017, totalling 1,247,632 unique firms. Over this 20-year period, I began the sample selection process with 11,285,261 firm-year observations. To focus on for-profit start-ups relevant to the study, I first elected to retain only limited liability companies and partnerships, and removed all other entity types. This decision ensured that the firms included are comparable in terms of legal and financial structures, which is important for the consistency and validity of the analysis. This step reduced the dataset to 1,181,021 unique firms and 10,703,252 firm-year records.

Next, I narrowed the focus to firms founded between 1998 and 2017. By excluding firms registered outside of this window, I aimed to avoid survivorship bias and ensured that all firms could contribute data across the same time frame. This selection criterion reduced the dataset further to 426,095 unique firms and 3,389,697 firm-year observations. Concentrating on this cohort allowed the examination of firms that share a common macroeconomic environment at their inception, so enhancing the comparability of the analysis.

Subsequently, I aimed to exclude non-active firms and spin-off entities to concentrate on operational start-ups that have moved beyond the nascent stage of development. To achieve this, I excluded firms that have ever had less than two employees during the observation period. I acknowledge that some start-ups may begin with a single

[5] It is mandatory for all firms in Sweden to annually complete financial, organizational, and staffing reporting. This data are collected, anonymized, and compiled into the Serrano dataset. For this reason, I am confident that the Serrano dataset is a population dataset of all formal corporations in Sweden.
[6] The Serrano dataset also includes information on firm bankruptcy, liquidation (voluntary or involuntary), and company status.

founder, but setting this threshold ensured that included firms have demonstrated a minimum level of operational activity, thereby enhancing the relevance and reliability of the performance analysis. This final filtering step resulted in a dataset of 66,069 unique firms and 533,464 firm-year observations.

Table 4: Sample selection table

Description	Number of unique firms	Firm-year records
Serrano dataset	1,247,632	11,285,261
Of which are limited liability companies and partnerships	1,181,021	10,703,252
Of which are start-up cohorts between 1997 and 2017	426,095	3,389,697
Of which have had at least two or more employees[7]	66,069	533,464

The substantial reduction in sample size from the initial dataset is a result of applying these selection criteria, and which is designed to improve the internal validity of the study. By focusing on active for-profit start-ups founded in a specific period and exhibiting a minimal level of operational activity, I aimed to create a homogeneous sample that allows for more accurate estimation of the impact of leverage on firm performance. However, I recognised that these exclusions may introduce limitations regarding the generalisability of the findings to the broader population of Swedish firms, in particular very small start-ups or those with different organisational structures. I addressed potential biases arising from the sample selection by conducting robustness checks and sensitivity analyses, which are discussed in later sections.

These 66,069 firms with 533,464 observations made up the final dataset, as described in Table 4. To be precise, the data are not a sample, but the entire population of such firms in Sweden between 1998 and 2017. The empirical benefits of using a population dataset are numerous, so enhancing both precision and validity in analysis. First, population datasets eliminate sampling error, and provide exact estimates rather than probabilistic approximations – dispensing the need for relying on p-values for empirical estimates (Wooldridge, 2014). This leads to high internal validity, so ensuring that findings are fully representative of the defined population without generalisation concerns. With increased statistical power, even small effects become detectable, so allowing for nuanced investigations. Longitudinal trends and macroeconomic dynamics can be studied comprehensively,

[7] I include firms in our sample who have at least two employees. I reviewed the resultant dataset with this and other conditions. A limit of at least one employee allowed for a sample which is sufficiently comprised of 'zombie' firms to bias our results. I chose a limit of at least 2 employees to remove the bulk of zombie firms and ensure a sample of economically active firms.

unaffected by under-representation or omitted observations. Furthermore, such datasets enable advanced econometric modelling, including non-linear interactions and robust benchmarks that would be underpowered in smaller samples. Importantly, the reliance on p-values diminishes in a population context, as the dataset provides the actual parameters of interest rather than inferential statistics based on samples (Wooldridge, 2014).

3.2.3. Data cleaning and preprocessing

Each variable of interest in the dataset was carefully examined to identify potential outliers and abnormalities. This process began with the generation of histograms and summary statistics for all variables deemed relevant to the research. The objective was to retain as much data as possible, so minimising the removal of entire records even in the presence of anomalies or outliers.

To address such instances, I used winsorisation, a technique that adjusts extreme values by recoding them to a specified cutoff percentile. This approach ensured that outlier values beyond a predetermined threshold were replaced with the value of the threshold itself, so preserving the integrity of the dataset while mitigating the influence of extreme observations. In this study, I applied winsorisation at the 1st and 99th percentiles (p1 and p99), at the 99th percentile (p99) alone, or, in some cases, not at all. A detailed summary of the treatment applied to each variable is provided in the Appendix.

3.3. Variable selection and development

In this section I detail the approach followed to select and operationalise dependent, treatment, and control variables.

3.3.1. Dependent variables

Dependent variable choice

Given the context of the study being start-ups in Sweden, I argue that the most appropriate measures to consider are those of fundamental financial performance. This is because: 1) start-ups are typically not public companies and market performance is impractical to measure, and 2) the data are of a financial nature are not conducive to measuring other performance metrics which may relate to customer satisfaction or employee turnover, for example.

In examining the appropriate dependent variables for analysing the impact of leverage on firm performance in start-ups, I surveyed and analysed the empirical literature. I summarise the findings in the Appendix. The selection of these variables is crucial, as they determine how performance is measured and how the effects of leverage are interpreted in the context of start-up enterprises.

One prominent option is the operating income ratio (OIR), which measures operating income as a percentage of sales. This ratio focuses on the profitability derived from a firm's core business operations, excluding financing and tax expenses. Tsuruta (2015) used the OIR in his study of Japanese SMEs to assess how leverage influences operational efficiency. For start-ups, which often operate with limited resources and face intense competitive pressures, operational efficiency is paramount. By focusing on OIR, researchers can isolate the effects of leverage on the fundamental profitability of the firm's primary activities, so providing insights into managerial effectiveness and cost control.

Another compelling dependent variable is sales growth, which represents the rate at which a company's sales revenue increases over a specific period. Sales growth is a critical indicator of market acceptance and expansion capability, both essential factors for start-ups striving to establish their market presence. In Tsuruta's (2015) analysis, sales growth was significantly affected by leverage levels, which suggests that borrowed capital may enable start-ups to scale their operations, invest in marketing, or expand into new markets. However, excessive leverage could also strain resources, so potentially hindering growth if debt servicing becomes burdensome.

Operating income growth, which tracks the increase in operating income over time, is another lens for viewing firm performance. This measure captures not just the efficiency at a single point but the dynamic progression of operational profitability. Start-ups typically experience volatile growth patterns, and operating income growth can reflect their ability to scale operations sustainably. Tsuruta (2015) found that leverage can have a nuanced impact on operating income growth, potentially facilitating expansion but also introducing financial risks that could offset operational gains.

Return on assets (ROA) is also frequently used in empirical studies as a measure of firm performance. It assesses how effectively a company uses its assets to generate earnings, and combines operational efficiency with asset use. Agostino and Trivieri (2010) used ROA to evaluate the effects of banking competition on SME performance in Italy, so indirectly linking leverage through financing conditions. While ROA provides a broad view of performance, it incorporates the effects of both operational decisions and financing strategies, which may confound the specific impact of leverage on operational performance in start-ups with unconventional asset structures.

Considering the high failure rates among start-ups, firm survival emerges as a fundamental dependent variable. Cole and Sokolyk (2018a) investigated how debt financing affects the survival and growth of start-up firms, using survival analysis techniques. Survival as a metric encapsulates the ultimate measure of a start-up's performance – its ability to continue operations over time. Leverage can play a dual role in this context, and provide the necessary capital to sustain operations while simultaneously increasing financial obligations that may threaten viability if revenues are insufficient.

The investment rate, defined as capital expenditures divided by beginning-of-period capital stock, is another potential dependent variable. Studies such as Aivazian, Ge, and Qiu (2005b) examined how leverage influences

corporate investment decisions, which are critical for growth and competitiveness. For start-ups, investment often represents a commitment to innovation and market development. However, using the investment rate as a dependent variable may shift the focus from performance outcomes to strategic financial decisions, which may be more appropriately modelled as mediating factors rather than as direct measures of performance.

Finally, performance variability – the variance of performance metrics over time – provides insight into the stability and risk associated with a firm's operations. Tsuruta (2017) explored how leverage affects the variability of operating income and sales growth in small businesses. While this measure captures the risk dimension of performance, start-ups inherently face high variability because of market uncertainties, and focusing on variability could obscure the average effects of leverage on performance levels.

After considering these options, I decided to use operating income ratio and sales growth stand out as the most appropriate dependent variables for the study. The OIR directly measures operational profitability, offering a clear view of how leverage impacts the efficiency of core business activities. This focus aligns with the findings of Tsuruta (2015), who demonstrated that leverage influences operational outcomes in SMEs. For start-ups, where operational success is critical amidst resource constraints, understanding this relationship is vital.

Sales growth complements this perspective by capturing the firm's ability to expand its revenue base. Leverage may provide the financial means to invest in growth opportunities, and suggest a positive relationship between reasonable levels of debt and sales expansion. However, excessive leverage could hinder growth if it leads to financial distress. By analysing sales growth, I can assess how leverage affects the firm's market performance and capacity to scale, which are crucial determinants of long-term success.

In conclusion, selecting the OIR and sales growth as dependent variables offered a balanced and comprehensive approach to evaluating the impact of leverage on start-up performance. These measures capture both internal operational efficiency and external market success, and reflect the multifaceted nature of performance in early-stage firms. By grounding the analysis in established empirical research, such as that of Tsuruta (2015) and Agostino and Trivieri (2010), I built on proven methodologies while contributing new insights that are specific to start-ups. This approach facilitated a nuanced understanding of how leverage influences performance, and provided valuable implications for entrepreneurs, investors, and policymakers concerned with the financial management and success of start-up ventures.

Variable operationalisations

I followed Tsuruta's (2015, 2017) operationalisation of operating income ratio (OIR) for the study. A firm's OIR is the firm's change operating income (from year t-1 to t+1) divided by its total assets (in year t-1) in absolute terms. I calculated the measure for each firm-year, and then adjusted for industry differences, which I did by

subtracting the industry median from the measure. I chose to 'de-median' rather than 'de-mean' to minimise the effect of outliers that are unrepresentative of typical industry performance.[8]

I computed industry-adjusted (adjOIR) as:

$$adjOIR_{t,i,j} = OIR_{t,i} - \overline{OIR_{t,j}} \quad (1)$$

$$OIR_{t,i} = \frac{operating\ income_{t+1,i} - operatin\ \ income_{t-1,i}}{assets_{t-1,i}} \quad (2)$$

$$\overline{OIR_{t,j}} = median_{t,j}\left(\frac{operating\ income_{t+1,j} - operating\ income_{t-1,j}}{assets_{t-1,j}}\right) \quad (3)$$

Where $\overline{OIR_{t,j}}$ is the median of OIR for an industry, *j*, in year, *t*. And $OIR_{t,i}$ is the OIR for any firm, *i*, in industry, *j*, and in year, *t*.

Regarding sales growth, I followed Opler and Titman (1994), Molina and Preve (2012), and Tsuruta (2015, 2017) in their operationalisation of sales growth as a dependent variable. To do so, I took the difference in firm sales over time (from year t-1 to t+1) and divided it by firm assets (year t-1). I calculated the measure for each firm-year, and then adjusted for industry differences, which is done by differencing the industry median from the measure.

I computed industry-adjusted sales growth (adjSalesGrowth) as:

$$adjSalesGrowth_{t,i,j} = SalesGrowth_{t,i} - \overline{SalesGrowth_{t,j}} \quad (4)$$

$$SalesGrowth_{t,i} = \frac{sales_{t+1,i} - sales_{t-1,i}}{assets_{t-1,i}} \quad (5)$$

$$\overline{SalesGrowth_{t,j}} = median_{t,j}\left(\frac{sales_{t+1,j} - sale\ _{t-1,j}}{assets_{t-1,j}}\right) \quad (6)$$

Where $\overline{SalesGrowth_{t,j}}$ is the median of $SalesGrowth$ for an industry, *j*, in year, *t*. And $SalesGrowth_{t,i}$ is the sales growth for any firm, *i*, in industry, *j*, and in year, *t*.

3.3.2. Treatment variables

Leverage

Again, I followed Opler and Titman (1994), Molina and Preve (2012), and Tsuruta (2015, 2017) in their operationalisation of leverage. I considered leverage to be the book value of debts (both current and non-current liabilities) over the book value of assets in year t-2. I used ex-ante leverage to avoid confounding, endogeneity, and spurious correlations between the treatment variables and dependent variables.

[8] Tsuruta (2015, 2017) elected to 'de-mean' their OIR measure. For the reasons stated, I used 'de-median' instead.

I operationalised leverage as:

$$Leverage_{t-2,i} = \frac{liabilities_{t-2,i}}{assets_{t-2,i}} \quad (7)$$

Where $Leverage_{t-2,i}$ is leverage in year *t*-2 for any firm, *i*.

High leverage

I defined a binary dummy variable for high leverage. This variable is coded to 1 when leverage is considered high, and 0 when leverage is not high. I defined leverage as being high when the leverage for a firm is in the top quintile in a particular industry year.

I operationalised high leverage as:

$$HighLeverage_{t-2,i} = \begin{cases} 1, & if\ Leverage_{t-2,i} \geq Q_{0.8}(L_{t-2,i}) \\ 0, & if\ Leverage_{t-2,i} < Q_{0.8}(L_{t-2,i}) \end{cases} \quad (8)$$

Where $Q_{0.8}(L_{t-2,i})$ was calculated based on the distribution of leverage among all firms in the same industry, *j*, and year, *t*-2.

3.3.3. Control variables

In the empirical analysis, several control variables were incorporated to isolate the effect of leverage on start-up firm performance and to mitigate potential omitted variable bias. These controls were carefully selected based on their theoretical relevance and empirical support in the literature. By including firm size, age, industry and year dummies, liquidity, profitability, and collateral availability, I aimed to account for factors that could confound the relationship between leverage and performance. Each control variable was measured at time t−2 to address endogeneity concerns arising from reverse causality.

Firm size was operationalised as the natural logarithm of sales (ln(sales)) and named ***scale***, so reflecting the scale of the firm's operations. Larger firms may benefit from economies of scale, enhanced bargaining power (both with customers and suppliers), and greater access to financial and human resources – all of which can influence performance outcomes (Porter, 1985). Tsuruta (2015) demonstrated that firm size significantly affects operating income and sales growth in Japanese SMEs, so suggesting its importance as a control variable. By using the logarithmic transformation, I accounted for diminishing marginal effects of size on performance, which is consistent with the approach in Agostino and Trivieri (2010).

Firm ***age***, measured by the number of years since establishment, was included to capture the life cycle effects on performance. Older firms may have more established market positions, customer bases, and refined business processes, so potentially leading to better performance. Conversely, younger firms may exhibit higher growth potential but face greater uncertainty and operational challenges. Tsuruta (2015) and Weill (2008) included firm age as a control – acknowledging its impact on firm dynamics and performance metrics.

I incorporated industry and year dummy variables to control for unobserved heterogeneity arising from industry-specific characteristics and temporal effects. Industry dummies account for factors such as competitive intensity, regulatory environments, and typical capital structures that vary across sectors. Year dummies control for macroeconomic conditions, technological changes, and other time-specific influences that could affect all firms in a given period. Ahn et al. (2006) and Lang et al. (1996) used industry and year fixed effects to mitigate bias from omitted variables correlated with both the independent and dependent variables.

Liquidity was controlled for by using the ***current ratio***, which is defined as the natural logarithm of current assets divided by current liabilities. Liquidity reflects a firm's ability to meet short-term obligations and manage cash flows, which can influence operational stability and investment capacity. Firms with higher liquidity may be better positioned to withstand financial shocks and capitalise on growth opportunities, so potentially affecting performance independently of leverage. Tsuruta (2015) found that liquidity ratios significantly affect operating income and sales growth, which underscores their relevance in performance analyses.

Profitability was measured using the natural logarithm of return on assets (***ROA***) at time $t-2$, so capturing the firm's efficiency in using assets to generate earnings in prior periods. Past profitability can influence current performance through retained earnings available for reinvestment, reputation effects, and internal financing capabilities. Including lagged ROA helps control for persistent performance traits and reduces endogeneity concerns. Cole and Sokolyk (2018a) included prior profitability to isolate the effect of financing choices on start-up outcomes.

Collateral availability was proxied by the natural logarithm of the ratio of tangible assets to total assets, which indicates the extent to which a firm possesses assets that can be pledged as security for debt. Higher ***collateral*** availability can enhance access to external financing on favourable terms, so affecting both leverage levels and performance. Firms with substantial tangible assets may secure larger loans or lower interest rates, which facilitates investment and growth. Tsuruta (2015) highlighted the role of collateral in SMEs' financing decisions and its subsequent impact on performance metrics.

