Norwegian School of Economics
Bergen, Spring 2023

Financing of Start-ups

An Empirical Study of Debt Financing in Norwegian Start-ups

Sindri S. Antoineson van Kasteren & Mads Wilhelmsen Larsen

Supervisor: Svein-Arne Persson

Master thesis, Economics and Business Administration
Majors: Finance and Business Analysis and Performance Management

NORWEGIAN SCHOOL OF ECONOMICS

Abstract

The main goal of this thesis is to identify factors which determine the debt levels of Norwegian start-ups and how debt financing develops as firms mature. This is achieved by analysing a dataset consisting of 100.381 observations on 18.923 individual start-up firms from eight different industries.

Our findings show that there are significant differences in debt ratios between industries, however, the development of debt ratios follows the same trend across industries. As start-ups mature, they tend to tend to take on more *interest-bearing debt*. Nonetheless, prefer utilizing retained earnings which results in declining debt ratios over time.

Results from our regression analysis indicate that both the asset size- and structure significantly impact the accessibility of long-term debt for Norwegian start-ups. Furthermore, profitable firms tend to favour internal financing given by the negative relationship between *Return on Average Assets* (ROAA) and both the long- and short-term debt ratio. However, our results also reveal that start-ups prefer to finance growth with external debt. This is evidenced by both *Growth Sales* and *Growth Opportunity* being positively correlated with *long-term interest-bearing debt ratio* (LTDR), whereas *short-term interest-bearing debt ratio* (STDR) is positively correlated with *Growth Sales* but negatively affected by increased *Growth Opportunity*. Indicating that start-ups prefer using *long-term interest-bearing debt* to finance future growth opportunities.

When investigating whether the initial capital structure has any impact on the development of debt financing, our findings support the *Financial Growth Cycle* theory but contradict earlier empiricism. Based on our findings, the initial capital structure appears inconsequential as all debt ratios revert towards an overall mean over time. The difference being highly initial debt-financed start-ups appear more mature and less informational opaque than their counterparts at commencement.

Acknowledgement

This thesis marks the end of our challenging, yet rewarding master's degree program at the Norwegian School of Economics. It fills us with great pleasure to express our gratitude to all those who have supported us throughout our academic journey, enriching it with unforgettable memories and invaluable experiences.

The process of writing this thesis has been a rollercoaster of emotions, taking us through all the different ups and downs imaginable. From the seemingly never-ending long nights to the way too early mornings, we would like to voice our gratitude and appreciation to each other for making this a rewarding partnership.

Furthermore, we are immensely grateful for the understanding and encouragement of our friends and family. Their unwavering support, allowing us to vent our frustrations and celebrate our successes has truly been appreciated.

Ultimately, we would like to express our sincere gratitude to our supervisor, Professor Svein-Arne Persson for providing us with valuable contributions, insight, and guidance throughout this process.

Contents

List of Figures

List of Tables

1. Introduction

The chapter commences by going over the background of the thesis topic and subsequently presenting the research question. Next, it examines various definitions of start-ups, specifying the definition adopted for this thesis. It then proceeds to introduce start-ups and their operating environment. Furthermore, it explores the concept of debt, referencing prior research that has contributed significant theories to the field. Lastly, it presents start-up financing, including a description of the available financing options for start-ups in Norway.

1.1 Background and Motivation

Amidst rising interest rates, inflation, and political turmoil, the economic and business environment is immersed with uncertainty. Moreover, the aftermath of COVID-19 continues to impact the economic and political environment, further intensifying the volatile nature of the finance and business landscape. The long-term effects of recent crises as well as the current undergoing restructuring revolving around the green shift make businesses of tomorrow difficult to foresee. In this highly uncertain and changing market, there are however significant opportunities to play a part in the changing environment. Newly founded businesses are an immensely important part of driving innovation and growth, as well as triggering the entrepreneurial spirit in the population. The risks coinciding with start-ups are huge from an investor's perspective, however, it also provides a nearly boundless upside. With the majority of start-ups failing, and many due to not having access to the required capital for scaling up their business, it begs the question how are start-ups financed?

The Norwegian market is especially interesting as it has a less mature venture market, with the equity gap being a frequent research topic in Norway. Thus, making the lack of research on debt usage among Norwegian start-ups particularly fascinating. With the recent problems in the bank sector, start-ups are likely to face challenging times. The collapse of two major providers of venture debt, namely Silicon Valley Bank and Credit Suisse will undoubtedly make financing less accessible. Making this topic not only relevant for understanding debt financing in Norwegian start-ups but also a topic for future studies. Thus, we want to investigate what factors determine debt levels and how debt financing develops as start-ups mature.

1.2 Research Question

The main goal of this thesis is to identify factors which determine the debt levels of Norwegian start-ups and how debt financing develops as firms mature. Based on this we have formulated the following objectives:

- Examine relevant factors which contribute to the variation in debt ratios for Norwegian start-ups.
- Analyse the development of debt financing in Norwegian start-ups as they mature.
- Investigate if the initial interest-bearing debt ratio has an impact on the development of debt financing in Norwegian start-ups

1.3 Start-up Definition

Start-up is subject to various interpretations and attempted definitions, with different perspectives on the importance of different characteristics and features. Initially, start-ups are commonly understood as newly established firms. However, as the discussion progresses, it becomes apparent that additional factors should be considered, resulting in more refined definitions. For instance, a start-up may be defined as a newly founded company within the technology industry, consisting of no more than 20 employees, and demonstrating a strong ambition for growth. The definition of a start-up varies widely, ranging from broad interpretations to highly specific criteria, depending on the individual or group being consulted.

The definition of a start-up remains unclear in the literature, as noted by Mantanio, Gervasio and Pulcini (2020). However, there are some attempts on creating a definition. For example, Davila and Foster (2005) point out that a start-up is an independent firm and not related or tied to another firm, thus it cannot be a subsidiary. They agree with Kollman et al (2021) that start-ups cannot be older than 10 years old. Kollman et al (2021) emphasize that there should be a goal to increase the number of employees and/or sales. S. Blank (2020) partially agrees with Kollman's perspective that start-ups should focus on growth.

As there is no universal start-up definition, we have set the following parameters based on the attempts outlined:

> *A start-up refers to an independent firm that is established without any affiliation to another firm, thus excluding the possibility of being a subsidiary. Moreover, a start-up must be no more than 10 years old and have the ambition to grow. Its growth ambition is determined by taking on interest-bearing debt as well as employing someone, within the given 10-year timeframe.*

1.4 Start-up Environment

The start-up environment is a vibrant and dynamic ecosystem that fosters innovation, attracts risk-takers and encourages entrepreneurial endeavours. In this environment, entrepreneurs and investors come together to hopefully create a disruptive and value-adding product or service which can benefit society. As larger firms are more rigid and strict, smaller, and flexible entrepreneurial start-ups have the upper hand in creating truly value-adding products. These start-ups can then go on to become the next cornerstone firm in our society or develop a product that can improve a current one. However, the risk coinciding with these firms is immense, resulting in the majority failing and struggling to turn a profit. Some reoccurring reasons for failing start-up businesses are (1) Running out of cash, (2), No market need, and (3) Competition (CB Insights, 2021).

As of 2016, small and medium-sized businesses accounted for roughly 44% of the total value creation from Norwegian firms. Among this half is contributed by small businesses (1-20 employees). This amounts to roughly NOK 321 billion for small businesses and 700 billion for all SME firms (small and medium-sized enterprises). Norway is characterized by a large public sector, however, roughly 99% of all active firms are considered either small or medium-sized. Small business in Norway also employs roughly a fifth of the national workforce (NHO, n.d.). Interestingly, of all newly started firms only approximately 46% survive the first year and only 26% survive the first 5 years (Statistics Norway, 2022). Even if the contribution and importance of these businesses are priceless, there is a lack of research on the financing of them. In ***Chapter 1.6 Start-up Financing*** and ***Chapter 1.7 Financing Options for Norwegian Start-ups*** we will introduce the financing options in Norway.

1.5 Debt

In a firm's balance sheet, there are three fundamental components: assets, liabilities, and equity. The capital structure represents how firms combine equity and liabilities to finance their operations and growth (Vernimmen et al., 2014). Several theories covering capital structure have exhibited how important it is for firms to have an optimal combination of equity and liabilities, to try to maximize the firm's value (Myers, 1984). Equity represents the ownership interest held by shareholders in a firm, reflecting their stake in the firm. On the other hand, liabilities encompass the debts or obligations that a firm owes to external parties.

Liabilities cover a firm's financial obligations, with all liabilities subject to interest categorised as debt. Debt encompasses all the financial obligations associated with unpaid loans. In our thesis, we exclusively focus on *interest-bearing debt*, as this is used to fund new projects. Debt can be divided into two different types based on maturity, these being long-term- and short-term debt.