Finally, because interest rates are a key determinant of leverage, I controlled for ***interest rate*** as derived as the natural logarithm of a firm's interest expenses divided by its short- and long-term liabilities in any given year (Tsuruta, 2015, 2017).

By measuring these control variables at time $t-2$, I addressed potential reverse causality where current performance could influence the contemporaneous values of the controls. Lagging the variables ensures that the controls are predetermined with respect to the dependent variable, so enhancing the causal interpretation of the results. This approach is consistent with the methodologies used by Aivazian et al. (2005b) and Tsuruta (2015), who used lagged independent variables to mitigate endogeneity concerns.

In summary, including these control variables allowed us to account for firm-specific characteristics, industry and temporal effects, financial health, and asset structure that could influence start-up performance independently of

leverage. By controlling for firm size, age, liquidity, profitability, and collateral availability, and by incorporating industry and year dummies, I aimed to obtain unbiased estimates of the impact of leverage on OIR and sales growth. This comprehensive approach strengthened the robustness of the empirical findings and contributed to a deeper understanding of the financial dynamics affecting start-up firms.

3.4. Empirical approach

3.4.1. Estimation technique

To effectively address the research question and test the associated hypotheses, selecting a model estimation technique that aligns with the data's characteristics was crucial. The dataset comprised 66,069 firms observed over a 20-year period from 1997 to 2017. This large-N, small-T panel structure – with a vast number of cross-sectional units (firms) but relatively few time periods – requires a method suitable for such dimensions.

I used a static panel regression model as the primary estimation technique. This choice allows observation of the magnitude, sign, and significance of the regression coefficients, thereby empirically testing the hypotheses. Among the options for panel data analysis, I considered both fixed effects and random-effects models. The Fixed Effects Model emerged as the more appropriate tool for the study (Wooldridge, 2014). Fixed effects models control for all time-invariant differences between firms. They effectively eliminate biases arising from omitted variables that do not change over time, such as managerial style or corporate culture. Wooldridge (2014) emphasised that ceteris paribus effects are most convincingly estimated using fixed effects models. By using firm-specific intercepts, I captured unobserved heterogeneity across firms.

Moreover, the Fixed Effects Model accounted for differences in firm performance owing to economic cycles. Since the study spanned two decades, controlling for temporal effects was crucial. Incorporating time dummies or trends allowed mitigation of the influence of macroeconomic factors that could affect all firms simultaneously.

In conclusion, the fixed effects panel regression model suited the study because of its ability to control for unobserved heterogeneity and its compatibility with the dataset's structure. By satisfying the Classic Linear Model (CLM) assumptions and addressing statistical issues such as heteroskedasticity and autocorrelation, I enhanced the reliability of the estimation results (Wooldridge, 2014). This methodological approach allowed the rigorous examination of the impact of leverage on firm performance in Swedish start-ups over the specified period.

3.4.2. Model specification

After selecting the estimation technique and key dependent, treatment, and control variables, I established the four model specifications. These regression equations tested the two hypotheses across the two dependent variables of interest:

$$adjOIR_{t-1\rightarrow t+1,i,j} = \beta_0 + \beta_1 Leverage_{t-2,i} + \beta_n \mathrm{Z}_{t-2,i} + \eta_i + \epsilon_{t,i} \quad (9)$$

$$adjOIR_{t-1\rightarrow t+1,i,j} = \beta_0 + \beta_1 Leverage_{t-2,i} + \beta_2 Leverage_{t-2,i} \times HighLeverage_{t-2,i} + \beta_n \mathrm{Z}_{t-2,i} + \eta_i + \epsilon_{t,i} \quad (10)$$

$$adjSalesGrowth_{t-1\rightarrow t+1,i,j} = \beta_0 + \beta_1 Leverage_{t-2,i} + \beta_n \mathrm{Z}_{t-2,i} + \eta_i + \epsilon_{t,i} \quad (11)$$

$$adjSalesGrowth_{t-1\rightarrow t+1,i,j} = \beta_0 + \beta_1 Leverage_{t-2,i} + \beta_2 Leverage_{t-2,i} \times HighLeverage_{t-2,i} + \beta_n \mathrm{Z}_{t-2,i} + \eta_i + \epsilon_{t,i} \quad (12)$$

Where:

- $adjOIR_{t-1\rightarrow t+1,i,j}$ is a firm's industry-adjusted OIR.
- $adjSalesGrowth_{t-1\rightarrow t+1,i,j}$ is a firm's industry-adjusted sales growth.
- $Leverage_{t-2,i}$ is a firm's measure of leverage.
- $Leverage_{t-2,i} \times HighLeverage_{t-2,i}$ is the interaction effect of leverage and the high-leverage dummy variable
- $\mathrm{Z}_{t-2,i}$ is a vector of the control variables
- *t* is any given year, *i* is any given firm, and *j* is any given industry.

Equations (9) and (11) describe the models used to test $\boldsymbol{H_1}$ against OIR and sales growth as firm performance measures, respectively, whereas equations (10) and (12) test $\boldsymbol{H_2}$ against those same respective dependent variables.

3.5. Robustness testing

Before implementing the Fixed Effects Model, it is important to validate that the data and estimation technique satisfy the underlying assumptions necessary for reliable inference. These assumptions are based on the Classical Linear Model (CLM), which includes the five Gauss-Markov conditions: linearity in parameters, random sampling, no perfect multicollinearity, zero conditional mean of errors (exogeneity), and homoskedasticity (constant variance of errors) (Wooldridge, 2014). In addition, the CLM assumes normally distributed error terms for conducting hypothesis tests and constructing confidence intervals.

I conducted diagnostic tests to assess whether these assumptions held in the dataset. First, I tested for multicollinearity among the independent variables using variance inflation factors (VIFs). Ensuring that no perfect linear relationships exist between regressors is vital. Second, I examined the residuals for heteroskedasticity using the Breusch-Pagan test (Breusch & Pagan, 1979). If heteroskedasticity was detected, I adjusted the standard errors using robust or clustered standard errors to obtain consistent estimates.

Serial correlation, or autocorrelation, is another concern in panel data analysis, especially with large-N, small-T datasets. It occurs when error terms are correlated over time within the same firm, so leading to underestimated

standard errors and inflated t-statistics. I performed the Wooldridge test (Wooldridge, 2014) for autocorrelation in panel data to detect any serial correlation in the residuals.

An essential consideration in choosing between the fixed effects and random-effects models was whether unobserved individual effects are correlated with the explanatory variables. The Hausman test helps determine the appropriate model by comparing fixed and random-effects estimators (Hausman, 1978). A significant Hausman test result suggests that the Fixed Effects Model is preferred because it provides consistent estimates when individual effects correlate with regressors (Hausman, 1978). In the analysis, I performed the Hausman test and rejected the null hypothesis of no correlation. This outcome indicates that the Fixed Effects Model was indeed the appropriate choice for the study.

4. Results

In this chapter I present the empirical findings that explore the relationship between leverage and the performance of Swedish start-ups. Building on the theoretical frameworks and hypotheses developed in Chapter 2 and the methodological foundation established in Chapter 3, I provide a detailed analysis of key performance metrics, including profitability, growth, and resilience.

I begin with an overview of the descriptive statistics, which provide essential insights into the characteristics of the sampled firms and set the stage for our analyses. I then examine the pairwise correlations among key variables, which provide context for the regression analyses that follow. These analyses investigate both the effects of moderate leverage on firm performance and the impacts of high leverage. By doing so, I offer more nuanced results that can be related back to the fundamental theories examined in Chapter 2, such as the trade-off theory and the pecking order theory.

In addition, I quantify the magnitude of leverage's impact through effect size estimates and examine sectoral and temporal variations to better understand the context-dependent dynamics of leverage. Supplementary analyses deepen the investigation by considering whether there may be an optimal 'goldilocks' zone for start-up leverage. To ensure the robustness of the findings, I use a range of tests to address potential issues such as multicollinearity, heteroskedasticity, and outlier influence.

4.1. Descriptive statistics

The dataset for this study comprises population financial and operational panel data from 533,464 firms and spanning two decades. The variables analysed include measures of financial performance such as sales growth, adjusted OIR (adjOIR), leverage, return on assets (ROA), and interest rates, alongside firm characteristics such as firm size and collateral availability. These descriptive statistics establish the foundation for understanding how leverage affects firm performance across diverse contexts and firm profiles.

Table 5: Summary of descriptive statistics for variables of interest

Variable	N	Mean	SD	p5	p25	p50	p75	p95
Sales growth	362,984	41.11	180.05	-139.30	-35.94	0.00	71.12	352.33
adjOIR	403,332	5.94	38.51	-38.30	-11.34	0.00	13.78	70.63
Current asset ratio	533,246	4.24	0.50	3.13	4.10	4.46	4.58	4.62
Scale	533,447	8.55	1.50	6.32	7.75	8.52	9.37	10.93
ROA	447,163	2.54	1.02	0.55	1.95	2.71	3.29	3.92
Collateral availability	533,316	4.59	0.11	4.44	4.62	4.62	4.62	4.62
Leverage	532,733	18.98	24.06	0.00	0.00	6.92	33.22	69.97
High leverage	533,464	0.20	0.40	0.00	0.00	0.00	0.00	1.00
Leverage x High leverage	532,733	11.59	24.40	0.00	0.00	0.00	0.00	69.96
Sales	533,447	32,608.04	353,647.60	553.00	2,317.00	4,994.00	11,761.00	56,030.00
Assets	533,350	19,815.57	500,830.80	377.00	1,045.00	2,352.00	5,840.00	28,412.00
Interest rate	533,037	0.02	0.02	0.00	0.00	0.01	0.02	0.05

In Table 5 I outline the summary statistics for the variables included in this analysis. Sales growth, one of the key variables, exhibits a mean of 41.11% with a wide standard deviation of 180.05%, which reflects substantial variability among firms. The median growth rate is 0.00%, and the interquartile range suggests that between 50% and 75% of firms experience little to no growth, while a subset achieves extraordinary increases in sales. This wide dispersion in sales performance indicates the heterogeneity in the sample, where some firms are likely experiencing rapid expansion, while others may be struggling to maintain market presence or are in the pre-

revenue stage of development. Leverage, with an average value of 18.98%, similarly demonstrates considerable variability, as indicated by a standard deviation of 24.06%. A significant proportion of firms report little to no leverage, with the 25th percentile at 0.00%, while the upper quartile shows substantially higher levels of leverage at 33.22%. ROA, with a mean of 2.54% and a relatively narrow interquartile range from 1.95% to

3.29%, suggests that there is consistent profitability for most firms in the sample, despite notable variation in sales growth and leverage.

The sectoral composition of the dataset, shown in Table 6, highlights the concentration of firms in particular industries. Shopping Goods accounts for the largest share, and represents 26% of the sample, followed closely by Corporate Services at 22%. Construction is another significant contributor at 18%, while Health and Education make up 8%. These sectors dominate the entrepreneurial landscape, reflecting the economic activities most prevalent among start-ups in Sweden. Conversely, sectors such as Energy and Environment and Telecom and Media are minimally represented, with each accounting for 1% or less of firms. While this distribution only considers the volume of start-ups in each sector and not their value, it underscores the service-oriented and consumer-driven nature of the Swedish start-up ecosystem.

Table 6: Firm-year observations by sector

Sector	Total	% Total
Energy and Environment	2,463	0
Materials	9,924	2
Industrial Goods	39,667	7
Construction	93,790	18
Shopping Goods	139,047	26
Convenience Goods	28,242	5
Health and Education	40,016	8
Finance and Real Estate	16,832	3
IT and Electronics	28,617	5
Telecom and Media	7,097	1
Corporate Services	115,488	22
Other	12,014	2
Uncategorized	267	0
Total	533,464	100

Firm formation trends over the 1998–2017 period, as shown in Table 7, reveal dynamic shifts in entrepreneurial activity. Early in the observation period, the number of new firms increased steadily, and peaked in 1999 and 2000 with 30% and 14% year-over-year growth, respectively. However, this upward trajectory was disrupted in the years following the 2008 global financial crisis. A gradual decline in new firm formations is evident, and culminates in

dramatic decreases in 2016, where year-over-year changes fell by 31%.[9] These trends illustrate the sensitivity of entrepreneurial activity to macroeconomic conditions and potentially to changes in government policy or access to capital.

Table 7: Number of firms founded by year with percentage changes

Cohort	Firms founded	Percent change
1998	22,774	
1999	29,719	30
2000	33,981	14
2001	28,178	-17
2002	28,448	1
2003	26,817	-6
2004	30,346	13
2005	28,841	-5
2006	31,434	9
2007	35,268	12
2008	32,844	-7
2009	27,888	-15
2010	36,797	32
2011	34,581	-6
2012	26,038	-25
2013	24,080	-8
2014	21,278	-12
2015	18,851	-11
2016	13,045	-31
Total	**533,464**	

Leverage, a focal variable in this study, exhibits an intriguing trend when analysed by firm age – as seen in Figure 6. Younger firms tend to rely heavily on debt to finance their initial operations and growth efforts. However, leverage consistently decreases with firm age, stabilising at lower levels approximately five years after inception. This pattern suggests that as firms mature, they transition to alternative financing methods such as reinvested earnings or equity, so potentially reflecting greater financial stability and reduced reliance on external debt. This trend aligns with theoretical frameworks suggesting that financial strategies evolve over a firm's life cycle, with early-stage firms prioritising debt for immediate capital needs while older firms optimise for long-term sustainability.

[9] I excluded firms founded in 2017 as it is an outlier year with only 2,256 firms founded, which meet the criteria. Because of this deviation from the trend and lack of sufficient panel data from these firms, I did not include them in the analysis.

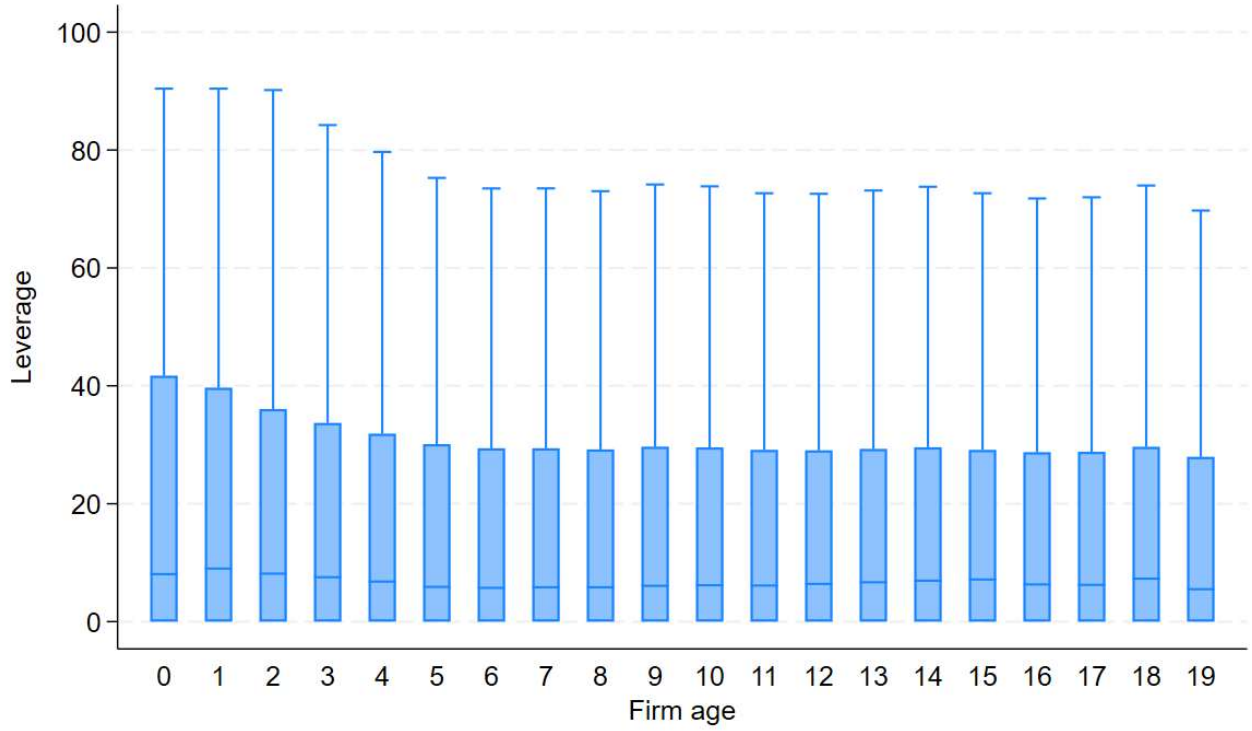

Figure 6: Box plot of leverage by firm age[10]

Interest rates, another critical financial variable, show remarkable stability over the observation period, with a mean of 2% and a narrow distribution around this value as seen in Figure 7. Most firms secure debt at rates of 1–2%, so suggesting a relatively consistent borrowing environment. However, slight increases in interest rates are evident during periods of economic downturn, likely reflecting heightened risk premiums imposed by lenders in uncertain conditions. This finding underscores the importance of macroeconomic stability in maintaining favourable financing conditions for start-ups.