1.5.1 Long-term- & Short-term Debt

Long-term debt refers to a financial obligation that a borrower must repay over a period of more than one year (Laurens & Tampang, 2018). This type of debt is often used to finance large projects, such as building a new factory, purchasing expensive equipment, or acquiring another firm. Examples of long-term debt include mortgages, corporate bonds, and long-term bank loans (Martinez Jr, 2020). Long-term debt is usually associated with lower interest rates than short-term debt. However, business owners taking on long-term debt usually end up with a higher total interest cost, as lenders take on more risk due to default risk increasing with maturity (Martinez Jr, 2020). Debt can either be secured or unsecured, meaning if it is backed by collateral as security for lenders or not. Lenders often require the loan to be secured when lending to other businesses to decrease their risk, especially when it comes to long-term debt.

Short-term debt refers to a financial obligation that a borrower must repay within one year or less. This type of debt is typically used to cover short-term expenses, such as payroll or inventory, or to bridge the gap between accounts payable and accounts receivable (Martinez Jr, 2020). Examples of short-term debt include lines of credit and short-term bank loans. Short-term debt is usually associated with higher interest rates than long-term debt, even though lenders are taking on less risk by lending money for a shorter period. Short-term debt can be a good solution for the borrower if it is secured correctly, with a personal guarantee from the borrower and the firm demonstrates a capacity to pay (Martinez Jr, 2020).

1.6 Start-up Financing

In general, there are two types of financing, equity and debt. As illustrated by Berger and Udell (1998) the size, age and information availability of a firm indicate what type of financing are accessible. As firms mature and build a financial track record, add collateral, and show a transparent business plan, longer-term debt and outside equity become available.

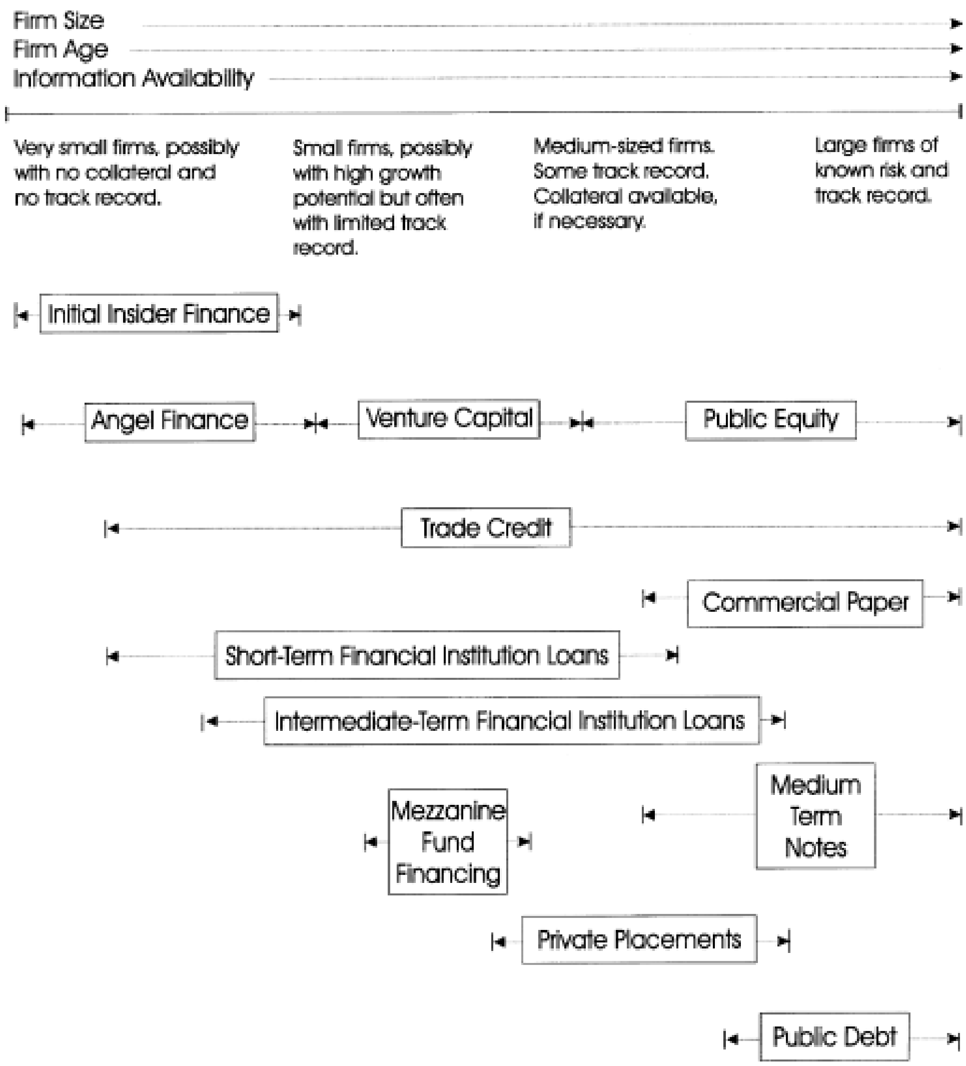

Figure 1-1 Firm continuum and sources of finance. Reprinted from Berger & Udell (1998)

The Figure illustrates sources of finance that are available to firms during their growth cycle. As the firm grows and matures more sources of financing become available to the firm.

For newly founded firms there is a problem of getting the required capital to scale up the business to reach its full potential. This is because the risk and uncertainty coinciding with start-ups are too big for traditional banks and financial institutions. However, there are options to obtain this capital other than only using personal funding. The main sources of funding for these start-ups are personal funds, loans from family and friends, and loans from traditional banks and financial institutions. Angel finance can also be used, this is an equity investment made early on into a start-up, typically by a wealthy individual. Venture capital is later equity investments from investors, investment banks or other financial institutions, made into start-ups and small businesses with long-term growth potential.

In the early stages of start-up financing, as illustrated by Berger & Udell, smaller, younger and more informational opaque (less transparency) firms tend to depend more on personal funds, short-term loans and angel investors if available. As they mature they access longer-term loans from banks and financial institutions, as well as equity investors such as venture capital and private equity. This is usually the last source of financing for a start-up as they now become mature enough for a buyout or an initial public offering.

The Kauffman survey (Robb & Robinson, 2008) on US start-ups from 2004 provides insight into the financing choices made at start-up. The results indicate that roughly 45% of all start-ups rely on external debt but only 6% have the backing of outside equity through angel investors and venture capitalists at start-up (Robb & Robinson, 2008). However, since the Kauffman survey, several innovations and trends have occurred in the start-up financing space. We will go deeper into the financing options and trends for start-ups in Norway in ***Chapter 1.7 Financing Options for Start-ups in Norway***.

1.7 Financing Options for Start-ups in Norway

As shown in ***Chapter 1.4 Start-up Environment***, small businesses in Norway play a pivotal role in the Norwegian economy by driving innovation, job creation and economic growth. However, on average only a quarter of start-ups survive the first five years. This risk coinciding with start-ups makes financing through traditional banks and financial institutions difficult and costly for these firms who already struggle to turn a profit. The Norwegian seed and venture investment market is also soaring compared to the neighbouring countries

Sweden, Denmark, and Finland. A report from Menon Economics (Wifstad et al., 2022) states that seed and venture investments in Norway are still less than half of the neighbouring countries per capita when measured against GDP. As an answer to this and improved financing accessibility, several governmental funding schemes are targeted towards start-ups and small businesses. New trends and innovative financing solutions have also come into play over the last years, improving the transparency of start-up firms and accessibility for retail investors. In this chapter, we will go over the financing options for Norwegian start-ups.

The majority of debt financing in Norwegian start-ups is contributed by commercial banks. Due to a lack of financial records and available collateral, these loans are usually high-interest loans. Menon state that since 2009 the fraction of start-ups with long-term debt financing has decreased to 13% in 2020 (Wifstad et al., 2022). However, the total debt levels have increased showing that start-ups with access to long-term financing get more than ever before. The availability of these loans is also determined by presenting a clear and precise business plan for achieving profitable results and growth. For start-ups, DNB (2013) states that key factors for obtaining debt are, (1) the firm's debt servicing capacity and (2) adequate collateral if the firm fails to service its debt. Government-supported organisations such as *Innovasjon Norge* offers start-up loans of up to NOK 2 million to firms that can illustrate an innovative product in a profitable market. This is support and loans with longer maturity and less restriction concerning financial records and collateral to fund innovative projects (Innovasjon Norge, 2023).

Over the last few years, innovative financing methods have also entered the Norwegian start-up financing market. Venture debt is loans that specifically target start-ups and high-growth firms to extend the runway in between equity financing rounds, issued by specialized banks. Venture debt has gained severe attention after the collapse of Silicon Valley Bank, however, barely scraped the Norwegian market with Funding Partner and Norselab being two venture debt providers. Crowdfunding has also emerged as an innovative method to raise funds as it reduces the gap between retail investors and private firms. This makes it easier for private firms and especially start-ups, to raise funds outside the stock exchange through an online platform. This is typically categorized by a big group of retail investors pitching in together to fund projects either through loans or investments. Funding Partner, Kameo and Folkeinvest are a few of the biggest actors in the Norwegian market. By bridging the gap between retail investors and private companies it increases the accessibility of external funding for Norwegian start-ups.

2. Literature Review

In this section, we will go over existing literature relevant to the topic of financing start-ups. This includes a review of theories related to capital structure, followed by an overview of relevant empiricism on financing and capital structure.

2.1 Modigliani Miller Theorem

The Modigliani-Miller Theorem, also known as the MM theorem, as currently understood, covers four distinct outcomes that came from a series of papers published between 1958 and 1963. The initial outcome states that a firm's market value remains unaffected by its debt-equity ratio under specific conditions. The second outcome indicates that a firm's leverage has no impact on its weighted average cost of capital, i.e., the cost of equity capital increases linearly with the debt-equity ratio. The third outcome establishes that a firm's market value is unrelated to its dividend policy. Finally, the fourth outcome establishes that equity holders are indifferent towards the financial policy of the firm (Villamil, A. P. 2008).

Modigliani and Miller (1958) put out two propositions in their theorem. Both propositions were considered under a perfect market, meaning there are no taxes, bankruptcy costs, agency costs and asymmetric information, it also considered these propositions under an imperfect market condition, such that we would find in a real-world market. Proposition I looks at the value of the firm based on its capital structure, while Proposition II looks at the expected rates of return based on the firm's capital structure.

2.1.1 Proposition I:

Modigliani and Miller (1958) state that in a perfect capital market, a firm's market value (V_j) is the combined market value of its debt (D_j) and its shares (S_j). For firm j, Proposition I can be stated with Equation 1 where $E[X_j]$ represent the expected return on assets owned by the firm:

$$(1) \qquad V_j = D_j + S_j = E[X_j]/\rho_k\,, for\ any\ firm\ j\ in\ class\ k.$$

By this equation, Modigliani and Miller (1958) state that: "*The market value of a firm is independent of their capital structure and is given by capitalizing its expected return at the rate* ρ_k *appropriate to its class"* (p.268).

Proposition I can also be stated in another way shown in Equation 2, where we look at the firm's average cost of capital (E*[X_j]/ V_j*), which is the ratio of its expected return to the market value of all its securities (Modigliani & Miller, 1958).

$$(2) \qquad \frac{E[X_j]}{(S_j+D_j)} = \frac{E[X_j]}{V_j} = \rho_k, for\ any\ firm\ j\ in\ class\ k.$$

From this equation Modigliani and Miller (1958) state that *"The average cost of capital of any firm is completely independent of its capital structure and is equal to the capitalisation rate of a pure equity stream of its class"* (p.268-269).

To establish Proposition I, Modigliani and Miller (1958) argue that if neither Equation 1 or 2 holds, there will be arbitrage opportunities available and so Equations 1 and 2 will always hold in an efficient market.

2.1.2 Proposition II:

To get Proposition II we need to derive the following proposition from Proposition I, concerning the rate of return on common stock in firms that have some debt in their capital structure. The expected rate or yield of return is a linear function of leverage represented by *i* on the stock of firm *j* belonging to *k* class shown by Equation 3.

$$(3) \qquad i_j = \rho_k + \frac{D_j}{S_j}(\rho_k - r)$$

Modigliani and Miller (1958) point out that *"The expected yield of a share of stock is equal to the appropriate capitalization rate* ρ_k *for pure equity stream in the class, plus a premium related to financial risk equal to debt-to-equity ratio times the spread between* ρ_k *and r"* (p.271).

To establish Proposition II, Modigliani and Miller (1958) noted that, by definition, the expected rate of return (*i*) is given by Equation 4:

$$(4) \qquad i_j = \frac{E[X_j] - rD_j}{S_j}$$

Modigliani and Miller incorporated Equation 4 into Equation 1 from Proposition I and, after simplification, derived Equation 3.

2.1.3 Proposition I & II with Tax

When introducing corporate tax into the propositions and moving from a perfect to an imperfect market, Modigliani and Miller (1958) state that capital structure starts to have an effect on the firm's value. Firms with debt can use it as a tax shield for the tax on their earnings after interest. Modigliani and Miller present the following Equation 5, after adding in the tax, that represents the total income for a firm net of taxes ($E[X_j^\tau]$):

$$E[X_j^\tau] = (E[X_j] - rD_j)(1-\tau) + rD_j = \pi_j^{-\tau} + rD_j \quad (5)$$

Where τ is the income tax rate and $\pi_j^{-\tau}$ is the expected net income accruing to the common stockholders. From the equation, we can see how adding debt will lead to an increase in total income by rD_j when the firm needs to pay taxes.

The propositions continue to have the same form after making the substitutions when adjusting for taxes, as the original. Therefore, Proposition I change to the following equation shown by Equation 6:

$$\frac{E[X_j^\tau]}{V_j} = \rho_{k^\tau}, for\ any\ firm\ j\ in\ class\ k. \quad (6)$$

and Proposition II change to the following equation shown by Equation 7:

$$i_j = \frac{\bar{\pi}_{j^\tau}}{S_j} = \rho_{j^\tau} + \frac{D_j}{S_j}(\rho_{k^\tau} - r) \quad (7)$$

where ρ_k^τ is the capitalization rate for income net of taxes in class k (Modigliani and Miller, 1958).

Modigliani and Miller's theorem serves as the foundation for subsequent capital structure theories, making it crucial to understand its essence and key takeaways. Later theories and empiricism build upon the findings of the MM theorem, showing the importance of understanding the core elements of capital structure theory.

2.2 Trade-off Theory

According to the MM theorem, given the tax shield, it might seem that a firm should be 100% levered to maximise the firm's value. Argued by illustrating that the firm's objective function becomes linear with no offsetting cost of debt, when introducing corporate income tax (Frank & Goyal, 2007). A reason why firms do not do this is because too much debt leads to an increased likelihood of financial distress. Financial distress is when a firm is in a situation where it cannot meet its financial obligations resulting in distress costs. Therefore, there exists a trade-off between leverage and distress costs. The trade-off is that as leverage increases, distress costs increase as well. At some point when increasing the leverage, the distress costs will overcompensate the benefit of increasing the leverage. This is called the *Trade-Off Theory* (Berk & DeMarzo, 2020).

Myers (1984) states that the *Trade-Off Theory* is based on the firm setting an optimal debt-to-value ratio. A firm's ideal amount of debt is typically believed to be found by considering the advantages and disadvantages of borrowing while assuming the firm's assets and investment plans stay the same. The firm is seen as weighing the benefits of tax shield from paying interest against the potential costs of bankruptcy or financial difficulties.

According to this theory, we acquire Equation 8 which is explained by Berk and DeMarzo (2020) as "*the total value of a levered firm equals to the value of the firm without leverage adding on the present value of the tax saving from debt and withdrawing the present value of financial distress cost*".

$$V(L) = V(U) + PV(Tax\ shield) - PV(Distress\ cost) \tag{8}$$

The equation shows us how if firms increase their leverage, they increase their benefit as well as increasing their cost. Firms have an incentive to increase leverage to benefit more from the tax benefit of debt. However, if debt increases too much the firm is more likely to experience the risk of default and incur financial distress costs (Berk & DeMarzo, 2020). Firms obtain the optimal level of debt by maximizing V(L). Firms will operate at the top of the curve in Figure 2-1 to maximize their firm value.

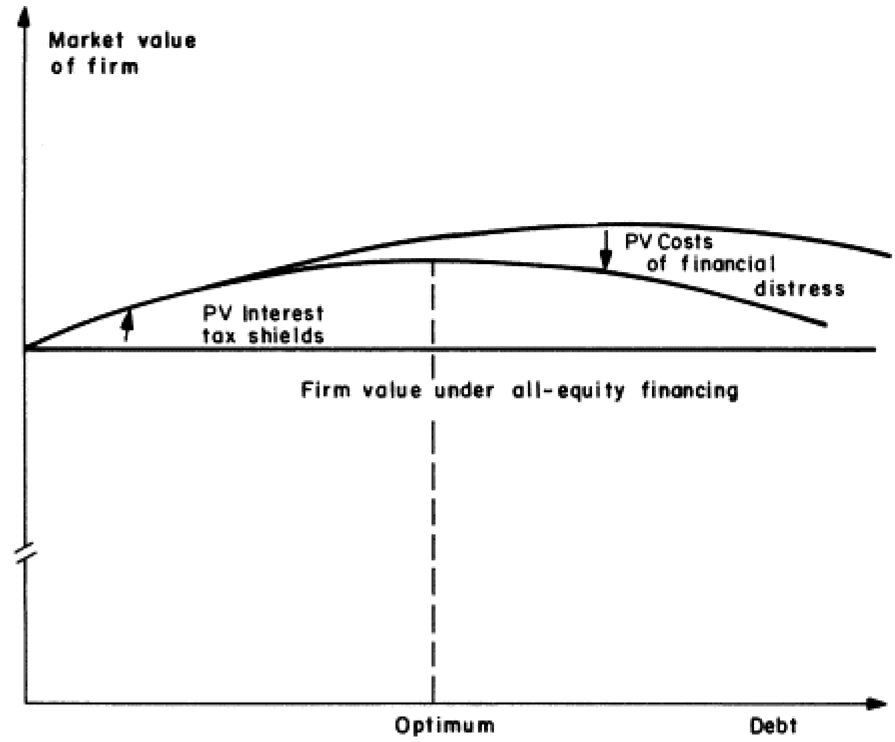

Figure 2-1 The static-tradeoff theory of capital structure. Reprinted from Myers (1984)

The Figure illustrates the tradeoff between interest tax shield and the cost of financial distress. It assumes that firms balance the marginal present value of tax shield with the cost of financial distress. Showing there is an optimum point on top of the PV interest tax shield curve, where a value-maximizing firm would operate at.