[10] Observations outside of the box plots have been excluded.

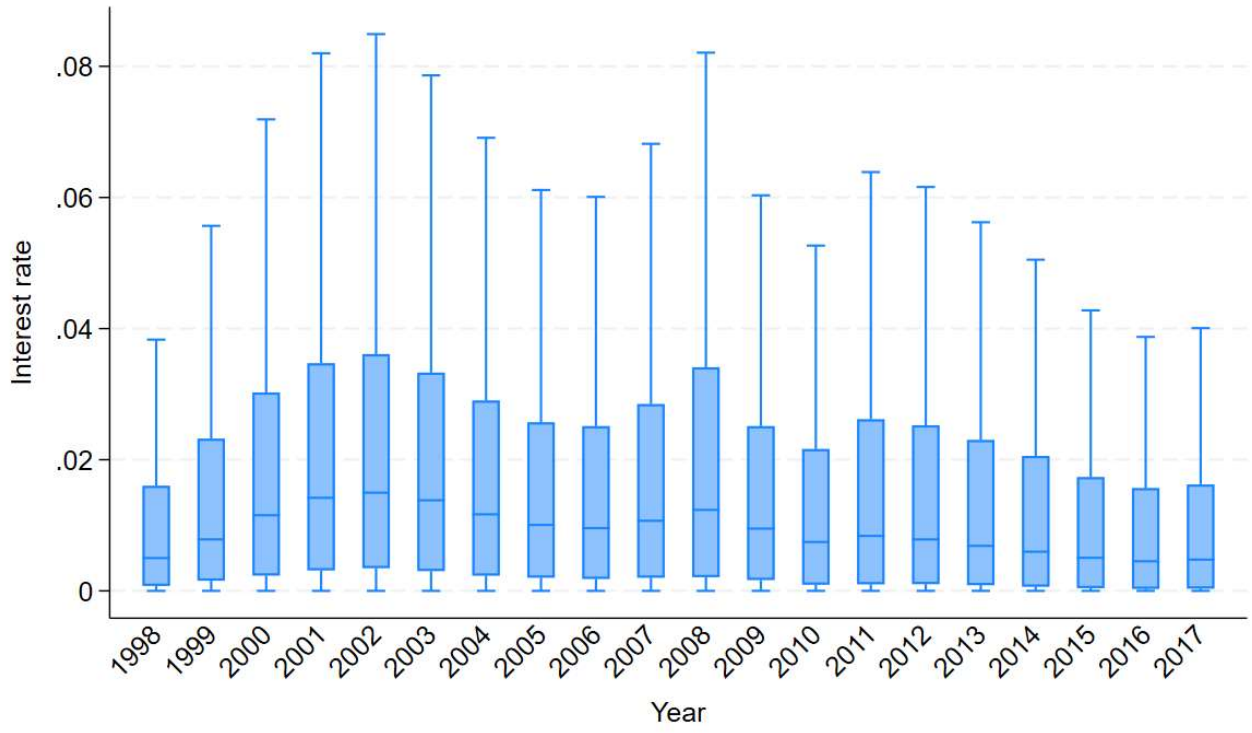

Figure 7: Box plot of firm interest rates by year[11]

The variability observed across key financial metrics, in particular sales growth and leverage, emphasises the heterogeneity of the firms in the sample. Sales growth, for instance, ranges from significant declines at the lower percentiles to exceptional gains at the upper extremes. Similarly, leverage spans a wide spectrum, with some firms entirely avoiding debt while others exhibit high reliance on external financing. This dispersion likely reflects differences in firm strategy and external conditions, and will be explored further in subsequent sections that analyse the drivers and outcomes of these financial patterns.

In summary, the data reveals significant variability in firm performance and financial behaviour, so underscoring the complexity of the relationships examined in this study. The trends observed in firm formation, sectoral representation, leverage, and interest rates not only contextualise the study but also highlight key themes that will inform the interpretation of results in later chapters. The insights gained are integral to understanding the nuanced dynamics of leverage and its impact on start-up performance in Sweden.

This section sets the stage for deeper investigation into these relationships, as detailed in the regression analyses that follow.

[11] Observations outside of the box plots have been excluded.

4.2. Correlations

The correlation analysis in Table 8 provides an initial understanding of the relationships among the key variables used in the model. By examining pairwise correlations, I could identify potential multicollinearity issues and explore the strength and direction of associations between regressors in the model.

Table 8: Pairwise correlation matrix of the regressors of the estimation model

Variable		1	2	3	4	5	6	7	8	9	10
1	Sales growth	1.00									
2	adjOIR	0.20	1.00								
3	Current asset ratio	0.07	0.03	1.00							
4	Scale	0.07	0.01	0.06	1.00						
5	ROA	0.07	0.06	0.22	0.11	1.00					
6	Collateral availability	-0.02	0.01	0.27	0.07	0.10	1.00				
7	Leverage	-0.04	-0.04	-0.55	0.03	-0.33	-0.17	1.00			
8	High leverage	-0.03	-0.03	-0.45	0.00	-0.25	-0.14	0.81	1.00		
9	Leverage x High leverage	-0.03	-0.03	-0.49	-0.02	-0.27	-0.15	0.87	0.95	1.00	
10	Interest rate	-0.08	-0.02	-0.25	0.04	-0.03	-0.06	0.29	0.21	0.21	1.00

Sales growth, one of two primary dependent variables, exhibits weak positive correlations with most financial metrics. For example, sales growth's relationship with scale and return on assets (ROA), shows even weaker positive correlations (both at 0.07), which indicates that while these factors may play a role in firm growth, their direct linear relationships are limited. OIR, the other dependent variable, exhibits similar correlations, with weak correlations across other financial metrics.

Leverage demonstrates notable negative correlations with several variables. It is strongly negatively correlated with the current asset ratio (-0.55), which indicates that firms with higher leverage tend to have lower liquidity levels. Similarly, leverage is negatively correlated with ROA (-0.33), which suggests that firms with higher debt levels are generally less profitable. These findings align with expectations in the corporate finance literature, where increased financial obligations often reduce operational flexibility and net returns (Opler & Titman, 1994; Agostino & Trivieri, 2010; Cai & Zhang, 2011).

The high-leverage variable, which identifies firms with exceptionally high-leverage ratios (top quintile), is highly correlated with leverage (0.81) and the interaction term leverage × high leverage (0.95). High-leverage is also negatively correlated with the current asset ratio (-0.49) and ROA (-0.25), which mirrors the patterns observed with the primary leverage variable.

Interest rates, while generally stable across the sample, show weak negative correlations with most variables. For instance, the interest rate is weakly negatively correlated with ROA (-0.03) and the current asset ratio (-0.25), which suggests that firms with stronger financial positions tend to access financing at lower costs. However, its

positive correlation with leverage (0.29) implies that firms with higher debt levels face slightly elevated borrowing costs, which reflects the added risk perceived by lenders.

The overall correlation matrix highlights some areas where multicollinearity may warrant attention. For example, the strong correlations between leverage, high leverage, and their interaction term suggest potential redundancy in the model if all three variables are included without proper controls. Similarly, the negative correlations between leverage and key performance indicators like ROA underscore the importance of controlling for the complex dynamics of debt and performance.

These correlations provide a preliminary overview of the relationships among the variables, and serve as a foundation for the regression analysis. While the correlations are generally modest, they signal important trends and align with theoretical expectations about the interplay of leverage, liquidity, profitability, and growth (O'Brien, 2003). The findings underscore the need for robust empirical techniques to isolate the independent effects of leverage and other predictors on firm performance. These are further explored in subsequent sections.

4.3. Effect of leverage on firm performance

This section examines the empirical findings presented in Table 9 in the context of the hypotheses. Hypothesis 1 (H_1) posits that there is a positive relationship between leverage and firm performance in start-ups. In contrast, Hypothesis 2 (H_2) asserts that high leverage is negatively associated with firm performance. The analysis focused on two key performance indicators: industry-adjusted sales growth (adjSalesGrowth) and industry-adjusted OIR (adjOIR), and provided insights into the growth and profitability dynamics of Swedish start-ups. While I refer to the complete set of model results and diagnostic indicators, because our analysis is of population data the regression coefficients are exact depictions of the relationships and are inferred from sample statistics.

Table 9: Multivariate analysis of research model

	(1)	(2)	(3)	(4)
Variables	**adjSalesGrowth**	**adjSalesGrowth**	**adjOIR**	**adjOIR**
L2.Leverage	-0.280***	-0.232***	-0.039***	-0.034***
	(0.000)	(0.000)	(0.000)	(0.000)
L2. Leverage x High		-0.056**		-0.006
leverage		(0.031)		(0.196)
L2.Scale	-71.014***	-71.023***	-2.694***	-2.695***
	(0.000)	(0.000)	(0.000)	(0.000)
L2.Age	-4.912***	-4.905***	-0.428**	-0.427**
	(0.000)	(0.000)	(0.020)	(0.020)

L2.Current assets ratio	6.806***	6.661***	3.531***	3.514***
	(0.000)	(0.000)	(0.000)	(0.000)
L2.ROA	-0.384	-0.382	-3.717***	-3.716***
	(0.433)	(0.437)	(0.000)	(0.000)
L2.Collateral availability	40.759***	40.996***	2.918**	2.945***
	(0.000)	(0.000)	(0.010)	(0.010)
L2.Interest rate	13.027***	12.911***	2.287***	2.273***
	(0.000)	(0.000)	(0.000)	(0.000)
Constant	463.149***	462.511***	8.786	8.711
	(0.000)	(0.000)	(0.110)	(0.114)
Firm fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Observations	294,141	294,141	294,046	294,046
R-squared	0.155	0.155	0.025	0.025
Number of orgnr	48,340	48,340	48,340	48,340

Note: Robust *p*-value in parentheses. Models are clustered by firm and year.

Key: *** p < 0.01, ** p < 0.05, * p < 0.1

4.3.1. Positive relationship between leverage and firm performance

Hypothesis 1 suggests that leverage should have a positive effect on firm performance, so enabling start-ups to finance growth opportunities and achieve higher profitability. However, the results presented in Table 9 provide no support for this hypothesis. Across all four models, the coefficient for lagged leverage (L2.Leverage) is consistently negative, which indicates that leverage, on average, reduces both growth and profitability.

For adjusted sales growth (adjSalesGrowth), Models 1 and 2 show that a one-unit increase in leverage is associated with a reduction of 0.280 and 0.232 percentage points in sales growth, respectively. These findings suggest that, rather than enhancing growth, higher leverage constrains the ability of start-ups to scale operations. This may reflect the financial rigidity imposed by debt, which limits the flexibility to allocate resources to growth-oriented activities. Start-ups, which typically operate with volatile revenue streams and limited financial buffers, are particularly vulnerable to these constraints.

Similarly, for adjusted OIR (adjOIR), Models 3 and 4 demonstrate that leverage has a significant negative effect on profitability. The coefficient for L2.Leverage is -0.039 in Model 3 and -0.034 in Model 4, which indicates that higher debt levels erode profitability. This is likely because of the fixed costs associated with servicing debt, which reduce the available funds for innovation, operational efficiency, and other profit-enhancing activities.

The lack of support for Hypothesis 1 challenges the conventional view that leverage can enhance firm performance by providing access to growth capital and tax benefits. While these theoretical advantages are well-documented in the trade-off theory (Kraus & Litzenberger, 1973a), their applicability to start-ups appears to be limited. For start-ups operating in high-risk environments, the costs of leverage, such as increased financial distress and reduced strategic flexibility, may outweigh its potential benefits.

4.3.2. Negative association between high leverage and firm performance

Hypothesis 2 posits that high leverage is negatively associated with firm performance, so reflecting the disproportionate risks faced by highly leveraged start-ups. The results in Table 9 provide support for this hypothesis, in particular in the context of growth metrics.

In Model 2, the interaction term L2.Leverage×High leverage is negative ($\beta=-0.056$, $p=0.031$), which indicates that the adverse impact of leverage on sales growth is more pronounced for firms with higher leverage ratios. This finding suggests that for highly leveraged firms the financial constraints imposed by debt are exacerbated, which further limits their ability to invest in growth. This aligns with the predictions of the trade-off theory, which highlights the escalating costs of financial distress as leverage increases (Kraus & Litzenberger, 1973a). For start-ups, these costs can include reduced access to additional financing, strained cash flows, and heightened vulnerability to market volatility.

Model 4 examines adjusted operating income ratio (adjOIR) and the interaction term L2.Leverage×High-leverage coefficient is negative ($\beta=-0.006$, $p=0.196$). This suggests that the negative relationship between leverage and profitability is relatively consistent across firms, regardless of their leverage levels. One possible explanation is that profitability, as a short-term performance measure, is more directly affected by the fixed costs of debt servicing than by variations in leverage ratios. For high-leverage firms, these costs may be partially offset by the ability to secure favourable financing terms through collateral or other mechanisms.

Additional covariates in the models provide further context for understanding the impact of high leverage. For example, the positive and significant coefficient for collateral availability (L2.Collateral availability) suggests that access to secured assets mitigates some of the risks associated with high leverage, in particular for profitability. Similarly, the current assets ratio (L2.Current assets ratio) consistently shows a positive effect on both growth and profitability, which reinforces the importance of liquidity in managing the financial challenges posed by high leverage.

The findings for Hypothesis 2 underscore the need for caution in the use of leverage, in particular for start-ups operating in resource-constrained environments. While debt can provide critical resources for scaling operations, the disproportionate risks associated with high leverage can undermine performance, especially in the context of long-term growth objectives.

4.4. Effect sizes

Effect sizes provide an essential bridge between statistical significance and practical relevance, and offer insights into the real-world implications of financial decisions. In this study, the effect sizes of leverage on firm performance were calculated to interpret the substantive impacts of the regression results presented earlier. This analysis demonstrates how a one standard deviation (SD) increase in leverage affects key performance metrics, such as sales growth and adjusted OIR (adjOIR). This reveals the practical implications of these relationships for Swedish start-ups. By focusing on the median firm in the sample, the analysis ensures that the findings are not only statistically rigorous but also relevant to the average firm's experience.

To calculate effect sizes, depicted in Table 10, the standard deviation of leverage (24.06) was used as a benchmark for standardising the results. This approach is widely recognised in financial and economic research as it allows for a comparison of impacts across variables with different units of measurement and ranges. The standardised coefficients derived from the regression models, specifically the coefficients for leverage and the interaction term leverage × high leverage, were multiplied by this standard deviation to estimate the implied changes in firm performance metrics. These changes were then applied to the median firm in the sample, a decision driven by the practical necessity of grounding findings in a relatable reference point. The median, as opposed to the mean, is particularly appropriate in this dataset because of the skewness of key variables like sales growth, where a small number of HGF could distort the average.

The results reveal a notably negative effect of leverage on firm performance. For sales growth, the total implied effect of a one SD increase in leverage is a reduction of 6.93 percentage points. This total effect is composed of a 5.58 point decline owing to the leverage coefficient and an additional 1.35 point reduction from the high-leverage interaction term. Similarly, the analysis shows a decline of 0.96 percentage points in adjOIR, with 0.82 points attributed to leverage and 0.14 points stemming from the high-leverage interaction. These findings align with the broader theoretical discussion presented in Section 2.4, in particular the trade-off theory, which highlights the escalating costs of financial distress as leverage increases. For start-ups, the implications of these results are profound, as they suggest that even moderate increases in debt can have compounding adverse effects, in particular for firms already operating with high leverage.

Table 10: Effect size of 1 standard deviation increase in leverage in percentage points

Standard deviation of leverage	24.06

Description	**Sales growth**	**adjOIR**
Leverage coefficient	-0.23	-0.03
High leverage x Leverage coefficient	-0.06	-0.01
Change owing to leverage	-5.58	-0.82
Change owing to high leverage	-1.35	-0.14
Total effect (percentage points)	-6.93	-0.96

Interpreting these results in practical terms offers further clarity. For the median firm, which exhibits limited growth and profitability, a 6.93 percentage point reduction in sales growth could represent the difference between stagnation and a modest expansion. Similarly, a 0.96 percentage point decline in adjOIR could erode already thin profit margins, which could potentially push a firm closer to financial distress. These findings underscore the high stakes of financial decisions for Swedish start-ups, in particular given the resource constraints and market volatility that characterise their operating environment, as discussed in Section 2.1. The substantial magnitude of these effects is consistent with the theoretical predictions of both the trade-off and pecking order theories, which emphasise the risks of debt financing for firms with uncertain revenue streams and limited internal capital (Kraus & Litzenberger, 1973a; Myers & Majiuf, 1981).