2.3 Pecking Order Theory

Myers and Majluf's (1984) developed a theory that introduced the idea of managers ranking capital when choosing how to raise funds. The theory comes from asymmetrical information. Information asymmetry arises when managers have more information and knowledge of a firm's fair value as they know more about its potential prospect and risks than new outside investors do. Thus, this theory is called the *Pecking Order Theory*.

The *Pecking Order Theory* explains the capital structure choices made by firms in the presence of information asymmetries with potential stakeholders. In this theory, due to information asymmetries between new investors, and current investors and management about a firm's current operations and future prospects, new investors, therefore, demand a higher rate of return on their investment compared to using existing internal funds. The higher the exposure to risk associated with information asymmetries, such as the duration of financing and seniority of contractual rights to the firm’s assets, the higher the return of capital demanded by each financing source. Because of these demands of a high rate of return on new capital, firms prefer inside finance, like retained earnings, to debt, and any debt to outside equity.

The *Pecking Order Theory* explains the capital structure choices made by firms in the presence of information asymmetries with potential stakeholders. Within this theory, information asymmetries between new investors, current investors, and management regarding a firm’s current operations and future prospects result in new investors demanding a higher rate of return on their investment.

The degree of risk exposure linked to information asymmetries, including factors such as financing duration and seniority of contractual rights to the firm’s assets, directly influences the return of capital demanded by each financing source. As a result of these increased return expectations for new capital, firms tend to prioritize internal financing options such as retained earnings over external debt and prefer external debt over external equity. This preference is driven by the desire to mitigate the higher costs associated with external financing sources (Leary & Roberts, 2010).

2.4 Financial Growth Cycle

In Berger and Udell’s study, they investigate the connection between a firm’s growth and its ability to secure external funding, referred to as the *Financial Growth Cycle* theory. They explore how firms gradually obtain access to various external financing options as they progress. At the initial stage, commonly referred to as the "start-up" phase, the firm is typically small, lacking collateral and an established track record. Consequently, the firm faces limited financial resources and often seeks external funding avenues to facilitate its growth. Typically, these external financing sources include personal funds, investments from friends and family, and occasionally angel investors.

As the firm grows and reaches what Berger and Udell (1998) categorise as a small firm, where it possesses significant growth potential but often lacks an extensive track record. At this stage, the firm begins to acquire new equity by issuing shares to fund its growth or introduces external debt as a financing option to grow. It may seek additional funding from venture capitalists, and private equity firms, as well as gradually incorporate debt from banks and financial institutions.

Subsequently, the firm transitions into a medium-sized firm, characterized by a modest track record and the availability of some collateral if needed. At this point, the firm gains access to public equity and debt markets. During this early phase of maturity and stability, the firm starts using its retained earnings to invest in its growth (Berger & Udell, 1998).

Ultimately, after successfully navigating and persevering through the preceding stages of the business life cycle, the firm reaches the classification of a large firm, as described by Berger and Udell (1998). A large firm possesses a recognized level of risk and an established track record. At this point, the firm has matured and primarily relies on internal financings, such as retained earnings, while also potentially starting to experience a gradual decline in performance.

Nonetheless, Berger and Udell (1998) highlight that the accessibility of financing alternatives can be contingent upon factors such as the industry, size, and ownership of the firm. They note that as small firms cultivate longer-term relationships with cooperatives, interest rates tend to decrease and credit availability rises. Consequently, the ownership of the firm as well as prior relationships with banks and financial institutions increase the availability of external debt funding.

2.5 Prior Empirical Research

The goal of selecting empirical research on the topic of capital structure and debt financing is to provide insight into the current empiricism as well as find comparable results. We have thus chosen to only select empiricisms that hold high and recognizable standards. As we are investigating key determining factors for debt financing in Norwegian start-ups, we have included a selection of sources on traditional capital structure determinants, firms in the Norwegian market, and research focusing on start-ups and small firms.

Frank and Goyal (2009) examine factors important for capital structure decisions in American-listed firms from 1950-2003. Throughout this study, they imply that there are factors which are robust throughout their regressions and can be seen as reliable independent variables in describing leverage decisions. Their findings indicate that *Median Industry Leverage*, *Market-To-Book assets ratio*, *Tangibility*, *Profits*, *Size*, and *Expected Inflation* are the most reliable factors. Indicating that the asset structure and performance of firms affect debt usage. Their findings also indicate that dividend-paying firms tend to have lower debt levels. Berger and Udell (1998) focus on the *Economics of Small business finance*, establishing the *Financial Growth Cycle* theory. The findings indicate that firms tend to go through different financial life cycles where the optimal capital structure differs as firms mature. The level of informational opaqueness in each firm explains the accessibility of external debt and thus explains the preferred financing method in each cycle. Both Frank and Goyal (2009) and Berger and Udell (1998) offer robustness of traditional research to our thesis, as a lot of our research is based around their findings.

Mjøs (2007) and Frydenberg (2004) both investigate Norwegian firms and thus give us interesting input on the capital structure in the same market as our study. Mjøs (2007) gives a comprehensive review of the capital structure in Norway by looking at 139,990 both private and public firms between 1992 and 2005. Findings report that *Size* and *Tangibility* are significant factors positively affecting *interest-bearing debt ratio* (IBDR). Dividend-paying, profitable firms on the other hand are correlated with lower debt levels. Frydenberg (2004) focuses on non-listed Norwegian manufacturing firms. Findings show that *Tangibility*, *Size*, *Growth*, *Non-Debt Tax Shield*, and *Return on Average Asset* (ROAA) are all determinants of capital structure. These findings, capsulate how a firm's financing preferences differ determined by performance-related factors and the asset structure. The findings also show signs of industry-specific differences. Öhman and Yazdanfar (2017) also focus on firms in the Scandinavian market, by investigating the short- and long-term debt determinants in Swedish small- and medium-sized firms. The study is conducted by including firms from five different sectors in the years between 2009 and 2012. The findings indicate that *Size*, *Age*, *Growth*, *Profitability*, *Tangibility* and *Non-Debt Tax Shield* are all factors associated to various extents with Swedish SME debt policies. Again, this highlights the differences in preferred financing methods based on the firm's maturity and performance, as described by Berger and Udell (1998).

La Rocca et al. (2009), and Teixeira and Coutinho dos Santos (2014) both investigate the financing decisions of firms along the *Financial Growth Cycle* developed by Berger and Udell (1998). La Rocca et al. (2009), focuses on small -and medium-sized Italian firms. They argue that the empirical literature regarding determinators of capital structure decisions fails to consider the level of informational opacity and the firm's characteristics at different stages in the life cycle. Results indicate that firms only take on debt when additional capital is needed, but preferably use retained earnings. The study gives support to the *Financial Growth Cycle* hypothesis as start-ups are more dependent on creditors than more profitable and mature firms. Teixeira and Coutinho dos Santos' (2014) study focus on Iberian firms, also showing support for the hypothesis that firms adopt specific financing strategies as they progress the different life cycles. Among those strategies, the study results show that the short-term debt ratio increase during the early stages and are substituted when firms mature.

Cassar (2004) focuses on the financing of business start-ups while criticizing earlier findings for not controlling for survivorship bias. The study also demonstrated the influence of initial start-up size, and asset structure on a firm's subsequent financing decisions. Hanssens et al. (2016) provide a panel data study over 15 years for Belgian non-financial start-ups founded between 1996 and 1998. Findings show that the debt policy of start-ups is stable over time, as well as supporting the findings of Cassar (2004) by providing new evidence that the initial debt policy is a significant and important determinator of future debt policies.

3. Important Factors and Interrelationships

In this section, we start by introducing interrelationships in debt financing before we go over how debt levels are measured in our analysis. Ultimately, we introduce important factors which impact the variation in different debt ratios.

3.1 Interrelationships in Debt Financing

As mentioned in ***Chapter 1.5 Debt***, external debt financing is an important factor in a start-up's capital structure to fund its growth. Debt financing is one of the key financing options in Norway because of the lack of equity financing options available for start-ups as showcased in ***Chapter 1.6 Start-up Financing.***

The availability and accessibility of external debt financing are dependent on qualitative firm-specific and economic factors, as stated in ***Chapter 2.4 Financial Growth Cycle***. External debt providers measure their risk based on the probability of loans being repaid, making firm-specific factors important to explain debt financing in Norwegian start-ups. Available collateral and profitability reduce the risk for a firm to default on its financial obligations, while a differentiated business strategy and diverse customer base ensure the stability of future cash flows. On the other hand, as the bankruptcy risk increases with dependency on external debt providers, debt financing also alters by a firm’s risk aversion and objective.