Table 11: Effect size of 1 standard deviation increase in leverage in Swedish Krona

Metric		2015	2017	Units	Calculation
A	Mean assets	12,373.05	13,891.83	Swedish Krona	From data
B	Number of firms	127,741	151,324	Firms	From data
C	Total assets	1,580,545,780.05	2,102,167,282.92	Swedish Krona	C = A x B
D	Leverage effect: sales growth	-6.95		Percent	Table 10
E	Leverage effect: OIR	-0.96		Percent	Table 10
F	Effect: sales growth	-109,847,931.71	-146,100,626.16	Swedish Krona	F = C x D
G	Effect: OIR	-15,173,239.49	-20,180,805.92	Swedish Krona	G = C x E
H	**Total effect**	**-125,021,171.20**	**-166,281,432.08**	**Swedish Krona**	**H = F + G**

In Table 11 I outline the effect size of a 1 SD change in leverage in Swedish Krona terms across our sample of companies at two points in time, 2015 and 2017. I find that a 1 SD increase in leverage is associated with a 125 million SEK and 166 million SEK decrease in revenues in 2015 and 2017, respectively.

The analysis also highlights the disproportionate impact of high leverage on firm performance, and reinforces the argument that the risks of debt increase exponentially as leverage rises. This is particularly evident in the interaction term, where the compounding negative effect of leverage on high-leverage firms becomes apparent. For these firms, the financial rigidity imposed by debt servicing may limit their ability to allocate resources to growth-oriented activities, as illustrated by the findings on sales growth. This dynamic is consistent with the empirical literature, which often finds that high leverage restricts strategic flexibility and heightens vulnerability to market fluctuations (Jensen, 1986; Cassar & Holmes, 2003).

The implications of these findings extend beyond theoretical validation. For entrepreneurs, they emphasise the need for prudence in leveraging debt, in particular for firms already operating at high levels of leverage. The results suggest that debt-financed growth may yield diminishing returns, especially when fixed debt-servicing costs constrain a firm's operational flexibility. Entrepreneurs should carefully evaluate whether the potential short-term gains from increased leverage outweigh the longer-term risks to growth and profitability. For policymakers, the findings provide a compelling case for interventions that mitigate the risks of debt for start-ups. Initiatives such as

low-interest loan programmes, equity financing incentives, and financial literacy training could help reduce the reliance on high-cost debt while supporting sustainable growth.

While these findings are robust, several limitations warrant consideration. The use of the median firm as a reference point, while methodologically sound, may obscure heterogeneity in the sample, in particular among high-growth or high-risk firms. Future research could explore alternative metrics, such as the mean or percentile-based approaches, in order to capture a broader spectrum of firm experiences. The analysis also focuses on two performance metrics – sales growth and adjOIR – which, though critical, do not capture the full complexity of start-up performance. Expanding the scope to include metrics like return on assets (ROA) or revenue volatility could provide a more comprehensive picture of leverage's effects.

In conclusion, the effect size analysis provides a nuanced understanding of the relationship between leverage and firm performance in Swedish start-ups. By quantifying the practical impact of a one SD change in leverage, the analysis bridges the gap between statistical significance and real-world relevance, and offers actionable insights for entrepreneurs, investors, and policymakers. These findings reinforce the broader narrative of the dissertation: leverage, while a powerful financial tool, carries significant risks that must be carefully managed to foster sustainable growth and profitability in resource-constrained environments.

The next section will build on these insights, and explore supplementary analyses that further contextualise these relationships within the entrepreneurial ecosystem.

4.5. Robustness tests

Robustness testing is essential to validate the findings of this study and ensure their reliability across different assumptions, models, and data subsets. This section discusses several diagnostic tests and supplementary analyses conducted to evaluate the consistency and validity of the results. These robustness checks include assessments of model appropriateness, multicollinearity, residual properties, and the influence of outliers.

4.5.1. Tests for model appropriateness

The selection of the fixed-effects model over the random-effects model is a crucial decision in the empirical approach that was outlined in Section 3.4.1. The Hausman test (Hausman, 1978), which evaluates the null hypothesis that differences in coefficient estimates between fixed and random effects are not systematic, provides robust evidence against the random-effects model. The chi-squared statistic ($\chi^2 = 14{,}045.64$, $p < 0.001$) clearly indicates that the random-effects assumptions do not hold, which makes the fixed-effects model the more appropriate choice. This finding is consistent with prior research, which often emphasises the fixed-effects approach for panel data when unobserved heterogeneity is likely to correlate with explanatory variables (Wooldridge, 2014). Rejecting the random-effects model reinforces the reliability of the estimates and ensures that time-invariant firm-specific factors are adequately controlled.

4.5.2. Multicollinearity diagnostics

Multicollinearity among regressors, while not fatal to model validity, can inflate standard errors and obscure the interpretation of individual coefficient estimates. To address this concern, variance inflation factors (VIF) were calculated for all independent variables. The mean VIF of 5.35 suggests moderate multicollinearity, which warrants cautious interpretation but does not undermine the overall robustness of the results. In the context of panel data and financial models, such levels of multicollinearity are not uncommon, as predictors like leverage, revenue, and operating expenses tend to exhibit some degree of correlation (Wooldridge, 2014). The inclusion of control variables, as detailed in Section 3.3.3, mitigates potential bias by accounting for confounding factors that could exacerbate collinearity.

4.5.3. Residual analysis

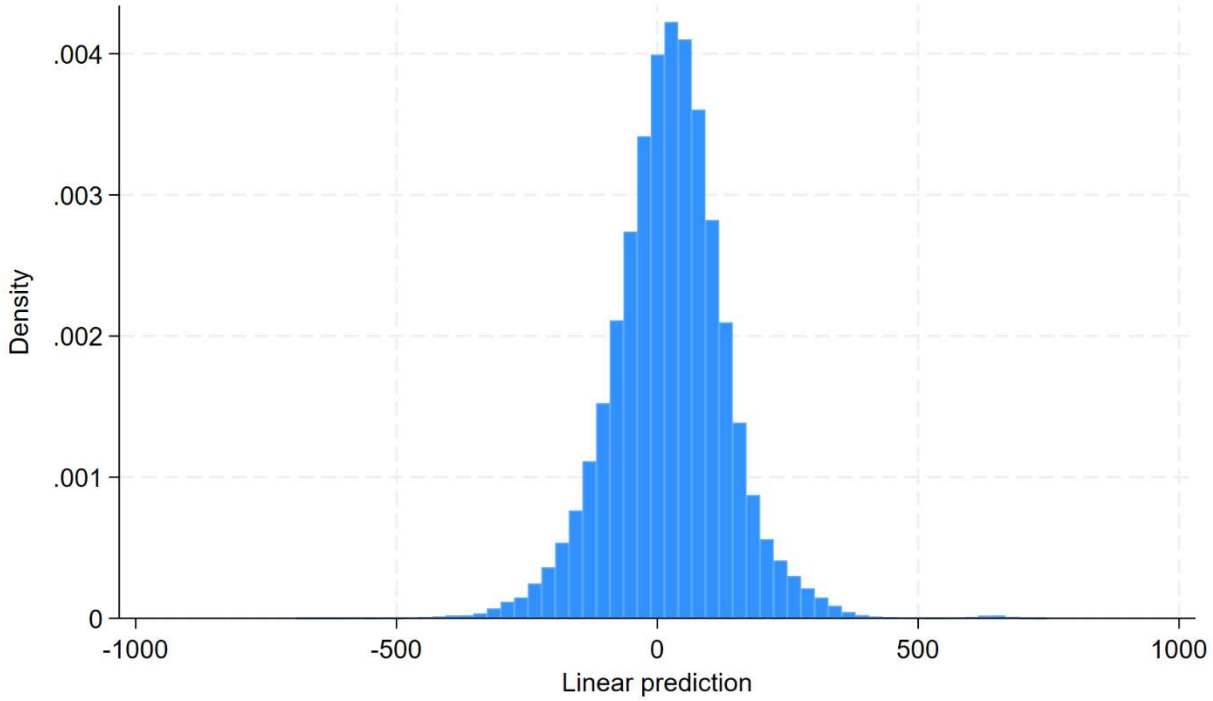

Figure 8: Histogram of model residuals

Residual diagnostics were conducted to evaluate whether the assumptions of linear regression hold in the dataset. Two tests, the Shapiro-Wilk and Shapiro-Francia tests, were used to assess the normality of residuals. Both tests reject the null hypothesis of normality ($p < 0.05$). However, given the sample size of over 340,000 observations, statistical tests for normality are highly sensitive and often yield significant results even for minor deviations (Wooldridge, 2014). Visual inspection of residual histograms (Figure 8) and quantile–quantile plots reveal that the residuals are approximately symmetric and bell-shaped, which suggests that deviations from normality are unlikely

to materially affect the validity of the regression estimates. These findings are consistent with prior studies that downplay the practical importance of strict normality assumptions in large-sample regressions (Wooldridge, 2014).

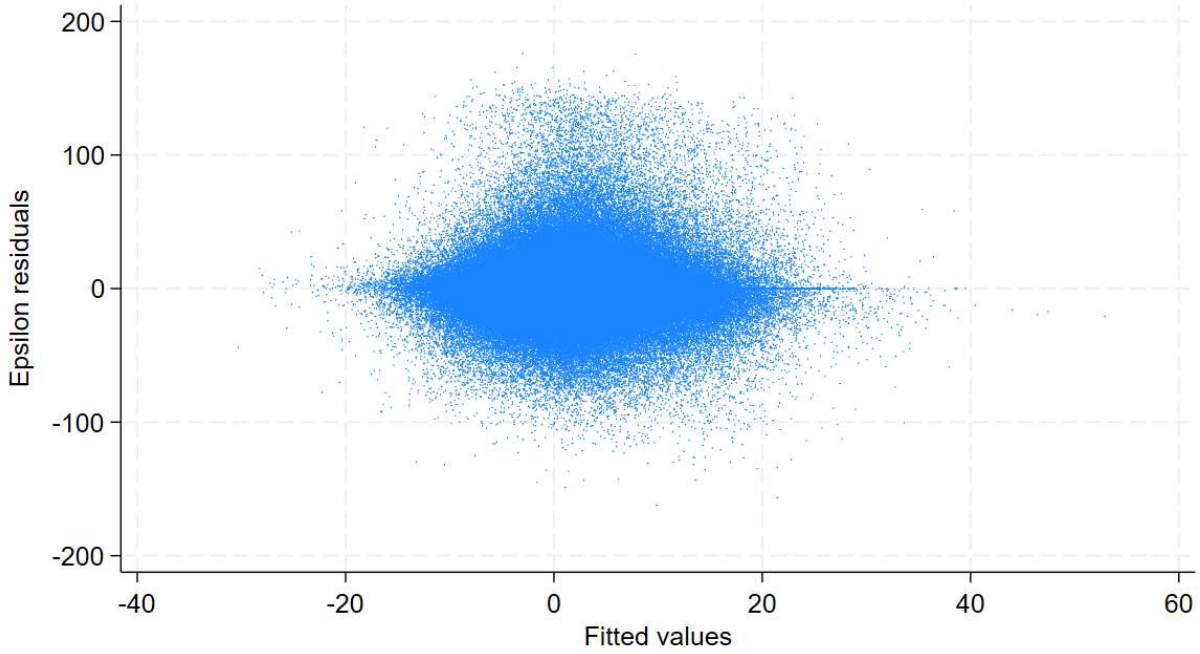

Figure 9: Epsilon residuals of model results

Another key diagnostic meant examining the homoscedasticity and zero conditional mean assumptions. Plotting residuals against fitted values (Figure 9) revealed no discernible patterns or heteroskedasticity, which indicates that the variance of residuals is consistent across all levels of the fitted values. Furthermore, residuals hover symmetrically at around zero, which supports the assumption of zero conditional mean. These findings imply that the model adequately captures the relationship between leverage and firm performance without systematic bias in the error term.

5. Discussion and conclusions

This chapter synthesises the study's findings on the impact of leverage on the performance of start-ups in Sweden. The central research question—"*What is the impact of leverage on the firm performance of start-ups in Sweden?*"—guided an investigation that integrated established theoretical frameworks with robust empirical analysis. The study drew upon seminal theories, including the trade-off theory (Kraus & Litzenberger, 1973a), the pecking order theory (Myers & Majiuf, 1981), and Agency Theory (Jensen, 1986), to develop hypotheses that were rigorously tested using a comprehensive dataset spanning 1998 to 2017.

Chapter 1 introduced the research rationale and contextualised the importance of capital structure decisions within Sweden's dynamic entrepreneurial ecosystem. Chapter 2 reviewed the academic literature and laid the theoretical foundation, while Chapter 3 outlined the methodology and empirical approach, and Chapter 4 presented detailed empirical findings that reveal a predominantly negative relationship between leverage and key performance indicators, such as adjusted operating income ratio and sales growth. These results underscore the financial risks associated with excessive debt, particularly in environments characterised by uncertainty and resource constraints.

In this chapter, I will discuss these findings in relation to existing theories and empirical evidence, outline the practical implications for entrepreneurs, investors, and policymakers, and highlight the theoretical, empirical, and societal contributions of the study. Every assertion is substantiated by either the empirical results or academic sources from the literature.

5.1. Discussion

5.1.1. Interpretation of key findings

The empirical evidence from this study unequivocally demonstrates that leverage exerts a predominantly negative impact on the performance of Swedish start-ups. Regression analyses (see Table 9) indicate that a one-unit increase in lagged leverage is associated with reductions of 0.280 and 0.232 percentage points in sales growth (in Models 1 and 2, respectively), as well as declines of 0.039 and 0.034 percentage points in the adjusted operating income ratio (adjOIR) (Models 3 and 4). Moreover, the inclusion of an interaction term for high leverage reveals that the adverse effect on sales growth is even more pronounced for firms already operating at exceptionally high debt levels. These findings are further underscored by the effect size analysis, which indicates that a one standard deviation increase in leverage—roughly 24.06 percentage points—corresponds to an overall reduction of 6.93 percentage points in sales growth and a 0.96 percentage point decline in adjOIR (Table 10).

The practical significance of these results is further highlighted when translated into Swedish Krona terms. Table 11 shows that for the median firm, a one standard deviation increase in leverage is associated with a reduction in revenues of approximately 125 million SEK in 2015 and 166 million SEK in 2017.

These substantial monetary effects emphasise that even moderate increases in debt levels can lead to sizeable economic losses, particularly for start-ups with relatively modest revenue bases. The stark figures in SEK serve as a potent reminder of the real-world implications of overleverage, underscoring the need for prudent financial management.

The theoretical underpinnings of these findings are well grounded in established frameworks. The trade-off theory (Kraus & Litzenberger, 1973a) posits that firms seek to balance the tax advantages derived from debt financing against the costs associated with potential financial distress. In theory, a moderate level of debt can provide a beneficial tax shield and facilitate access to external capital (Modigliani & Miller, 1963). However, our findings suggest that for start-ups—characterised by volatile cash flows and limited operating histories—even modest increases in leverage rapidly erode profitability and constrain growth. This observation is entirely consistent with Myers' (1977) contention that excessive leverage reduces strategic flexibility and heightens the likelihood of financial distress, as the fixed costs of debt servicing become increasingly burdensome.

In parallel, the pecking order theory (Myers & Majiuf, 1981) offers an alternative explanation based on the premise of information asymmetry. According to this theory, firms exhibit a preference for internal financing over external debt due to the adverse selection problems associated with the latter. Start-ups, which typically lack substantial retained earnings and operate under significant uncertainty, are particularly vulnerable to these issues. The consistently negative coefficients observed across our regression models lend strong support to this theoretical perspective, indicating that reliance on external debt financing is likely to impede rather than enhance performance.

Agency Theory (Jensen, 1986) further illuminates these results. Although debt can serve as a mechanism to discipline managerial behaviour by limiting the free cash flow available for discretionary spending, there exists a tipping point beyond which the benefits of such discipline are outweighed by the constraints imposed on managerial flexibility. In our study, the adverse impact of high leverage is evident; as debt levels increase, managers are forced to prioritise short-term debt servicing over long-term investments that could stimulate growth and innovation. This phenomenon, originally described by Jensen and Meckling (1976), is particularly salient for start-ups that do not have the financial buffers of more mature firms. The negative interaction effect for high leverage suggests that once a critical threshold is exceeded, the marginal cost of additional debt becomes prohibitively high, thereby severely limiting both revenue expansion and profitability.

Moreover, the effect size results in both percentage point changes and Swedish Krona terms reinforce the notion of an optimal threshold for debt utilisation in start-ups. The finding that a one standard deviation increase in leverage results in a reduction of nearly 7 percentage points in sales growth and nearly 1 percentage point in operating income ratio points to a narrow window in which debt might be beneficial. Beyond this window, the adverse effects—quantified as substantial revenue losses in the order of hundreds of millions of SEK across the sample—underscore the precarious balance that start-ups must maintain in their capital structure. This delicate

balance is critical; while moderate leverage may provide the necessary funds to invest in market expansion and innovation, any excess quickly results in diminishing returns.

The empirical results also suggest that the classical frameworks of capital structure theory need to be adapted when applied to the unique context of start-ups. Traditional models, such as the trade-off and pecking order theories, are built on the assumption of relatively stable cash flows and mature market conditions—assumptions that rarely hold for nascent firms. Our study extends these models by empirically demonstrating that start-ups operate under a much lower optimal debt threshold. This extension not only validates the theoretical predictions but also provides a more nuanced understanding of how leverage should be managed in high-risk, high-uncertainty environments.