To examine these interrelationships explaining the variations in debt financing for Norwegian start-ups we use a set of relevant factors which are based on economical reasoning and earlier empiricism. In ***Chapter 3.2 Debt Measurement*** we will go over the measurement of debt before we in ***Chapter 3.3 Explanatory Factors*** introduce key factors explaining the variations in debt financing.

3.2 Debt Measurement

To measure debt levels, we exclusively focus on *interest-bearing debt*, as this is used to fund new projects by taking up external debt. As described in ***Chapter 1.5.1***, the firm has a choice of either taking on *long-term interest-bearing debt* (LTD) or *short-term interest-bearing debt*

(STD) and as a measurement of the debt levels we use the ratio of total assets. Meaning that we calculate the *long-term interest-bearing debt ratio* (LTDR), the *short-term interest-bearing debt ratio* (STDR), as well as the *total interest-bearing debt ratio* (IBDR). Given the nature of our data, these values are calculated based on the book value of debt, whereas in empirical studies it is also common to calculate the market values. This is however not possible in our study, due to none of the firms being listed on a stock exchange.

Variable construction:

$$(9) \qquad IBDR = \frac{Total\ Interest\ Bearing\ Debt}{Total\ Equity\ and\ Liabilities}$$

$$(10) \qquad LTDR = \frac{Total\ Long\ Term\ Interest\ Bearing\ Debt}{Total\ Equity\ and\ Liabilities}$$

$$(11) \qquad STDR = \frac{Total\ Short\ Term\ Interest\ Bearing\ Debt}{Total\ Equity\ and\ Liabilities}$$

3.3 Explanatory Factors

3.3.1 Size

Size is an indicator of a start-up's maturity, arguing that larger firms have different financing needs and funding accessibility. *Size* also captures potential bankruptcy effects, as small firms tend to have more default risk than larger firms. Thus, making the *Size* variable interesting when looking at the debt usage in bankruptcy-prone firms such as start-ups. As a proxy for the *Size* of a start-up, we use the logarithm of total assets. We have constructed this proxy in line with earlier empiricism, such as Cassar (2004), Mjøs (2007), and Frank and Goyal (2009).

The *Trade-Off Theory* predicts a positive relationship between *Size* and debt as large firms are more diversified and thus face lower default risk. In addition, it predicts that older firms have more experience in the debt markets and will consequently face lower debt-related agency costs (Frank & Goyal, 2009). The *Pecking Order Theory* on the other hand predicts an inverse relationship as larger firms are "better known and have been around longer" and thus will have retained earnings as their preferred financing source (Frank & Goyal, 2009). As described by Berger and Udell (1998) in the *Financial Growth Theory*, start-ups, and growth firms are especially informational opaque. The larger initial *Size* will decrease the level of information opaqueness and thus be positively correlated with the less accessible long-term debt and negatively correlated with riskier short-term debt. An increase in *Size* over time will also have a positive relationship with long-term debt as larger firms typically have more financial history, and subsequently will substitute riskier short-term debt with long-term debt when possible.

Empirical research has shown mixed results on the effect increased *Size* has on debt. Mjøs (2007) and Frydenberg (2004) who investigate Norwegian firms report a positive relationship. However, according to Öhman and Yazdanfar (2017), long-term debt is negatively affected by increased size and short-term debt is positively affected for Swedish SMEs.

We predict a positive relationship between *Size* and both *IBDR* and *LTDR*, but a negative relationship with *STDR*. This prediction is partly supported by earlier research and both the *Financial Growth Theory* and the *Trade-off Theory*.

Variable construction:

$$(12) \qquad Size = ln\ (Total\ Assets)$$

3.3.2 Tangibility

The asset structure of firms is described using the *Tangibility* variable which measures how large degree of the total assets are tangible. Tangible assets are easier for outsiders to evaluate than intangible assets and therefore work better for banks and financial institutions as collateral. *Tangibility* shows the potential collateral a firm has and should thus be positively correlated to debt levels. An increase in *Tangibility* also describes the maturity of the firm, as the informational opaqueness decreases with a tangible asset structure. For start-ups especially, *Tangibility* should therefore be immensely important when trying to explain debt usage-and development.

The *Trade-Off Theory* predicts a positive relationship between leverage and *Tangibility* as it lowers the expected cost of distress and debt-related agency problems (Frank & Goyal, 2009). On the other hand, the *Pecking Order Theory* shows mixed results of increased *Tangibility*. As tangible assets are associated with low information asymmetry, equity is perceived as a cheaper financing method than financing with debt. Indicating that firms with tangible assets should have lower debt ratios. The *Financial Growth Theory* would suggest that high-risk, high-growth firms have more intangible assets and low-risk, low-growth firms have more tangible assets. High-risk firms have less access to external debt and are thus more inclined to be financed by external equity. Low-growth firms are however more inclined to be financed by external debt (Berger and Udell, 1998).

Empirical research supports the *Trade-Off Theory* as *Tangibility* is positively correlated with total debt levels and especially long-term debt levels (Cassar, 2004; Mjøs, 2007; Hanssens et al., 2016). In line with the *Financial Growth Theory,* Öhman and Yazdanfar (2017) report a positive relationship with long-term debt, but a negative relationship with short-term debt. Indicating that less informational opaque firms substitute short-term debt with long-term debt when possible.

We predict a positive relationship between *Tangibility* and both *IBDR* and *LTDR* and a negative relationship with *STDR*. This is supported by the *Financial Growth Theory, Trade-Off Theory,* as well as empirical research.

Variable construction:

$$(13) \qquad Tangibility = \frac{Tangible\ Assets}{Total\ Assets}$$

3.3.3 Growth Opportunity

Growth Opportunity is, opposite from *Tangibility*, the intangible asset structure of the firm. These are assets difficult to appraise but can indicate future earnings and performance through non-monetary assets such as goodwill, intellectual property, and research & development. As start-ups are categorized by high growth, *Growth Opportunities* make a particularly good indicator to see how firms choose to finance their new projects. As a proxy to try to capture the potential growth opportunities in a firm, we use the degree of intangible assets of the total assets. Adam & Goyal (2008) argues that the market-to-book assets ratio is the best proxy for *Growth Opportunity*. However, as we do not have the market value of assets we use the degree of intangible assets of total assets as our proxy, similar to Teixeira and Coutinho dos Santos (2005).

The *Trade-Off Theory* predicts a negative relationship between *Growth Opportunities* and debt. Growth increases financial distress and thus places greater value on shareholders by shifting risk over to debtholders. By increasing the shareholder value, equity is perceived as cheaper than debt and thus explains the negative relationship (Frank & Goyal, 2009). The *Pecking Order Theory* contradicts this by arguing that firms should accumulate more debt over time if it has lucrative investment opportunities (Frank & Goyal, 2009). Through the *Financial Growth Cycle,* we get mixed results regarding *Tangibility*. In our dataset, the firms are fairly young and small, thus making them informational opaque. This is reflected in the asset structure by being more intangible and thus having a negative relationship with long-term debt and a positive one with short-term debt (Berger and Udell, 1998). However, it also predicts that very young firms will take on debt as they become less informational and opaque when taking on positive NPV projects. This contradicts the previous statement by indicating that there may be a positive relationship, as higher *Growth Opportunities* are proxies for future revenue which will lead to higher long-term debt levels.

The majority of earlier research has shown to find a positive correlation between *Growth Opportunities* and long-term debt levels (Teixeira & Coutinho dos Santos, 2005; La Rocca et al., 2009; Hanssens et al., 2016), thus indicating a negative relationship with short-term debt levels.

We predict a positive relationship between *Growth Opportunities* and both *IBDR and LTDR*, as well as a negative relationship with *STDR.* Supported by the *Financial Growth Cycle,* start-ups naturally take on debt as they become less informational opaque. Although we naturally expect firms with high *Growth Opportunities* to rely less on external debt in their capital structure initially.

Variable construction:

$$Growth\ Opportunities = \frac{Intangible\ Assets}{Total\ Assets} \tag{14}$$

3.3.4 Return on Average Assets

Similar to Mjøs (2007) we use *Return on Average Assets* (ROAA) to investigate the changes in capital structure, but now for Norwegian start-ups. *ROAA* shows how well a firm is performing, and for start-ups, an increase in *ROAA* could imply both a positive and negative relationship with debt ratios. In general, a high *ROAA* suggests retained earnings and thus a natural negative relationship. However, for start-ups, high earnings are also essential to obtain external debt given no historical financial records. For this reason, performance is an essential factor when investigating debt levels and debt development in Norwegian start-ups.