In conclusion, the study provides robust empirical evidence that supports the central tenets of the trade-off and pecking order theories while also highlighting the limitations of these models in the context of start-up finance. The findings unequivocally demonstrate that excessive leverage significantly undermines both sales growth and profitability, with negative effects that are both statistically and economically significant. The conversion of these effects into Swedish Krona terms further amplifies their practical importance, revealing that even moderate increases in debt can have far-reaching adverse consequences. These insights, firmly supported by both the empirical results presented in Chapter 4 and the extensive academic literature (Myers & Majiuf, 1981; Opler & Titman, 1994; Berger & Udell, 1998; Cassar & Holmes, 2003), underscore the imperative for start-ups to maintain a cautious and balanced approach to leveraging debt.

5.1.2. Implications

The findings of this study carry significant practical implications for key stakeholders in the Swedish start-up ecosystem—namely, entrepreneurs, investors, and policymakers. The evidence suggests that start-ups must exercise considerable caution when structuring their capital, as even moderate increases in leverage can have a detrimental impact on both revenue growth and profitability.

For entrepreneurs, the negative association between leverage and performance underscores the necessity of maintaining a balanced capital structure. The results indicate that reliance on debt beyond a modest threshold constrains a firm's operational flexibility and impedes long-term strategic investment. In practical terms, start-up founders should carefully assess their financing needs and opt for alternative funding sources—such as equity or internally generated funds—whenever possible, to avoid the adverse consequences of excessive debt (Myers & Majiuf, 1981). Given that start-ups typically operate with volatile cash flows and limited historical data, the risks associated with high debt levels are magnified. Entrepreneurs are therefore encouraged to adopt a dynamic approach to financing, continuously monitoring debt ratios in light of changing business conditions and avoiding overreliance on external borrowing (Jensen, 1986).

Investors, too, can draw on these insights to refine their evaluation of start-ups. The empirical results clearly demonstrate that higher levels of leverage are associated with lower growth rates and diminished profitability, which should serve as a red flag during due diligence. By scrutinising the capital structure of prospective investments, investors can identify firms that may be overleveraged and, as a result, face heightened financial distress. This is particularly pertinent in high-risk environments where the cost of debt can quickly outweigh its benefits. As the study reveals, even a one standard deviation increase in leverage can result in a substantial reduction in revenue—in some cases amounting to a loss of hundreds of millions of Swedish Krona (Table 11). Such quantifiable metrics provide investors with a concrete basis for assessing the risk–reward profile of a start-up, thereby informing more judicious investment decisions (Berger & Udell, 1998; Cassar & Holmes, 2003).

Policymakers also have a critical role to play in fostering a conducive financing environment for start-ups. The evidence that excessive leverage undermines firm performance suggests that regulatory and financial support mechanisms should be tailored to encourage moderate debt utilisation. Policy interventions might include the provision of loan guarantees or the introduction of tax incentives that reward prudent debt management. Such measures can help mitigate the risks associated with external financing while enabling start-ups to access the capital needed for innovation and growth (Kraus & Litzenberger, 1973a). Moreover, given that start-ups are often pivotal drivers of technological advancement and job creation, policymakers should ensure that the regulatory framework does not inadvertently compel these firms into unsustainable debt levels. A balanced approach to financing is essential—not only to safeguard individual firms but also to support the broader health of the entrepreneurial ecosystem.

These practical implications are further reinforced by the substantial effect sizes observed in this study. The translation of the regression results into Swedish Krona terms reveals the stark economic consequences of overleverage; the potential loss in revenue and operating income for the median firm is not merely a statistical abstraction but represents real financial strain that can jeopardise survival. Hence, both entrepreneurs and investors should consider these findings as a call to re-examine traditional financing strategies. They must ensure that the benefits of debt—such as increased capital for expansion—do not come at the cost of long-term financial stability.

In sum, the study advises a cautious and measured approach to leveraging debt. Start-up founders should strive to maintain a capital structure that preserves managerial discretion and fosters strategic flexibility, while investors and policymakers must work to create conditions that facilitate access to financing without encouraging overleverage. By adhering to these principles, stakeholders can better support the sustainable growth and innovation that are essential for the continued success of Swedish start-ups (Myers, 1977; Opler & Titman, 1994).

5.2. Contributions

This study makes contributions on several fronts—namely, theoretical, empirical, practical, and societal—each of which is underpinned by a rigorous empirical approach that enhances the reliability and relevance of the findings.

From a theoretical perspective, the research extends classical capital structure models to the unique and dynamic context of Swedish start-ups. Traditional frameworks, such as the trade-off theory (Kraus & Litzenberger, 1973a) and the pecking order theory (Myers & Majiuf, 1981), typically assume stable cash flows and mature financial structures. By contrast, this study demonstrates that start-ups operate under conditions of high uncertainty and resource constraints, necessitating a lower optimal debt threshold. The evidence—revealed through fixed effects panel regressions on a robust population dataset drawn from the Serrano database—underscores that even moderate increases in leverage can significantly diminish operational income and impede sales growth. This finding is consistent with Myers' (1977) argument regarding the costs of excessive debt, yet it also enriches the theoretical discussion by quantitatively delineating the narrow window within which debt might be beneficial for early-stage firms. Moreover, by incorporating Agency Theory (Jensen, 1986) into the analysis, the study refines our understanding of how high leverage can restrict managerial flexibility—a phenomenon particularly pronounced in start-ups that lack substantial financial buffers (Jensen & Meckling, 1976).

Empirically, the study contributes novel and precise estimates of the impact of leverage on key performance indicators. Utilizing a population dataset of 66,069 Swedish start-ups with 533,464 firm-year observations, the analysis benefits from the elimination of sampling error, thereby enhancing internal validity (Wooldridge, 2014). The operationalisation of dependent variables—industry-adjusted operating income ratio (adjOIR) and industry-adjusted sales growth (adjSalesGrowth)—follows established methodologies (Opler & Titman, 1994; Tsuruta, 2015, 2017), and ensures that performance is measured relative to industry norms. Furthermore, by carefully constructing treatment variables, such as leverage (operationalised as the ratio of liabilities to assets at t-2) and the binary high-leverage dummy (based on the top quintile within each industry-year), the study isolates the effect of debt on performance with a high degree of precision. Robustness tests—including variance inflation factors for multicollinearity, and the application of the Hausman test (Hausman, 1978) to justify the fixed effects model—lend further credence to the empirical results. The conversion of effect sizes into both percentage points and Swedish Krona terms (with losses in revenue estimated between 125 and 166 million SEK for a one standard deviation increase in leverage) offers a quantification of the economic consequences of overleverage.

On a practical level, the findings offer clear and actionable insights for entrepreneurs, investors, and policymakers. For start-up founders, the research highlights the critical importance of maintaining a balanced capital structure; even moderate increases in debt, as shown by the empirical results, can erode profitability and hinder growth. The study thus advises a dynamic approach to financing decisions, where external debt is used judiciously to avoid constraining long-term strategic investments. Investors, on the other hand, are provided with quantifiable benchmarks—derived from industry-adjusted performance metrics and robust effect size estimates—that can aid in evaluating the risk–reward profiles of potential investments. The stark revenue losses associated with overleverage serve as cautionary indicators, enabling investors to better identify firms that may be financially

overextended. For policymakers, the study's findings underscore the need to design financial support mechanisms that encourage sustainable leverage practices. Interventions such as loan guarantees or targeted tax incentives could help mitigate the risks of excessive debt, thus fostering a more resilient and innovative entrepreneurial ecosystem in Sweden.

Finally, the societal contributions of this research are noteworthy. Many Swedish start-ups are increasingly expected to align their business models with broader social and environmental objectives. By demonstrating that moderate leverage can facilitate investments in innovation and operational efficiency—without imposing excessive financial burdens—the study illustrates how sound financial strategies can enable firms to contribute to sustainability and inclusivity. This dual focus on economic performance and societal impact extends the traditional scope of entrepreneurial finance and emphasises the broader role of financial decisions in shaping sustainable business practices.

In summary, the integration of a rigorous empirical approach with robust theoretical frameworks not only deepens our understanding of the adverse effects of leverage on start-up performance but also provides valuable, actionable insights for multiple stakeholders. These contributions, supported by extensive academic literature (Myers & Majiuf, 1981; Opler & Titman, 1994; Berger & Udell, 1998; Cassar & Holmes, 2003; Cassar, 2004), pave the way for future research and inform policy and practice in the management of capital structures within high-risk, high-uncertainty environments.

5.3. Limitations and further research

While this study offers robust insights into the impact of leverage on start-up performance in Sweden, several limitations must be acknowledged. These limitations arise from methodological choices, data constraints, and the inherent complexity of measuring firm performance in an evolving entrepreneurial environment.

One key limitation pertains to the dataset and sample selection. The analysis is based on the Serrano database, which, although comprehensive and representing the entire population of Swedish for-profit start-ups (with 66,069 unique firms and 533,464 firm-year observations), necessitated a series of filtering criteria. Firms with fewer than two employees were excluded, which may have omitted very early-stage start-ups or micro-enterprises that could behave differently in terms of capital structure and performance (Cassar, 2004). This stringent selection, while enhancing internal validity, potentially limits the generalisability of the findings to the broader spectrum of Swedish entrepreneurial ventures.

Another limitation arises from the reliance on secondary financial data spanning 1998 to 2017. Although the long panel provides substantial precision and power for the analysis, it does not capture more recent developments, such as the impact of digital transformation or the economic repercussions of the Covid-19 pandemic. As a result, the findings may not fully reflect current market conditions or the evolving nature of start-up financing.

Methodologically, the study employs a static fixed effects panel regression model. This choice is well-suited to the large-N, small-T structure of the dataset and effectively controls for time-invariant heterogeneity across firms (Wooldridge, 2014). However, such a static framework may not adequately capture the dynamic adjustments in capital structure that occur as start-ups mature. Start-ups are inherently volatile, with rapid shifts in financial performance and strategic priorities; a dynamic panel model or time-series analysis could provide additional insights into the evolution of debt effects over a firm's life cycle (Myers & Majiuf, 1981).

Moreover, the operationalisations of key variables—such as industry-adjusted operating income ratio (adjOIR) and industry-adjusted sales growth (adjSalesGrowth)—are based on established methodologies (Opler & Titman, 1994; Tsuruta, 2015, 2017). While these measures allow for comparability across industries, they may not capture all dimensions of firm performance. Non-financial outcomes, including innovation capacity, customer satisfaction, or social impact, remain unobserved. Future research could integrate qualitative assessments or alternative quantitative indicators to provide a more holistic view of start-up performance.

The use of lagged independent variables (measured at t–2) is a strength in mitigating endogeneity concerns; however, this approach may still fall short of fully addressing reverse causality. For instance, while poorer performance might lead to higher leverage due to constrained access to alternative financing, the causal direction remains difficult to disentangle completely. Advanced econometric techniques, such as instrumental variable approaches or structural modelling, could be employed in future studies to better identify causal effects (Berger & Udell, 1998)).

In addition, while diagnostic tests were conducted to address issues such as multicollinearity, heteroskedasticity, and autocorrelation, the inherent limitations of the Classical Linear Model (CLM) assumptions persist. Even though the large population dataset minimises sampling error, any measurement error in the financial statements or anomalies in the data-cleaning process (e.g. winsorisation) could still bias the results. Future work might explore alternative data sources or more sophisticated error correction techniques to further validate these findings.

Looking forward, several avenues for future research emerge. First, extending the analysis to include more recent data could shed light on how contemporary economic shocks and digitalisation affect the leverage–performance nexus. Second, incorporating additional performance metrics—such as return on assets (ROA), revenue volatility, or non-financial indicators—would enrich the understanding of how debt influences various dimensions of start-up success. Third, considering the use of instrumental variable techniques to account for unobserved biases such as founder characteristics or investor involvement would improve the empirical robustness of future studies.

Fourth, comparative studies across different national contexts would be valuable. Given that the institutional framework in Sweden is relatively supportive of start-ups (Bosma & Kelley, 2018; Bosma, Hill Rolf Sternberg & Skopińska, 2023), exploring similar dynamics in less favourable environments could yield important insights into the role of institutional context in capital structure decisions.

Finally, further research should consider the impact of alternative financing instruments, such as venture debt or revenue-based financing, which have gained prominence in recent years. These instruments may offer different risk–reward profiles compared to traditional bank debt and could potentially mitigate some of the adverse effects observed in this study (Robb & Robinson, 2014).

In conclusion, while this study significantly advances our understanding of the adverse effects of excessive leverage on start-up performance, the aforementioned limitations suggest that our grasp of entrepreneurial finance remains incomplete. Addressing these challenges in future research will not only refine the theoretical frameworks but also inform more effective financial strategies and policy interventions in high-risk, high-uncertainty environments.

5.4. Conclusions

This study has demonstrated that leverage, while a potentially valuable source of external capital, exerts a predominantly negative influence on the performance of Swedish start-ups. In particular, the fixed effects panel regressions provide compelling evidence that increases in leverage are associated with statistically significant declines in both adjusted sales growth and operating income ratio. These findings reaffirm the core tenets of the trade-off theory (Kraus & Litzenberger, 1973a) and the pecking order theory (Myers & Majiuf, 1981), while also illustrating the practical limitations imposed by high levels of debt. In essence, the evidence suggests that start-ups operate under a much lower optimal debt threshold than mature firms, and that any excess—quantified both in percentage points and in Swedish Krona terms—can undermine financial stability and growth prospects.

The contributions of this research are multifaceted. Theoretically, by adapting classical capital structure models to a population of Swedish start-ups, the study extends the applicability of traditional frameworks to environments characterised by high uncertainty and resource constraints. It is now clear that, for start-ups, even modest increases in debt can rapidly escalate the risks of financial distress and constrain managerial flexibility, thereby reducing the scope for long-term strategic investments. Empirically, the study delivers robust and precise estimates—bolstered by a comprehensive dataset and rigorous methodological approaches—that quantify the adverse impact of leverage on both revenue growth and profitability. The conversion of effect sizes into Swedish Krona terms further highlights the significant economic implications for start-ups, where a one standard deviation increase in leverage corresponds to substantial revenue losses.

From a practical perspective, the study offers clear guidance to entrepreneurs, investors, and policymakers. Entrepreneurs are advised to carefully calibrate their capital structures, recognising that the advantages of debt financing are quickly offset by the fixed costs associated with high leverage. Investors can use the quantifiable risk indicators provided herein to better assess the financial soundness of start-ups, while policymakers are encouraged to design targeted interventions—such as loan guarantees or tax incentives—that promote sustainable leverage

practices. Each of these insights is firmly anchored in the empirical evidence and supported by relevant academic literature (Opler & Titman, 1994; Berger & Udell, 1998).

In societal terms, the findings underscore the broader implications of financial strategy. As Swedish start-ups increasingly align their operations with sustainability and inclusivity objectives, maintaining moderate leverage is crucial not only for individual firm success but also for achieving wider economic and social benefits. This dual focus reinforces the notion that financial decisions must be carefully managed to support both economic growth and societal progress.

In summary, the study makes a significant contribution to entrepreneurial finance by demonstrating that excessive leverage undermines start-up performance in measurable and economically significant ways. The integration of rigorous empirical analysis with established theoretical frameworks offers a comprehensive understanding of the risks associated with high debt levels in volatile environments. These conclusions not only advance academic knowledge but also provide actionable insights for practitioners and policymakers, thereby fostering a more resilient and innovative start-up ecosystem in Sweden.

6. References

Acs, Z.J. & Armington, C. 2004. Employment growth and entrepreneurial activity in cities. *Regional Studies*. DOI: 10.1080/0034340042000280938.

Acs, Z.J. & Audretsch, D.B. 1988. American Economic Association Innovation in Large and Small Firms: An Empirical Analysis. *Source: The American Economic Review*. 78(4):678–690.

Acs, Z.J., Parsons, W. & Tracy, S. 2008. *High-Impact Firms: Gazelles Revisited*. Available: www.sba.gov/advo/rss-.

Aghion, P. & Howitt, P. 1992. A Model of Growth Through Creative Destruction. *Econometrica*. 60(2):232–351. Available: https://ir.lib.uwo.ca/economicsresrpt.

Agostino, M. & Trivieri, F. 2010. Is banking competition beneficial to SMEs? An empirical study based on Italian data. *Source: Small Business Economics*. 35(3):335–355. DOI: 10.1007/sl.

Ahn, S., Denis, D.J. & Denis, D.K. 2006. Leverage and investment in diversified firms. *Journal of Financial Economics*. 79(2):317–337. DOI: 10.1016/j.jfineco.2005.03.002.

Aivazian, V.A., Ge, Y. & Qiu, J. 2005a. *Debt Maturity Structure and Firm Investment*.

Aivazian, V.A., Ge, Y. & Qiu, J. 2005b. The impact of leverage on firm investment: Canadian evidence. *Journal of Corporate Finance*. DOI: 10.1016/S0929-1199(03)00062-2.