Research shows that profitability is significantly negatively correlated with debt levels. Giving support to the *Pecking Order Theory*, as firms prefer to use retained earnings as the main source of funding. The *Trade-Off Theory* argues that profitable firms will have bigger incentives to increase their debt levels as they have lower expected costs of financial distress (Frank & Goyal, 2009). Thus, they are more valuable if they take on more debt and increase the value of their tax shield. However, if the firm is not able to invest the free cash flow created, the retained earnings will increase the equity level and thus lower the debt ratios. The *Financial Growth Cycle* indicates that the youngest and most informational opaque firms will need to have earnings to access long-term debt. Hence, giving evidence that the youngest firms can have a positive relationship between debt ratios and profitability. It also states that firms normally prefer to pay down debt once they achieve retained earnings, which happens roughly around observation 5 (Berger and Udell, 1998).

The findings of Mjøs (2007) and Frydenberg (2004) in Norwegian firms indicate a negative relationship. Antoniou et al. (2002), Öhman and Yazdanfar (2017), La Rocca et al. (2009) and Hanssens et al. (2016) report the same results when investigating capital structure determinants in Europe and for smaller firms, respectively. We find little evidence of a positive relationship, although Teixeira and Coutinho dos Santos (2005) find an insignificant negative relationship between profitability and long-term debt for start-ups and growth firms.

We predict a negative relationship between $ROAA$ and all types of debt, supported by the overwhelming evidence in previous empirical research.

Variable construction:

$$(15) \qquad ROAA = \frac{Net\ Income}{((Total\ Assets_t + Total\ Assets_{t-1})/2)}$$

3.3.5 Pay-out Ratio

Following the argumentation for profitable firms, dividends are normally associated with financially healthy firms and are an indicator of excess capital. This indicates that the firm is able to finance projects without taking on extra debt by just using retained earnings, and even paying out excess cash to the shareholders. As with *ROAA*, the *Pay-out Ratio* is a performance-related proxy. We can thus argue for both a positive and negative relationship with debt levels. Dividends reduce the informational opaqueness of the firm and are perceived as a strong performance sign for banks and financial institutions. For start-ups, retained earnings make external debt more accessible, however, gives a natural negative relationship with debt levels given the increased equity.

The *Pecking Order Theory* argues that firms prefer internal financing over external funds and if investments and dividends are fixed, then profitable firms will become less levered (Frank & Goyal, 2009). This pay-out of retained earnings would indicate a positive relationship as the debt ratio increases with less equity in the mix. However, dividend pay-outs are also a sign of strength and reduce the asymmetric information and informational opaqueness of the start-up. This would indicate that equity is cheaper than debt, resulting in a negative relationship between *Pay-out Ratio* and all debt levels. The *Trade-Off Theory*, argued by Jensen (1986) shows that debt is more valuable for profitable firms as they are more prone to have free cash flow problems. The same argument can be made for dividends, as it works as a disciplinary tool for management and reduces overinvestments. This indicates a negative relationship between *Pay-out Ratio* and all debt levels.

Mjøs (2007) and Frydenberg (2004) report a significant negative relationship between *Pay-out Ratio* and *long-term interest-bearing debt ratios*. Frydenberg (2004) reports a positive relationship between dividends and short-term debt, however, this is due to dividends being reported as promised dividend pay-out and thus a short-term liability in the accounting data.

We predict a negative relationship between *Pay-out Ratio* and all debt levels, as we believe dividend payments are a signal of strength and correlate with retained earnings.

Variable construction:

$$(16) \qquad Payout\ Ratio = \frac{Dividends}{Net\ Profit}$$

3.3.6 Growth Sales

As a measure of actual growth, we use the growth in sales. How firms' managers finance growth projects are a key question in explaining debt usage- and development. In start-ups where the access to capital is limited and the informational asymmetry is great, we could argue that managers only take on debt when they have positive NPV (Net present value) projects. Growth is also a positive sign for banks and financial institutions, which can explain a positive relationship as it reduces informational opaqueness.

As argued earlier when describing *Growth Opportunities,* the *Trade-Off Theory* argues that growth increases financial distress and reduces free cash flow problems. The increased financial distress results in a decreasing optimal debt ratio for firms. The reduced free cash flow problem also results in a negative correlation as it works as a disciplinary action to the firm's manager and reduces overinvestments. This increases the shareholder value, and the *Trade-Off Theory* thus argues that equity is cheaper than debt for growing firms. As discussed earlier when looking at *Growth Opportunities,* the *Pecking Order Theory* argues that growing firms have more investments and will therefore accumulate more debt over time. Resulting in a positive correlation between an increase in *Growth Sales* and all debt levels (Frank & Goyal, 2009).

The *Financial Growth Cycle* theory indicates that growing firms have more intangible asset structures. Thus, making start-ups dependant on both growing and showing good financial results to obtain bank loans or other forms of external debt from financial intermediaries (Berger and Udell, 1998). The *Financial Growth Cycle* hence indicates an initial negative relationship whereas growth firms have less debt due to their asset structure. However, successful firms will take on external debt and do that by growing and becoming profitable, thus indicating a positive relationship between *Growth Sales* and *IBDR, LTDR* and *STDR*.

Growth has shown in empirical research some mixed results, with Frydenberg (2004), Hanssens et al. (2016), and Öhman and Yazdanfar (2017) reporting significant positive correlations. Mjøs (2007) reports a negative coefficient very close to zero, and Teixeira and Coutinho dos Santos (2005) report positive but insignificant coefficients very close to zero as well.

Based on a growing start-up's need for capital we predict a positive relationship between *Growth Sales* and *IBDR, LTDR* and *STDR.*

Variable construction:

$$(17) \qquad Growth\ Sales = \frac{Sales_t - Sales_{t-1}}{Sales_{t-1}}$$

3.3.7 Tax Shield

Tax is an all-essential part of capital structure theory as we have been discussing earlier. A tax shield is the value of the deductibles in a firm, which lowers the overall tax-rate expense and by doing this optimizes the profitability of the firm. We focus on the non-debt tax shields, meaning the deductibles related to the depreciation of assets. What effects tax has on capital structure choices at different firms, and especially how much this matters for start-ups is difficult to determine. Both the asset structure and tax shield are elementary to explain a firm's debt levels. However, the non-debt *Tax Shield* does not reduce the informational opaqueness as the asset structure does. An increased level of deductibles reduces the optimal debt level by decreasing the value of the interest-expense tax shield. Higher taxes give a higher incentive to take on more debt, as the value of the interest-expense tax shield increase with the tax rate (Frank & Goyal, 2009). However, the value of non-debt deductibles decreases this incentive.

Non-debt *Tax Shield* has the inverse relationship and works as a substitute for interest-cost tax benefits, as the *Trade-Off Theory* would indicate that a higher non-debt *Tax Shield* decreases the incentive of interest-cost tax shield benefits. In our data, an increase in depreciation/total assets will give the firm's managers less incentive to take on more debt, as non-debt *Tax Shield* increases. Hence, we predict a negative relationship for all debt levels.

Variable construction:

$$(18) \qquad Tax\ Shield = \frac{Depriciation}{Total\ Assets}$$

3.3.8 NIBOR 3m

The market interest rate works as a proxy for the accessibility of external debt. For start-ups, an increase in the interest rate will make debt less accessible, and thus have a natural negative relationship with long-term debt levels. While long-term debt becomes less accessible, more firms have to take on costlier debt with shorter maturity. This leads to a natural positive relationship between *NIBOR 3m* and *short-term interest-bearing debt ratio* (STDR).

We believe that when the market interest rate is low, the accessibility of external debt is greater for all firms and especially start-ups. Therefore, we predict a negative relationship between the *NIBOR 3m* and *interest-bearing debt ratio* (IBDR) and *long-term interest-bearing debt* *ratio* (LTDR). We also predict that short-term debt will be used when long-term debt is unavailable, therefore showing a positive relationship between *NIBOR 3m* and *short-term interest-bearing debt ratio* (STDR).

3.4 Hypotheses

In ***Table 1*** we can see the summary of our predictions regarding the causality each of the explanatory variables will have on the different dependent variables. We will present the result of our predictions in ***Chapter 6.6 Empirical Findings***

Table 1 Hypotheses

	Predictions		
	Dependent variables		
Independent variables	IBDR	LTDR	STDR
Size			
Prediction	+	+	-
Tangibility			
Prediction	+	+	-
Growth Opportunity			
Prediction	+	+	-
Payout Ratio			
Prediction	-	-	-
NIBOR 3m			
Prediction	-	-	+
Tax Shield			
Prediction	-	-	-
ROAA			
Prediction	-	-	-
Growth Sales			
Prediction	+	+	+

The Table illustrates our predictions of the correlations between independent variables and dependent variables. Column 1 shows predictions of correlations between IBDR (dependent variable) and the independent variables. While column 2 does the same for LTDR and column 3 does the same for STDR. The use of +/- is to indicate if we predict that the independent variable has a positive or a negative correlation with the dependent variable.