Aldrich, H.E. & Martinez, M.A. 2001. Many are Called, but Few are Chosen: An Evolutionary Perspective for the Study of Entrepreneurship. *Entrepreneurship Theory and Practice*. DOI: 10.1177/104225870102500404.

Altman, E.I. 1984. A Further Empirical Investigation of the Bankruptcy Cost Question. *The Journal of Finance*. 39(4):1067–1089.

Anderson, B.S., Wennberg, K. & McMullen, J.S. 2019. Editorial: Enhancing quantitative theory-testing entrepreneurship research. *Journal of Business Venturing*. 34(5). DOI: 10.1016/j.jbusvent.2019.02.001.

Ang, J.S. 1992. On the Theory of Finance for Privately Held Firms. *The Journal of Entrepreneurial Finance*. DOI: 10.57229/2373-1761.1121.

Anton, S.G. 2019. Leverage and firm growth: an empirical investigation of gazelles from emerging Europe. *International Entrepreneurship and Management Journal*. 15(1):209–232. DOI: 10.1007/s11365-018-0524-5.

Antoncic, B. & Hisrich, R.D. 2001. INTRAPRENEURSHIP: CONSTRUCT REFINEMENT AND CROSS-CULTURAL VALIDATION. *Journal of Business Venturing*. 16:495–527.

Arrington, M. 2008. Facebook No Longer The Second Largest Social Network. *Tech Crunch*. 12 June.

Audretsch, D.B. 1995. *Innovation and industry evolution*. Cambridge, MA: The MIT Press.

Audretsch, D.B. 2007. Entrepreneurship Capital and Economic Growth. *Oxford Review of Economic Policy*. 23(1).

Audretsch, D.B. & Keilbach, M. 2007. The Theory of Knowledge Spillover Entrepreneurship. *Journal of Management Studies*. 44(7):1242–1254.

Audretsch, D.B. & Thurik, A.R. 2000. What's new about the new economy? Sources of growth in the managed and entrepreneurial economies. *Industrial and Corporate Change*. 10(1):267–315. Available: www.erim.eur.nl.

Autio, E., Sapienza, H.J. & Almeida, J.G. 2000. Effects of Age at Entry, Knowledge Intensity, and Imitability on International Growth. *The Academy of Management Journal*. 43(5):909–924. Available: http://www.jstor.orgURL:http://www.jstor.org/stable/1556419http://www.jstor.org/stable/1556419?seq=1&cid=pdf-reference#references_tab_contents.

Avgerou, C. 2011. Discourses on Innovation and Development in Information Systems in Developing Countries Research. In *The Oxford Handbook of Management Information Systems: Critical Perspectives and New Directions*. DOI: 10.1093/oxfordhb/9780199580583.003.0029.

Ayyagari, M., Demirgüç-Kunt, A. & Maksimovic, V. 2010. Formal versus informal finance: Evidence from China. *Review of Financial Studies*. DOI: 10.1093/rfs/hhq030.

Baker, M. & Wurgler, J. 2002. Market Timing and Capital Structure. *Journal of Finance*. 57(1):1–32.

Balawi, A. & Ayoub, A. 2022. Assessing the entrepreneurial ecosystem of Sweden: a comparative study with Finland and Norway using Global Entrepreneurship Index. *Journal of Business and Socio-economic Development*. 2(2):165–180. DOI: 10.1108/jbsed-12-2021-0165.

Barbero, J.L., Casillas, J.C. & Feldman, H.D. 2011. Managerial capabilities and paths to growth as determinants of high-growth small and medium-sized enterprises. *International Small Business Journal*. DOI: 10.1177/0266242610378287.

Barney, J. 1991. Firm Resources and Sustained Competitive Advantage. *Journal of Management*. 17(1):99–120.

Baron, J.N. & Hannan, M.T. 2002. DOI: 10.2307/41166130.

Barringer, B.R., Jones, F.F. & Neubaum, D.O. 2005. A quantitative content analysis of the characteristics of rapid-growth firms and their founders. *Journal of Business Venturing*. 20(5):663–687. DOI: 10.1016/j.jbusvent.2004.03.004.

Beck, T., Demirgüç-Kunt, A. & Maksimovic, V. 2008. Financing patterns around the world: Are small firms different? *Journal of Financial Economics*. DOI: 10.1016/j.jfineco.2007.10.005.

Becker, G. 1964. *A theoretical and empirical analysis, with special reference to education*. 3rd ed. National Bureau of Economic Research.

Belleflamme, P., Lambert, T. & Schwienbacher, A. 2014. Crowdfunding: Tapping the right crowd. *Journal of Business Venturing*. DOI: 10.1016/j.jbusvent.2013.07.003.

Berger, A.N. & Udell, G.F. 1998. The economics of small business finance: The roles of private equity and debt markets in the financial growth cycle. *Journal of Banking & Finance*. 22:613–673.

Bhatti, Y.A. & Ventresca, M. 2013. How Can 'Frugal Innovation' Be Conceptualized? *SSRN Electronic Journal*. DOI: 10.2139/ssrn.2203552.

Bhide, A. 1992. Bootstrap Finance: The Art of Start-ups.

Birch, D.L. 1979. *The Job Generation Process*.

Blank, S. & Dorf, B. 2020. *The startup owner's manual: the step-by-step guide for building a great company*. Hoboken, NJ: John Wiley & Sons .

Bosma, N. & Kelley, D. 2018. *Global Entrepreneurship Monitor Global Report*.

Bosma, N., Hill, S., Ionescu-Somers, A., Kelley, D., Levie, J. & Tarnawa, A. 2020. *Global Entrepreneurship Monitor 2019/2020 Global Report AUTHORS*. Available: http://www.witchwoodhouse.com.

Bosma, N., Hill Rolf Sternberg, S. & Skopińska, A. 2023. *GEM European Regional Report*. London.

Botsman, R. & Rogers, R. 2010. *What's Mine Is Yours*. New York, NY: HarperBusiness.

Bradley, M., Jarrell, G.A. & Kim, E.H. 1984a. On the Existence of an Optimal Capital Structure: Theory and Evidence. *The Journal of Finance*. DOI: 10.2307/2327950.

Bradley, M., Jarrell, G.A. & Kim, E.H. 1984b. On the Existence of an Optimal Capital Structure: Theory and Evidence. *The Journal of Finance*. DOI: 10.2307/2327950.

Brander, J.A. & Lewis, T.R. 1986. Oligopoly and Financial Structure: The Limited Liability Effect. *The American Economic Review*. 76(5):956–970.

Brearly, R.A., Myers, S.C. & Allen, F. 2014. *Principles of Corporate Finance*. 11th ed. Irwin: McGraw-Hill.

Breusch, T.S. & Pagan, A.R. 1979. A Simple Test for Heteroscedasticity and Random Coefficient Variation. *Econometrica*. 47(5):1287. DOI: 10.2307/1911963.

Bruderl, J. & Schussler, R. 1990. Organizational Mortality: The Liabilities of Newness and Adolescence. *Administrative Science Quarterly*. 35(3):530. DOI: 10.2307/2393316.

Brush, C.G., Greene, P.G. & Hart, M.M. 2001. From initial idea to unique advantage: The entrepreneurial challenge of constructing a resource base. *Academy of Management Perspectives*. 15(1):64–78. DOI: 10.1109/EMR.2002.1022409.

Cai, J. & Zhang, Z. 2011. Leverage change, debt overhang, and stock prices. *Journal of Corporate Finance*. 17(3):391–402. DOI: 10.1016/j.jcorpfin.2010.12.003.

Campbell, J.Y., Hilscher, J.D. & Szilagyi, J. 2011. Predicting Financial Distress and the Performance of Distressed Stocks. *Journal of Investment Management*. 9(2):14–34.

Cantillon, R. 1755. Essai sur la nature du commerce en général. *Institut Coppet*. Available: www.institutcoppet.org.

Carpenter, R.E. & Petersen, B.C. 2002. DOI: 10.1162/003465302317411541.

Cassar, G. 2004. The financing of business start-ups. *Journal of Business Venturing*. 19(2):261–283. DOI: 10.1016/S0883-9026(03)00029-6.

Cassar, G. & Holmes, S. 2003. Capital structure and financing of SMEs: Australian evidence. *Accounting and Finance*. DOI: 10.1111/1467-629X.t01-1-00085.

Chesbrough, H. 2003. *Open innovation: the new imperative for creating and profiting from technology*. Boston: Harvard Business School Press.

Coad, A. & Rao, R. 2008. Innovation and firm growth in high-tech sectors: A quantile regression approach. *Research Policy*. DOI: 10.1016/j.respol.2008.01.003.

Coad, A., Daunfeldt, S.O., Hölzl, W., Johansson, D. & Nightingale, P. 2014. High-growth firms: Introduction to the special section. *Industrial and Corporate Change*. 23(1):91–112. DOI: 10.1093/icc/dtt052.

Coad, A., Frankish, J.S. & Storey, D.J. 2020. Too fast to live? Effects of growth on survival across the growth distribution. *Journal of Small Business Management*. DOI: 10.1080/00472778.2019.1662265.

Coase, R.H. 1937. The Nature of the Firm. *Economica*. 4:386–405.

Coff, R. 2000. Human Capital, Shared Expertise, and the Likelihood of Impasse in Corporate Acquisitions. *Journal of Management*. 28:107–128. Available: https://www.researchgate.net/publication/249961690.

Cohen, S. & Hochberg, Y. V. 2014. Accelerating Startups: The Seed Accelerator Phenomenon. *SSRN Electronic Journal*. DOI: 10.2139/ssrn.2418000.

Cole, R.A. & Sokolyk, T. 2018a. Debt financing, survival, and growth of start-up firms. *Journal of Corporate Finance*. 50:609–625. DOI: 10.1016/j.jcorpfin.2017.10.013.

Cole, R.A. & Sokolyk, T. 2018b. Debt financing, survival, and growth of start-up firms. *Journal of Corporate Finance*. DOI: 10.1016/j.jcorpfin.2017.10.013.

Coleman, S. 2004. THE ROLE OF EDUCATION AND EXPERIENCE IN SMALL FIRM ACCESS TO BANK LOANS: IS THERE A LINK? *Journal of Business and Entrepreneurship*. 16(1):1–16.

Coleman, S. & Robb, A. 2012. Capital structure theory and new technology firms: Is there a match? *Management Research Review*. 35(2):106–120. DOI: 10.1108/01409171211195143.

Colombo, M.G. & Grilli, L. 2007. Funding gaps? Access to bank loans by high-tech start-ups. *Small Business Economics*. DOI: 10.1007/s11187-005-4067-0.

Cosh, A., Cumming, D. & Hughes, A. 2009. Outside entrepreneurial capital. *Economic Journal*. DOI: 10.1111/j.1468-0297.2009.02270.x.

Covin, J.G. & Slevin, D.P. 1989. Strategic Management of Small Firms in Hostile and Benign Environments. *Strategic Management Journal*. 10(1):75–87. Available: https://www.jstor.org/stable/2486395.

Cowling, M., Liu, W. & Zhang, N. 2016. Access to bank finance for UK SMEs in the wake of the recent financial crisis. *International Journal of Entrepreneurial Behaviour and Research*. DOI: 10.1108/IJEBR-06-2015-0126.

Cressy, R. 2006. Why do most firms die young? *Small Business Economics*. DOI: 10.1007/s11187-004-7813-9.

Cumming, D.J. 2005. Agency costs, institutions, learning, and taxation in venture capital contracting. *Journal of Business Venturing*. DOI: 10.1016/j.jbusvent.2003.07.001.

Davidsson, P., Steffens, P. & Fitzsimmons, J. 2009. Growing profitable or growing from profits: Putting the horse in front of the cart? *Journal of Business Venturing*. DOI: 10.1016/j.jbusvent.2008.04.003.

Davila, A., Foster, G. & Gupta, M. 2003. Venture-Capital Financing and the Growth of Startup Firms. *Journal of Business Venturing*. 18(6):689–708.

DeAngelo, H. & Masulis, R.W. 1980. Optimal capital structure under corporate and personal taxation. *Journal of Financial Economics*. DOI: 10.1016/0304-405X(80)90019-7.

Delmar, F. & Shane, S. 2006. Does experience matter? The effect of founding team experience on the survival and sales of newly founded ventures. *Strategic Organization*. 4(3):215–247. DOI: 10.1177/1476127006066596.

Delmar, F., Davidsson, P. & Gartner, W.B. 2001. Arriving at the High Growth Firm. *Journal of Business Venturing*. 18(2):189–216.

Demir, R., Wennberg, K. & McKelvie, A. 2017. The Strategic Management of High-Growth Firms: A Review and Theoretical Conceptualization. *Long Range Planning*. 50(4):431–456. DOI: 10.1016/j.lrp.2016.09.004.

Dewar, R.D. & Dutton, J.E. 1986. The Adoption of Radical and Incremental Innovations: An Empirical Analysis. *Management Science*. 32(11):1422–1433. DOI: 10.1287/mnsc.32.11.1422.

Djankov, S., La Porta, R., Lopez-de-Silanes, F. & Shleifer, A. 2002. The regulation of entry. *Quarterly Journal of Economics*. DOI: 10.1162/003355302753399436.

Drucker, P.F. 1986. *Innovation and entrepreneurship: practice and principles*. 1st Perennial Lib. ed. London: Harper & Row.

Dutta, S., Lanvin, B. & Wunsch-Vincent, S. 2017. *The global innovation index 2017 : innovation feeding the world*. World Intellectual Property Organization.

Edelman, B.G. & Geradin, D. 2016. EFFICIENCIES AND REGULATORY SHORTCUTS: HOW SHOULD WE REGULATE COMPANIES LIKE AIRBNB AND UBER? *Stanford Technology Law Review*. 19(1):293–328. Available: https://web.archive.org/web/20121010232053/http://.

Fairlie, R.W. & Robb, A.M. 2008. *Race and entrepreneurial success: Black-, Asian-, and White-owned businesses in the United State*. Cambridge, MA: The MIT Press.

Fischer, E.O., Heinkel, R. & Zechner, J. 1989. Dynamic Capital Structure Choice: Theory and Tests. *The Journal of Finance*. DOI: 10.1111/j.1540-6261.1989.tb02402.x.

Frank, M. & Goyal, V. 2008. Trade-off and pecking order theories of debt. In *Handbook of empirical corporate finance*. 135–202.

Garrahan, M. 2007. MySpace clicks to Canada and Mexico. *Financial Times* (Los Angeles). 29 January.

Gehl, R.W. 2012. Real (Software) Abstractions. *Social Text*. 30(2(111)). DOI: 10.1215/01642472-1541772.

George, G. 2005. Slack Resources and the Performance of Privately Held Firms. *Academy of Management Journal*. 48(4):661–676. DOI: 10.5465/amj.2005.17843944.

Glasner, J. 2021. *These Countries Have The Most Startup Investment For Their Size*.

Gompers, P.A. 1997. Optimal Investment, Monitoring, and the Staging of Venture Capital. In *Venture Capital*. 1st ed. New York: Routledge.

Gompers, P.A. & Lerner, J. 2004. *The venture capital cycle*. MIT Press.

Gompers, P., Lerner, J. & Scharfstein, D. 2005. *Entrepreneurial Spawning: Public Corporations and the Genesis of New Ventures, 1986 to 1999*.

Greiner, L.E. 1998. Evolution and Revolution as Organizations Grow. *Harvard Business Review*. 73(3).

Hall, J.K., Daneke, G.A. & Lenox, M.J. 2010. Sustainable development and entrepreneurship: Past contributions and future directions. *Journal of Business Venturing*. 25(5):439–448. DOI: 10.1016/j.jbusvent.2010.01.002.

Haltiwanger, J., Jarmin, R.S. & Miranda, J. 2013. DOI: 10.1162/REST_a_00288.

Hanel, P. 2006. Intellectual property rights business management practices: A survey of the literature. *Technovation*. 26(8):895–931. DOI: 10.1016/j.technovation.2005.12.001.

Hansen, D.R.. & Mowen, M.M.. 2007. *Managerial accounting*. 8th ed. J. Calhoun, Ed. Thomson/South-Western.

Harris, M. & Raviv, A. 1991. DOI: 10.1111/j.1540-6261.1991.tb03753.x.

Hausman, J.A. 1978. Specification Tests in Econometrics. *Econometrica*. 46(6):1251. DOI: 10.2307/1913827.

Healy, P.M. & Wahlen, J.M. 1999. A REVIEW OF THE EARNINGS MANAGEMENT LITERATURE AND ITS IMPLICATIONS FOR STANDARD SETTING. *Accounting horizons*. 4(13):365–383.

Henrekson, M. & Johansson, D. 2010. Gazelles as job creators: A survey and interpretation of the evidence. *Small Business Economics*. 35(2):227–244. DOI: 10.1007/s11187-009-9172-z.

Henrekson, M., Johansson, D. & Stenkula, M. 2010. Taxation, Labor Market Policy and High-Impact Entrepreneurship. *Journal of Industry, Competition and Trade*. 10(3):275–296. DOI: 10.1007/s10842-010-0081-2.

Heyman, F., Norbäck, P.-J., Persson, L. & Andersson, F. 2019. *Has the Swedish Business Sector Become More Entrepreneurial than the U.S. Business Sector? Has the Swedish Business Sector Become More Entrepreneurial than the US Business Sector?* (1147). Stockholm. Available: www.ifn.se.

Highsmith, J. 2011. *Agile project management: creating innovative products*. 2nd ed. Pearson Education.

Hisrich, R.D. & Peters, M.P. 2002. *Entrepreneurship*. 5th ed. McGraw-Hill.

Holland, D.A. & Matthews, B.A. 2017. *Beyond earnings: Applying the HOLT CFROI and economic profit framework*. Hoboken: John Wiley & Sons, Inc.

Hollanders, H., Es-Sadki, N., Merkelback, I. & Khalilova, A. 2020. *European Innovation Scoreboard 2020*. Luxembourg.

Hovakimian, A., Opler, T. & Titman, S. 2001. The Debt-Equity Choice. *The Journal of Financial and Quantitative Analysis*. 36(1):1. DOI: 10.2307/2676195.

Hunt, V., Layton, D. & Prince, S. 2015. *Diversity Matters*.

Huselid, M.A. 1995. *THE IMPACT OF HUMAN RESOURCE MANAGEMENT PRACTICES ON TURNOVER, PRODUCTIVITY, AND CORPORATE FINANCIAL PERFORMANCE*. Available: http://ssrn.com/abstract=1803666.

Isenberg, D.J. 2010. How to Start an Entrepreneurial Revolution. *Harvard Business Review*. 88(6):40.

Jensen, M.C. 1986. Agency Costs of Free Cash Flow, Corporate Finance, and Takeovers. *The American Economic Review*. 76(2):323–329.

Jensen, M.C. & Meckling, W.H. 1976. THEORY OF THE FIRM: MANAGERIAL BEHAVIOR, AGENCY COSTS AND OWNERSHIP STRUCTURE. *Journal of Financial Economics*. 3:305–360.

Joy, H. 2016. *Tracing the Evolution of the "Buy One, Give One" Model Through a Comparative Case Study Analysis of Warby Parker and SoapBox Soaps*. Available: http://repository.upenn.edu/joseph_wharton_scholarshttp://repository.upenn.edu/joseph_wharton_scholars/12.

Kashyap, A.K., Stein, J.C. & Wilcox, D.W. 1993. *Monetary Policy and Credit Conditions: Evidence from the Composition of External Finance*.

Kim, W.C. & Mauborgne, R. 2005. Value innovation: A leap into the blue ocean. *Journal of Business Strategy*. 26(4):22–28. DOI: 10.1108/02756660510608521.

Kirzner, I.M. 1973. *Competition and entrepreneurship*. Chicago: University of Chicago Press.

Klaesson, J. & Karlsson, C. 2014. *Market potential, start-up size and the survival of new firms*. (384). Available: http://www.cesis.se.

Klapper, L., Amit, R., Guillén, M.F., Manuel, J., The, Q. & Bank, W. 2007. *Entrepreneurship and Firm Formation Across Countries*. Available: http://econ.worldbank.org.

Knight, F. 1921. *Risk, uncertainty and profit*. New Edition ed. Wilmington: Vernon Press.

Kotler, P. & Keller, K.L. 2012. *Marketing Management*. 14th ed. Boston: Pearson Prentice Hall.

Kraus, A. & Litzenberger, R.H. 1973a. A State-Preference Model of Optimal Financial Leverage. *The Journal of Finance*. DOI: 10.2307/2978343.

Kraus, A. & Litzenberger, R.H. 1973b. *A State-Preference Model of Optimal Financial Leverage*.

Lamont, O. 1995. Corporate-Debt Overhang and Macroeconomic Expectations. *The American Economic Review*. 85(5):1106–1117.

Lang, L., Ofekb, E. & Stulz, R.? M. 1996. Leverage, investmemt, and firm growth. *Journal of Financial Economics*. 40:3–29.

Leary, M.T. & Roberts, M.R. 2005. Do firms rebalance their capital structures? *Journal of Finance*. DOI: 10.1111/j.1540-6261.2005.00811.x.

Lee, N., Sameen, H. & Cowling, M. 2015. Access to finance for innovative SMEs since the financial crisis. *Research Policy*. DOI: 10.1016/j.respol.2014.09.008.

Leland, H.E. & Pyle, D.H. 1977. Informational Asymmetries, Financial Structure, and Financial Intermediation. *The Journal of Finance*. DOI: 10.2307/2326770.

Lerner, J. 1999. The government as venture capitalist: The long-run impact of the SBIR program. *Journal of Business*. 72(3):285–318. DOI: 10.1086/209616.

Lerner, J. 2010. *The Boulevard of broken dreams: Why public efforts to boost entrepreneurship and venture capital have failed and what to do about it*. Princeton, NJ: Princeton University Press.

Mair, J. & Marti, I. 2006. Social entrepreneurship research: A source of explanation, prediction, and delight. *Journal of World Business*. 41(1):36–44.

Marshall, A. 1890. *Principles of Economics*. V. Vol. I. London and New York: MacMillan & Co.

Mason, C. & Brown, R. 2013. Creating good public policy to support high-growth firms. *Small Business Economics*. 40(2):211–225. DOI: 10.1007/sl.

Mawson, S. & Brown, R. 2017. Entrepreneurial acquisitions, open innovation and UK high growth SMEs. *Industry and Innovation*. 24(4):382–402. DOI: 10.1080/13662716.2016.1244764.

McGrath, R.G. 1999. Falling Forward: Real Options Reasoning and Entrepreneurial Failure. *Academy of Management Review*. 24(1):13–30. DOI: 10.5465/amr.1999.1580438.

Mills, K.G. & Mccarthy, B. 2014. *The State of Small Business Lending: Credit Access during the Recovery and How Technology May Change the Game*.

Modigliani, F. & Miller, M.H. 1958. The Cost of Capital, Corporation Finance and the Theory of Investment. *American Economic Review*. 48(3):261–297.

Modigliani, F. & Miller, M.H. 1963. Corporate income taxes and the cost of capital: a correction. *The American Economic Review*. 53(3):433–443.

Molina, C.A. & Preve, L.A. 2012. An Empirical Analysis of the Effect of Financial Distress on Trade Credit. *Financial Management*. 187–205. Available: http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/.

Myers, S.C. 1977. DETERMINANTS OF CORPORATE BORROWING. *Journal of Financial Economics*. 5(2):145–175.

Myers, S.C. 1984. CAPITAL STRUCTURE PUZZLE. *The Journal of Finance*. 39(3):575–592.

Myers, S.C. & Majiuf, N.S. 1981. CORPORATE FINANCING AND INVESTMENT DECISIONS WHEN FIRMS HAVE INFORMATION THE INVESTORS DO NOT HAVE. *Journal of Finance*. 13(2):187–221.

Nambisan, S. 2017. Digital Entrepreneurship: Toward a Digital Technology Perspective of Entrepreneurship. *Entrepreneurship: Theory and Practice*. 41(6):1029–1055. DOI: 10.1111/etap.12254.

National Institute of Economic Research (Konjunkturinstitutet). 2017. Swedish Economy March 2017. Stockholm: National Institute of Economic Research. Available: www.konj.se/en.

NESTA. 2013. *Plan I: the case for innovation-led growth*. London.

O'Brien, J.P. 2003. The capital structure implications of pursuing a strategy of innovation. *Strategic Management Journal*. DOI: 10.1002/smj.308.

OECD. 2010. High-Growth Enterprises: What Governments Can Do to Make a Difference. In *OECD Studies on SMEs and Entrepreneurship*. (OECD Studies on SMEs and Entrepreneurship). OECD Publishing. DOI: 10.1787/9789264048782-en.

OECD. 2017. *OECD Science, Technology and Industry Scoreboard 2017: The digital transformation,*. Paris.

OECD. 2018a. *Inclusive Entrepreneurship Policies: Country Assessment Notes*. Available: www.oecd.org/employment/leed/inclusive-entrepreneurship.htm.

OECD. 2018b. *Financing SMEs and Entrepreneurs 2018*. (Financing SMEs and Entrepreneurs). OECD. DOI: 10.1787/fin_sme_ent-2018-en.

OECD. 2019a. *OECD Economic Surveys Sweden*. Available: www.oecd.org/eco/surveys/economic-survey-sweden.htm.

OECD. 2019b. *Financing SMEs and Entrepreneurs 2019*.

OECD. 2023. *OECD Economic Surveys SWEDEN*. Paris.

Opler, T.C. & Titman, S. 1994. Financial Distress and Corporate Performance. *Source: The Journal of Finance*. 49(3):1015–1040.

Penman, S.H. 2013. *Financial Statement Analysis and Security Valuation*. 5th ed. McGraw-Hill Education.

Penrose, E. 1959. *The Theory of the Growth of the Firm*. 4th ed. Oxford: Oxford University Press. DOI: 10.1093/0198289774.001.0001.

Peteraf, M.A. 1993. The cornerstones of competitive advantage: A resource-based view. *Strategic Management Journal*. DOI: 10.1002/smj.4250140303.

Petersen, M.A. & Rajan, R.G. 1994. The Benefits of Lending Relationships: Evidence from Small Business Data. *The Journal of Finance*. DOI: 10.2307/2329133.

Pirolo, L. & Presutti, M. 2010. The Impact of Social Capital on the Start-ups' Performance Growth. *Journal of Small Business Management*.

Porter, M.E.. 1980. *Competitive strategy: techniques for analyzing industries and competitors*. New York: Free Press.

Porter, M.E. 1985. *Competitive advantage creating and sustaining superior performance with a new introduction*. First Free Press ed. New York: Free Press.

Porter, M.E., Stern, S. & Green, M. 2017. *SOCIAL PROGRESS INDEX 2017*.

Van Praag, C.M. & Versloot, P.H. 2007. What is the value of entrepreneurship? A review of recent research. *Small Business Economics*. DOI: 10.1007/s11187-007-9074-x.

Regulatory Policy Committee. 2016. *Cutting red tape: annual report 2016*. London.

Rideout, E.C. 2013. Does Entrepreneurship Education Really Work? A Review and Methodological Critique of the Empirical Literature on the Effects of University-Based Entrepreneurship Education. *Journal of Small Business Management*. 2013(3).

Ries, E. 2011. *The lean startup: How today's entrepreneurs use continuous innovation to create radically successful businesses*. Crown Currency.

Rimmer, M. 2018. Elon Musk's open innovation: Tesla, intellectual property, and climate change. In *Intellectual Property and Clean Energy: The Paris Agreement and Climate Justice*. DOI: 10.1007/978-981-13-2155-9_19.

Robb, A.M. & Robinson, D.T. 2014. The capital structure decisions of new firms. *Review of Financial Studies*. 27(1):153–179. DOI: 10.1093/rfs/hhs072.

Ross, S.A. 1977. The Determination of Financial Structure: The Incentive-Signalling Approach. *The Bell Journal of Economics*. 8(1):23–40.

Samuelsson, M. & Jutterström, M. 2023. An empirical test of sponsorship theory on a population of business incubators between 2005 and 2017–is it working or not? *Innovation: Organization and Management*. DOI: 10.1080/14479338.2023.2187395.

Saxenian, A. 1994. *Regional advantage: culture and competition in Silicon Valley and Route 128. Cambridge*. 1st ed. Cambridge, MA: Harvard University Press.

Schumpeter, J. 1934. *Innovation: The theory of economic development*. E. Elgar, Ed. Cheltenham.

Schumpeter, J.A. 1942. *Capitalism, socialism, and democracy*. 5th ed. New York: Routledge.

Schwab, K., Sala-i-Martin, X. & Samans, R. 2017. *The Global Competitiveness Report 2017*.

Schwab, K., Geiger, T., Crotti, R., Tan, J.T., Brown, S., Baller, S. & Di Battista, A. 2018. *The Global Competitiveness Report 2018*.

Shane, S. 2009. *Illusions of entrepreneurship: the costly myths that entrepreneurs, investors, and policy makers live by*. New Haven, CT: Yale University Press.

Shane, S. & Venkataraman, S. 2000. The Promise of Entrepreneurship as a Field of Research. *The Academy of Management Review*. 25(1):217–226.

Siepel, J., Cowling, M. & Coad, A. 2017. Non-founder human capital and the long-run growth and survival of high-tech ventures. *Technovation*. 59:34–43. DOI: 10.1016/j.technovation.2016.09.001.

Smith, A. 1776. *The Wealth of Nations*. Fifth Edition ed. E. Cannan, Ed. New York: Bantam Dell.

Smith, C.W. & Warner, J.B. 1979. On financial contracting. An analysis of bond covenants. *Journal of Financial Economics*. DOI: 10.1016/0304-405X(79)90011-4.

StartupBlink. 2023. *Global Startup Ecosystem Index 2023*. Zurich.

Steffens, P., Davidsson, P. & Fitzsimmons, J. 2009. Performance configurations over time: Implications for growth- and profit-oriented strategies. *Entrepreneurship: Theory and Practice*. DOI: 10.1111/j.1540-6520.2008.00283.x.

Steinmo, S. 2013. Governing as an Engineering Problem: The Political Economy of Swedish Success. In *Politics in the Age of Austerity*. 84–107.

Stevenson, H.H. & Gumpert, D.E. 1985. The heart of entrepreneurship. *HARVARD BUSINESS REVIEW*. 63:85–94.

Stiglitz, J.E. 1969. A Re-Examination of the Modigliani-Miller Theorem. 59(5):784–793.

Stiglitz, J.E. 1988. Why Financial Structure Matters. *Journal of Economic Perspectives*. 2(4):121–126.

Stiglitz, J.E. & Weiss, A. 1981. Credit Rationing in Markets with Imperfect Information. *American Economic Review*. 71(3):393–410.

Stinchcombe, A.L. 1965. *Social Structure and Organizations*. Rand McNally.

Storey, D.J. 2016. *Understanding The Small Business Sector*. Routledge. DOI: 10.4324/9781315544335.

Teece, D.J., Pisano, G. & Shuen, A. 1997. Dynamic capabilities and strategic management. *Strategic Management Journal*. 18(7):509–533. DOI: 10.1002/(SICI)1097-0266(199708)18:7<509::AID-SMJ882>3.0.CO;2-Z.

Terziovski, M. 2010. DOI: 10.1002/smj.841.

The World Bank. 2023a. *DataBank*.

The World Bank. 2023b. *Country Profile: Sweden*.

Titman, S. & Wessels, R. 1988. The Determinants of Capital Structure Choice. *The Journal of Finance*. DOI: 10.1111/j.1540-6261.1988.tb02585.x.

Trigeorgis, L. 1993. The Nature of Option Interactions and the Valuation of Investments with Multiple Real Options. *The Journal of Financial and Quantitative Analysis*. DOI: 10.2307/2331148.

Tsuruta, D. 2015. Leverage and firm performance of small businesses: evidence from Japan. *Small Bus Econ*. 44:385–395. Available: https://about.jstor.org/terms.

Tsuruta, D. 2017. Variance of Firm Performance and Leverage of Small Businesses. *Journal of Small Business Management*. 55(3):404–429. DOI: 10.1111/jsbm.12243.

Ucbasaran, D., Westhead, P., Wright, M. & Flores, M. 2010. The nature of entrepreneurial experience, business failure and comparative optimism. *Journal of Business Venturing*. 25(6):541–555. DOI: 10.1016/j.jbusvent.2009.04.001.

Vance, A. 2015. *Elon Musk: Tesla, SpaceX, and the Quest for a Fantastic Future*. First edition ed. New York: Ecco, an imprint of HarperCollinsPublishers.

Warner, J.B. 1977. Bankruptcy Costs: Some Evidence. *Source: The Journal of Finance*. 32(2):337–347.

Wasserman, N. 2012. *The Founder's Dilemmas : Anticipating and Avoiding the Pitfalls That Can Sink a Startup*. 1st ed. Princeton University Press.

Weidenman, P. 2016. *The Serrano Database for analysis and register-based statistics*.

Weill, L. 2008. Leverage and Corporate Performance: Does Institutional Environment Matter? *Source: Small Business Economics*. 30(3):251–265. DOI: 10.1007/sl.

Wendling, Z.A., Emerson, J.W., Esty, D.C., Levy, M.A., de Sherbinin, A. & et al. 2018. *2018 ENVIRONMENTAL PERFORMANCE INDEX*. New Haven, CT. Available: https://epi.yale.edu/.

Wernerfelt, B. 1984. A resource-based view of the firm. *Strategic Management Journal*. 5(2):171–180.

Wiklund, J. & Shepherd, D. 2003. Knowledge-based resources, entrepreneurial orientation, and the performance of small and medium-sized businesses. *Strategic Management Journal*. 24(13):1307–1314. DOI: 10.1002/smj.360.

Wooldridge, J.M. 2014. *Introduction to Econometrics*. EMEA ed. Andover: Cengage Learning.

World Bank Group. 2017. *Economy Profile of Sweden: Doing Business 2018 Indicators*.