4. Data

The Data chapter will include a discussion on data collection, data characteristics, and data preparation for the subsequent analysis. Firstly, we will explain the type of data at hand and its source. Secondly, we will highlight essential characteristics of the data utilized and provide a brief overview of its contents. Lastly, we will delve into the process of data preparation, ensuring its compliance with the criteria outlined in the thesis.

4.1 Data Collection

There are two types of data, primary data, and secondary data. Primary data is data that is collected by the researcher himself/herself for that research specifically. Secondary data is data that was collected initially for some other purpose usually by an organization or corporation. Use of secondary data is often used to undertake further analysis of the data for other reasons than the original purpose. Secondary data can be accessed through different organisations. Most organisations collect and store a wide variety and large volume of data, this is to support their operations (Saunder et al., 2019). In our research, we will be using secondary data, accessed through *Regnskapsdatabasen – Norwegian Corporate Accounts* (Mjøs & Flatebø, 2022). This dataset gives us access to all reported accounting data from 1992 until 2020 for all private and publicly listed firms in Norway.

4.2 Data Characteristics

Our data consists of the balance sheets and profit statements from all private and publicly listed firms in Norway. *Regnskapsdatabasen* acquire these directly from the Brønnøysund Register Centre to which public and private firms are required to prepare and disclose annual financial records, thus ensuring the validity and reliability of our data

The firms in the dataset were categorized by *Standard Industrial Classification 2007 (SIC 2007)* made by Statistics Norway (Statistics Norway, n.d.), which encompassed a range of sectors such as Agriculture, Construction, Electricity, Finance, Manufacturing, Offshore Shipping, Other Services, Retail Wholesale, Telecom, IT and Tech, and Transport.

- The *Agriculture* sector consists of firms that are involved in activities related to agriculture, such as producing or connected to fertilizers, crop and animal products, hunting, fishing, and forestry.
- The *Construction* sector includes firms involved in building construction, civil engineering, and specialized construction activities, among others.
- The *Electricity* sector comprises firms that supply electricity, gas and steam to the public or other businesses.
- The *Finance* sector encompasses various firms involved in financial activities such as financing and insurance. This includes entities like investment banks, traditional banks, and venture capital firms.
- The *Manufacturing* sector involves firms engaged in manufacturing activities, including food products, beverages, tobacco products, textiles, and electrical equipment, among others.
- The *Offshore Shipping* sector includes firms related to offshore shipping, such as offshore supply terminals, and supply shipping offshore.
- The *Other Services* sector involves firms that are not categorised or do not fit under any of the other definitions.
- The *Retail Wholesale* sector comprises firms engaged in wholesale and retail trades, including the retail of motor vehicles and food, and the wholesale of flowers and food.
- The *Telecom IT Tech* sector involves firms engaged in telecommunications, wireless and wired, computer programming, and information services.
- The *Transport* sector includes firms involved in land, water, and air transportation, warehousing for transportation, and postal and courier services.

4.3 Data Preparation

In the preparation of the data, we refer to the definition provided in ***Chapter 1.3 Start-up Definition*** as the basis for our data preparation:

> *"A start-up is an active firm that is started up with no relation to another firm, hence it cannot be a subsidiary. The start-up cannot be any older than 10 years old. It needs to have the ambition to grow, which is determined by taking on interest-bearing debt and employing someone within our 10-year span."*

Based on our definition, we exclude all firms that are categorised as non-active and remove all firms established before 2003. Observations prior to 2003 have missing data needed for our analysis, thus making 2003 our starting point. In line with our start-up definition, we only keep the first 10 observations of each firm.

We remove all firms categorised as a subsidiary in our data. However, an issue we faced was that some firms were not categorised correctly as a subsidiary. Meaning that they appeared as a stand-alone firm, whereas in reality, they were not. To control this, we remove every firm with outstanding debt from a group company at any point in time during the 10-year period. This works as a subsidiary indicator proxy, as internal debt is a sign of relation to another firm.

As a proxy for the ambition to grow, we require our start-ups to employ someone during the time period, as well as take on *interest-bearing debt* in the same time frame. All firms not falling under these parameters are not considered a start-up in our data, given the lack of ambition to grow.

In the data, we experience impossible values, which certainly are due to errors in the dataset. That being negative equity and *interest-bearing debt* values. With these values, we experience impossible ratios in our analysis which do not have an economical explanation. To account for this, we require the total *interest-bearing debt ratio*, *long-term interest-bearing debt ratio*, *short-term interest-bearing debt ratio*, and *equity ratio* to be between 0 and 1.

We only include industries where we believe the capital structure and financing choices behave in the same way. Thus, we exclude the *Finance* sector, as debt determinants and financing choices behave differently. We also exclude *Other Services* as it does not provide a relevant comparison basis. After preparing the working dataset, the *Electricity* sector is also excluded due to the small number of observations making it not representative of the sector as a whole.

5. Methodology

In this chapter, we present the quantitative method used in answering the research question of this thesis. As the research questions entail, we choose a method that is suitable to estimate causality between the dependent and independent variables. Hence, we decide to use regression analysis to reach this target. Following, we will present different types of regression analyses in depth.

5.1 Data Types

In regard to our research, we are no better than the data we have available. Hence, it is important to examine the characteristics of the data to ensure that the proper analysis method is applied for our purpose. At large, we differentiate between three different types of data: time-series data, cross-sectional, and panel data.

Time-series data is a selection of observations on a single variable, collected at different times, for example, daily, weekly, monthly, and yearly. Cross-sectional data is data collected at one or multiple variables at the same time but across different entities. In our case, this is across different firms and different sectors. Panel data is used when we want multiple observations for the same entity over time. Thus, by combining time-series and cross-sectional data we can increase the sample size and achieve better data quality.

In this thesis, we want to explore how debt level in Norwegian start-ups is affected by different factors, and how debt financing develops over time. For this purpose, panel data is suitable and chosen for the following analysis.

5.2 Regression Analysis

Regression analysis is one of the most frequently used tools in market research. It allows us to analyse the relationship between one independent variable and one dependent variable. By adjusting the value of an independent variable, we can see what effect it has on the value of the dependent variable. This gives us insight into the dependency of the two variables.

Ordinary Least Squared (OLS) is a simple regression model to prove causality between two variables. A simple linear model is used to show how an independent variable affects the dependent variable. The regression equation for OLS is shown by Equation 19:

$$y = \beta_0 + \beta_1 x + \mu \tag{19}$$

By OLS we mean that the coefficient will have a linear relationship with the dependent variable. In this equitation, *y* is the dependent variable, *x* is the independent variable, β_0 the constant term, β_1 the coefficient for x, and μ the error term. The regression model estimates the coefficients which minimize the sum of the error term, μ. The error term catches the variance in the dependent variable which is not explained by the independent variable. Thus, minimizing the distance between the observed value of *y* and the estimated value of *y*. The OLS estimation determines the regression coefficients, and by doing this creates a regression line. This line lies as close to the observed data as possible, where the vertical distance between the observed data and the regression line is called a residual.

$$\hat{\mu} = y - \hat{y} = y - \widehat{\beta_0} - \widehat{\beta_1 x} \tag{20}$$

This model estimates what effect a change in *x* has on *y*. These estimates can also be used to predict new observations of *y* based on a given *x* value. By increasing the size and variance of the dataset we are then able to estimate these coefficient effects more accurately.

5.2.1 Multiple Regression Analysis

In a multiple regression analysis, the variation in the dependent variable is explained by multiple independent variables. In our case we can imagine that the debt financing choices are not explained by a single variable, thus making the model too simple. Equation 21 represents a multiple regression model:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_k x_k + \mu \tag{21}$$

In Equation 21, each independent variable has its own beta coefficient, estimating the effect of the given variable on the dependent variable. In a multiple regression model, the coefficient is given while controlling for the effect of the other independent variables. Thus, each coefficient can be used to estimate how much a change in an independent variable affects the dependent variable.

To use an OLS model some assumptions, need to be satisfied for the estimates to be unbiased. We will explain them in further detail in ***Chapter 5.3 OLS Assumptions***.

5.3 OLS Assumptions

The Gauss-Markov theorem provides a theoretical justification for using the OLS estimator, given that the assumptions below are met. If these assumptions are met then we can conclude with the OLS estimator being BLUE (Best Linear Unbiased Estimator) and thus the preferred model (Stock, 2011).

5.3.1 Linearity

The first assumption to establish the unbiasedness of the OLS estimator is to assume it being a linear relationship between the dependent and independent variables. If this relationship isn't linear the beta coefficient would be biased.

5.3.2 Random Sampling

The random sampling assumption is based on that the sample is representative of the population. This implies that the results from the analysis should be applicable to the generalized population. Thus, making the results unbiased and ensuring the statistical inference.

5.3.3 Multicollinearity

The third assumption for OLS is that there is no perfect linear relationship between the independent variables. With a such relationship multicollinearity would occur and make the coefficients biased. Naturally, the independent variables may be somewhat correlated but not perfectly or close to perfectly correlated (1 or -1). Being highly correlated makes it difficult to interpret the effect of the independent variables on the dependent variable, hence giving us a wrong estimate. By running a VIF test or correlation matrix we can identify a potential multicollinearity problem. If there is multicollinearity in the data, the guilty variable(s) should be replaced or removed from the model.