World Bank Staff. 2014. *Doing Business 2015 : Comparing Business Regulations for Domestic Firms in 189 Economies.* World Bank Publications.

World Integrated Trade Solution. 2021. *TRADE SUMMARY FOR SWEDEN 2021*.

Zacharakis, A.L., Meyer, G.D. & Decastro, J. 1999. Differing Perceptions of New Venture Failure: A Matched Exploratory Study of Venture Capitalists and Entrepreneurs'^. *Journal of Small Business Management*.

Zahra, S.A. & Nambisan, S. 2012. Entrepreneurship and strategic thinking in business ecosystems. *Business Horizons*. DOI: 10.1016/j.bushor.2011.12.004.

Zhao, H. & Seibert, S.E. 2006. The big five personality dimensions and entrepreneurial status: A meta-analytical review. *Journal of Applied Psychology*. 91(2):259–271. DOI: 10.1037/0021-9010.91.2.259.

Zingales, L. 1998. Survival of the fittest or the fattest? Exit and financing in the trucking industry. *Journal of Finance*. DOI: 10.1111/0022-1082.00039.

7. Appendix

7.1. Innovation and start-ups

Innovation is at the heart of start-ups and is the cornerstone of their existence and the primary driver of their growth and competitiveness. Start-ups distinguish themselves from established firms through their relentless pursuit of novel ideas and their capacity to disrupt traditional markets. This intrinsic connection between start-ups and innovation fosters an environment where creativity thrives, and then groundbreaking solutions emerge to address unmet needs and challenges.

The unique nature of start-up innovation is agility, flexibility, and a pronounced willingness to embrace risk and uncertainty. Unlike larger corporations encumbered by bureaucratic structures, start-ups operate with lean teams and streamlined processes, so enabling rapid decision-making and swift adaptation to changing market conditions (Blank & Dorf, 2020). This agility allows start-ups to experiment with unconventional ideas and to pivot their strategies in response to feedback and emerging opportunities.

One of the fundamental strategies used to drive innovation by start-ups is the adoption of the lean start-up methodology. As articulated by Ries (2011), this approach emphasises the development of a minimal viable product (MVP) to test hypotheses and iteratively gather customer feedback. By focusing on validated learning, start-ups minimise waste and align their products closely with market demands. The iterative process of build-measure-learn cycles enables start-ups to refine their offerings efficiently, so reducing the time and resources required to achieve product–market fit.

Agile development processes complement the lean start-up methodology by promoting collaboration, flexibility, and responsiveness in product development. Start-ups leverage agile principles to break down projects into manageable increments, so facilitating continual integration of customer insights and technological advancements (Highsmith, 2011). This approach not only accelerates innovation but also enhances the quality and relevance of the solutions developed.

Start-ups often pursue disruptive innovation and blue ocean strategies to create uncontested market spaces and render competition irrelevant. By targeting underserved markets or creating entirely new demand, start-ups challenge established industry norms and introduce transformative products or services (Kim & Mauborgne, 2005). The success of companies like Uber and Airbnb exemplifies how start-ups can revolutionise industries through innovative business models that leverage technology and reimagine value propositions.

Resource constraints inherent in start-ups are catalysts for creative problem-solving and frugal innovation. Limited financial and human resources compel start-ups to innovate efficiently, so optimising processes and leveraging available assets to maximum effect (Bhatti & Ventresca, 2013). This necessity-driven innovation fosters a culture of resourcefulness and resilience, enabling start-ups to compete with larger firms despite disparities in resources.

Bootstrap financing, where start-ups rely on personal funds or revenue generated from operations, influences innovation pathways by maintaining autonomy over strategic decisions. While external funding can provide much-needed capital, it may also introduce pressures to conform to investor expectations, potentially stifling innovative pursuits that deviate from conventional trajectories (Wasserman, 2012). Bootstrapping allows start-ups to prioritise long-term innovation goals over short-term financial returns.

Collaboration and open innovation are integral to the innovation strategies of start-ups. Engaging in innovation networks with universities, research institutions, and other firms enables start-ups to access external knowledge, technologies, and resources that complement their internal capabilities (Chesbrough, 2003). Participation in accelerators and incubators provides start-ups with mentorship, infrastructure, and opportunities for networking, so amplifying their innovative potential (Cohen & Hochberg, 2014).

Management of intellectual property (IP) poses opportunities and challenges for start-ups. Strategic use of IP protection mechanisms, such as patents and trademarks, safeguards innovations and enhances competitive advantage. However, the costs and complexities associated with IP management can be burdensome for start-ups that have limited resources (Hanel, 2006). Balancing the need for protection with the benefits of collaboration requires careful consideration, as overly stringent secrecy can hinder partnerships and knowledge sharing that are essential for innovation.

The role of venture capital and alternative financing models significantly affects start-up innovation. Venture capitalists not only provide funding but also influence the strategic direction of innovation through their expectations and industry expertise (Gompers & Lerner, 2004). While this support can accelerate growth, it may also steer start-ups towards less risky, more commercially viable innovations at the expense of radical or long-term projects. Equity crowdfunding emerges as a democratising force, allowing start-ups to obtain financing from a broader base of investors and maintain greater control over their innovation agendas (Belleflamme, Lambert & Schwienbacher, 2014).

Start-ups face numerous challenges in their innovation endeavours. Market uncertainties and the difficulty of predicting customer acceptance necessitate robust market research and the willingness to pivot strategies as required (Blank & Dorf, 2020). Talent acquisition and retention are additional hurdles, as start-ups compete with established firms for skilled personnel crucial to innovation. The scarcity of resources may limit their ability to offer competitive compensation or to development opportunities (Baron & Hannan, 2002).

Scaling innovations from prototypes to market-ready products introduces complexities related to production, distribution, and quality control. Start-ups must develop operational capabilities rapidly in order to meet growing demand without compromising the innovative essence of their offerings (Coad & Rao, 2008). This scaling phase is critical, as it determines the start-up's ability to capture market share and establish a sustainable business model.

Measuring innovation performance in start-ups requires tailored metrics that capture the nuances of their operations. Traditional innovation indicators, such as R&D expenditure or patent counts, may not adequately

reflect the efficacy of start-up innovation (Terziovski, 2010). Alternative metrics, including speed to market, customer acquisition rates, and user engagement levels, provide more relevant insights into innovation outcomes for start-ups.

Policy implications play a significant role in supporting start-up innovation. Government initiatives, such as grants, tax incentives, and innovation vouchers, help de-risk innovative activities and provide essential funding for R&D (NESTA, 2013). An adaptive regulatory environment that accommodates emerging technologies and business models without imposing undue constraints fosters a conducive ecosystem for start-up innovation (Regulatory Policy Committee, 2016).

To conclude, start-ups embody a unique approach to innovation characterised by agility, resourcefulness, and a willingness to challenge established paradigms. Their strategies, ranging from lean methodologies to open innovation, enable them to navigate resource constraints and market uncertainties effectively. While start-ups face significant challenges, their contributions to technological advancement and economic growth underscore the importance of fostering environments that support their innovative endeavours. Future research on the sustainability of start-up innovations and their long-term impact on industries and societies will further highlight the vital role start-ups play in shaping the future.

7.2. Analysis of empirical studies considering the effect of leverage on firm performance

Table 12: Analysis of empirical studies considering the effect of leverage on firm performance

Paper	Model Specification	Dependent variable	Controls	Time lags
Agostino & Trivieri (2010)	Panel data regression analysing the effect of banking competition on SME performance.	Firm Performance: Measured by Return on Assets (ROA) and Return on Equity (ROE).	Firm size, age, industry dummies, regional dummies, banking competition indicators, ownership structure.	Lagged independent variables to address potential endogeneity.
Ahn, Denis & Denis (2006)	Multivariate regression examining the relationship between leverage and investment in diversified firms.	Investment: Capital expenditures scaled by beginning-of-period assets.	Cash flow, Tobin's Q, firm size, diversification measures, industry effects.	Lagged variables included to mitigate simultaneity issues.
Aivazian, Ge & Qiu (2005a)	Dynamic panel data model assessing leverage impact on firm investment in Canadian firms.	Investment Rate: Capital expenditures over beginning-of-period capital stock.	Leverage, cash flow, Tobin's Q, sales growth, firm size, industry dummies.	Lagged dependent variables to capture dynamics.
Aivazian, Ge & Qiu (2005b)	Analysis of debt maturity structure's effect on firm investment decisions.	Investment Rate: Capital expenditures over beginning-of-period capital stock.	Debt maturity structure, leverage, cash flow, Tobin's Q, firm size, growth opportunities.	Lagged variables included to address endogeneity.
Altman (1984)	Cross-sectional analysis investigating bankruptcy costs and their influence	Bankruptcy Costs: Estimated direct and indirect costs as a percentage of firm value.	Firm size, industry classification, leverage ratios, profitability.	Not explicitly mentioned; cross-sectional analysis.

Paper	Model Specification	Dependent variable	Controls	Time lags
	on corporate financial decisions.			
Cai & Zhang (2011)	Event study and regression analysis on leverage changes, debt overhang, and stock price reactions.	Stock Returns: Cumulative abnormal returns (CAR) related to leverage change announcements.	Market-to-book ratio, firm size, prior stock performance, leverage levels, debt overhang indicators.	Event windows analysed; time lags inherent in event studies.
Cole & Sokolyk (2018)	Survival analysis using Cox proportional hazards model and growth regressions for start-up firms.	Firm Survival: Time until failure or exit. Firm Growth: Growth in sales and employment.	Initial firm size, industry sector, owner characteristics, credit history, financing sources (debt vs. equity), profitability.	Time-varying covariates and lagged variables considered.
Lang, Ofek & Stulz (1996)	Regression analysis on the relationship between leverage, investment, and firm growth in U.S. firms.	Investment: Capital expenditures over beginning-of-period assets.	Leverage, Tobin's Q, cash flow, firm size, industry effects.	Lagged variables used to address causality concerns.
Opler & Titman (1994)	Regression analysis on financial distress impact during industry downturns.	Firm Performance: Sales growth, profitability ratios, market share changes.	Leverage, firm size, industry conditions, profitability, capital expenditures.	Lagged performance measures included.

Paper	Model Specification	Dependent variable	Controls	Time lags
Tsuruta (2015)	Regression analysis on leverage and firm performance in Japanese SMEs.	Firm Performance: Operating Income Ratio (OIR), sales growth, operating income growth.	Firm age, size, industry dummies, collateral availability, credit score, liquidity ratios.	Lagged independent variables to address potential reverse causality.
Tsuruta (2017)	Analysis of how leverage affects the variance of firm performance in small businesses.	Performance Variability: Variance of Operating Income Ratio, sales growth, operating income growth over multiple periods.	Leverage ratios, firm size, age, industry effects, risk measures.	Historical data used; lagged variables considered.
Weill (2008)	Cross-country regression analysis of leverage and corporate performance in transition economies.	Firm Performance: ROA, labour productivity, profit margins.	Leverage, institutional variables (e.g., legal environment), firm size, ownership structure, industry dummies, country fixed effects.	Lagged variables included to address endogeneity and dynamics.

7.3. Sample breakdown by sector and year

Table 13: Firms founded by cohort and sector

Sector	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total	% Total
Energy and Environment	71	228	94	133	119	113	129	182	251	212	174	67	190	132	117	89	62	65	30	5	2,463	0
Materials	674	634	829	707	557	548	656	594	561	738	637	417	646	615	333	268	207	181	104	18	9,924	2
Industrial goods	3,088	3,144	3,715	3,101	3,092	3,036	2,554	2,275	2,467	2,101	1,825	1,735	1,785	1,555	1,225	1,022	738	695	444	70	39,667	7
Construction	2,917	4,029	4,809	4,089	4,319	4,213	4,577	4,826	5,802	7,253	6,023	5,145	7,982	7,380	5,132	4,409	4,088	3,638	2,648	511	93,790	18
Shopping Goods	5,325	7,260	7,802	6,790	7,207	6,809	7,836	7,632	8,031	8,549	8,375	7,480	9,180	9,748	7,671	7,194	6,248	5,387	3,914	609	139,047	26
Convenience Goods	1,475	1,826	1,985	1,849	1,642	1,813	2,385	1,519	1,414	1,681	1,405	1,434	1,262	1,646	1,288	1,213	932	821	563	89	28,242	5
Health and Education	1,618	2,182	2,693	2,311	2,223	1,760	1,943	1,859	1,762	2,817	2,915	2,904	3,272	2,539	1,790	1,584	1,355	1,624	752	113	40,016	8
Finance and Real Estate	926	1,057	840	588	960	870	1,131	1,056	1,078	1,222	977	1,055	1,152	857	644	656	658	650	397	58	16,832	3
IT and Electronics	1,279	2,145	2,558	1,979	1,451	1,373	1,580	1,500	1,899	1,933	1,577	1,190	1,711	1,434	1,101	1,148	1,041	872	717	129	28,617	5
Telecom and Media	255	494	388	298	261	299	549	468	507	447	410	347	392	489	354	366	321	225	198	29	7,097	1
Corporate Services	4,569	5,877	7,400	5,812	5,920	5,434	6,417	6,363	7,042	7,572	7,771	5,481	8,134	7,484	5,770	5,590	5,081	4,227	2,985	559	115,488	22
Other	537	813	847	502	687	541	580	564	619	741	751	633	1,090	701	612	524	539	424	252	57	12,014	2
Missing	40	30	21	19	10	8	9	3	1	2	4		1	1	1	17	8	42	41	9	267	0
Total	22,774	29,719	33,981	28,178	28,448	26,817	30,346	28,841	31,434	35,268	32,844	27,888	36,797	34,581	26,038	24,080	21,278	18,851	13,045	2,256	533,464	100

Table 14: Percentage (%) distribution of firms founded by cohort and sector

Sector	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total
Energy and Environment	0	1	0	0	0	0	0	1	1	1	1	0	1	0	0	0	0	0	0	0	0
Materials	3	2	2	3	2	2	2	2	2	2	2	1	2	2	1	1	1	1	1	1	2
Industrial Goods	14	11	11	11	11	11	8	8	8	6	6	6	5	4	5	4	3	4	3	3	7
Construction	13	14	14	15	15	16	15	17	18	21	18	18	22	21	20	18	19	19	20	23	18
Shopping Goods	23	24	23	24	25	25	26	26	26	24	25	27	25	28	29	30	29	29	30	27	26
Convenience Goods	6	6	6	7	6	7	8	5	4	5	4	5	3	5	5	5	4	4	4	4	5
Health and Education	7	7	8	8	8	7	6	6	6	8	9	10	9	7	7	7	6	9	6	5	8
Finance and Real Estate	4	4	2	2	3	3	4	4	3	3	3	4	3	2	2	3	3	3	3	3	3
IT and Electronics	6	7	8	7	5	5	5	5	6	5	5	4	5	4	4	5	5	5	5	6	5
Telecom and Media	1	2	1	1	1	1	2	2	2	1	1	1	1	1	1	2	2	1	2	1	1
Corporate Services	20	20	22	21	21	20	21	22	22	21	24	20	22	22	22	23	24	22	23	25	22
Other	2	3	2	2	2	2	2	2	2	2	2	2	3	2	2	2	3	2	2	3	2
Missing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Table 15: Year-on-year percentage (%) change of firms founded by cohort and sector

Sector	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Energy and Environment		221	-59	41	-11	-5	14	41	38	-16	-18	-61	184	-31	-11	-24	-30	5	-54	-83
Materials		-6	31	-15	-21	-2	20	-9	-6	32	-14	-35	55	-5	-46	-20	-23	-13	-43	-83
Industrial Goods		2	18	-17	0	-2	-16	-11	8	-15	-13	-5	3	-13	-21	-17	-28	-6	-36	-84
Construction		38	19	-15	6	-2	9	5	20	25	-17	-15	55	-8	-30	-14	-7	-11	-27	-81
Shopping Goods		36	7	-13	6	-6	15	-3	5	6	-2	-11	23	6	-21	-6	-13	-14	-27	-84
Convenience Goods		24	9	-7	-11	10	32	-36	-7	19	-16	2	-12	30	-22	-6	-23	-12	-31	-84
Health and Education		35	23	-14	-4	-21	10	-4	-5	60	3	0	13	-22	-29	-12	-14	20	-54	-85
Finance and Real Estate		14	-21	-30	63	-9	30	-7	2	13	-20	8	9	-26	-25	2	0	-1	-39	-85
IT and Electronics		68	19	-23	-27	-5	15	-5	27	2	-18	-25	44	-16	-23	4	-9	-16	-18	-82
Telecom and Media		94	-21	-23	-12	15	84	-15	8	-12	-8	-15	13	25	-28	3	-12	-30	-12	-85
Corporate Services		29	26	-21	2	-8	18	-1	11	8	3	-29	48	-8	-23	-3	-9	-17	-29	-81
Other		51	4	-41	37	-21	7	-3	10	20	1	-16	72	-36	-13	-14	3	-21	-41	-77
Total		30%	14%	-17%	1%	-6%	13%	-5%	9%	12%	-7%	-15%	32%	-6%	-25%	-8%	-12%	-11%	-31%	-83%