5.3.4 Zero Conditional Mean

The fourth assumption is that the conditional distribution of the error term, μ, given x has a mean of zero. This is also known as the exogeneity assumption and is one of the core assumptions for linear regressions. We can express this with Equation 22 (Stock, 2011):

$$(22) \qquad E(\mu_i|X_i) = 0$$

This does not assume that the variance in the error term should be zero but the variance in the error term has to be constant. This implies that the dependent variable is uncorrelated to the error term and thus independent of each other. An increase or decrease in the sample size would therefore not affect the coefficients meaning they are unbiased and consistent. Omitted variables or measurement errors in the independent variables can lead to violations of the *Zero Conditional Mean* assumption resulting in endogenous variables.

5.3.5 Homoscedastic

The assumption of homoscedasticity is given by the error term having the same variance for any given values of the independent variables (Wooldridge, 2012).

$$(23) \qquad E(\mu_i|x_1, \ldots, x_i) = \sigma^2$$

If the homoscedasticity assumption is violated it means that the variability of the error term is not constant across different values from the independent variable. For example, if there are outliers in the data or omitted variables not accounted for in the model, it can lead to heteroskedasticity.

5.3.6 Normality

The normality assumption is given by that the population error, μ, is independent of the explanatory variables, x_1, x_2, …, x_k and is normally distributed with zero mean and variance σ^2: $\mu \sim Normal(0, \sigma^2)$. Given this assumption, we are indirectly implying the assumption of *Homoscedasticity* and *Zero Conditional Mean* (Wooldridge, 2012). *Normality* is important to assure us that the p-values and coefficient values are both valid and reliable. For large sample sizes, however, violation of the normality assumption is not a serious problem (Wooldridge, 2012).

5.3.7 Autocorrelation

In time-series data *Autocorrelation* can be a problem as observations from the same entity are taken over time, as it violates the assumption of independence of observations for which are required. Furthermore, this can lead to biased estimates of regression coefficients and incorrect hypothesis testing as it increases the standard errors. This can be described mathematically as:

$$(24) \qquad Corr(\mu_t, \mu_s) = 0, for\ all\ t\ \neq s$$

To detect *autocorrelation,* we can use a *Breusch-Godfrey test*. If the assumption is violated, we will have to use robust standard errors for *autocorrelation* to encounter this violation.

5.4 Regression Models for Panel Data

5.4.1 Pooled Ordinary Least Squared

A *Pooled OLS* model is used when we have a panel data set, where we have both time-varying and cross-sectional dimensions. Meaning that we have observations from the same units, across several time dimensions. A standard OLS model assumes *Homoscedastic* and *Autocorrelation* by keeping the relationship between the dependent and independent variables the same for all cross-sectional units. The model thus estimates the coefficients of the independent variable that best fit the data from all units in the sample, while assuming a constant variance in the error term across all units. Equation 25 presents the regression equation:

$$(25) \qquad y_{it} = \beta_0 + \beta_1 x_{it} + \nu_{it},\ \nu_{it} = \alpha_i + \mu_{it}$$

Here, y_{it} is the dependent variable for each unit *i*, for each time period *t*. β_0 is the constant term, β_1 is the beta coefficient, and $x_{it}$is the independent variable for each unit *i*, for each time period *t*. ν_{it} is the pooled error term, while $\alpha_i + \mu_{it}$ represents the unobserved individual effect and the general error term, respectively.

In the *Pooled OLS* model, the correlation between $\alpha_i\ and\ \mu_{it}$ are assumed to be uncorrelated, however, in panel data, this often is not the case. If this is not the case, it will result in the estimations from the *Pooled OLS* model being wrong and more advanced panel data models will be necessary. These wrong estimations come from heterogeneity bias, which stems from omitting a time-constant variable (Wooldridge, 2012).

5.4.2 **Fixed Effects (FE)**

A *Fixed Effects* (FE) model is used to control for unit-specific effects, which are constant over time. The model controls for the unobserved time-invariant factors that differ across units and is removed from the coefficient estimates. Hence, the model controls for the time-invariant heterogeneity observed in the *Pooled OLS* model. In the *FE* model several transformation methods can be used, *LSDV*, *First Difference* or *Within Group*. For our analysis, the *Within Group* is preferred. For this, Equation 26 is performed for the regression:

$$(26) \qquad y_{it} = \beta_0 + \beta_1 x_{i1} + \beta_2 \tau_i + v_{it}, \qquad t = 1,2,3,\dots,T$$

$$where: v_{it} = \alpha_i + \mu_{it}$$

In Equation 26, x is our independent variable which varies over time, τ_i is an unobserved time constant variable which varies across entities. v_{it} are the entity-fixed effects, where α_i is the part of the entity fixed effects that stems from unobserved heterogeneity, and μ_{it} are the part that does not come from unobserved heterogeneity. We calculate the mean values of each variable for further transformation. For each *i,* we average Equation 26 over time.

$$(27) \qquad \bar{y} = \beta_0 + \beta_1 \bar{x_i} + \beta_2 \bar{\tau_i} + \alpha_i + \bar{\mu_i}$$

The constant term β_0, and unobserved heterogeneity α_i are constant and are thus present in both equations. We then subtract the average values from each observation ending up with the equations below:

$$(28) \qquad y_{it} - \bar{y}_i = \beta_0(1-1) + \beta_1(x_{it} - \bar{x}_i) + \beta_2(\tau_{it} - \bar{\tau}_i) + (\alpha_i - \alpha_i) + (\mu_{it} - \bar{\mu}_i), \quad t = 1,2,3,\dots,T,$$

Or simplified:

$$(29) \qquad \ddot{y_{it}} = \beta_1 \ddot{x}_{it} + \ddot{\mu}_{it}, \qquad t = 1,2,3,\dots,T,$$

Where $\ddot{y}_{it} = y_{it} - \bar{y}_{it}$ is the time-demeaned data on *y*, and similarly for $\ddot{x}_{it}$ and $\ddot{\mu}_{it}$ (Wooldridge, 2012). This is the *fixed effects* transformation, also called the *within* transformation. In the transformation, we have removed the time-fixed unobserved heteroscedastic variable, α_i. By removing these, we create estimates that are unaffected by omitted variables which are constant over time.

5.4.3 Random Effects (RE)

The *Random Effects* (RE) model differentiates itself from the *FE* model instead of trying to eliminate the time-fixed unobserved heteroscedastic variable α_i, we assume that it has a zero mean. If α_i, is uncorrelated with all independent variables in our model for each time period, then removing α_i results in inefficient estimators (Wooldridge, 2012). In the *RE* model, we thus assume:

$$(30) \qquad Cov(x_{itj}, \alpha_i) = 0, \quad t = 1,2,3, \ldots, T; j = 1,2,3, \ldots, k.$$

In the *RE* model, we use a *generalized least-squared* approach to deal with the autocorrelation. The basis of the transformation in the *RE* model is the same as in the *FE* model, however in the *RE* transformation we subtract the time averages from the corresponding variable. Equation 31 shows the transformation equation:

$$(31) \qquad \lambda = 1 - [\frac{\sigma_\mu^2}{(T\sigma_\alpha^2)}]^{\frac{1}{2}},$$

The fraction is between zero and one, by including this in the transformation equation we get Equation 32,

$$(32) \quad y_{it} - \lambda\bar{y}_i = \beta_0(1-\lambda) + \beta_1(x_{it} - \lambda\bar{x}_i) + \beta_2(\tau_{it} - \lambda\bar{\tau}_i) + (\mu_{it} - \lambda\bar{\mu}_i),$$

Which again can be expressed as with the *FE* model represented by Equation 33:

$$(33) \qquad \ddot{y_{it}} = \ddot{\beta} + \beta\ddot{x}_{it} + \beta\ddot{\tau}_i + \ddot{\mu}_{it}$$

Where $\ddot{y}_{it} = y_{it} - \lambda\bar{y}_i$ donates the time averages. The fraction depends on the values of σ_μ^2 and σ_α^2, as well as the number of time periods, *T* (Wooldridge, 2012). What we do see out of both the *RE* and *FE* equations is that when the fraction λ is 1, the *RE* model is identical to the *FE* model. How to choose what model to use we will go over further in ***Chapter 5.5 Tests Deciding Preferred Regression Model***.

5.4.4 RE vs FE

Both the *RE*- and *FE* models are more advanced methods than the *Pooled OLS* in proving causality. This makes it natural to compare the two more advanced models and describe when we prefer using one or the other. The key difference in the models is that the *FE* model allows for arbitrary correlation between α_i and x_{it}, while the *RE* model does not (Wooldridge, 2012). This means that the *FE* model removes time-fixed variables in the transformation described in

Chapter 5.4.2 Fixed Effects (FE), the *RE* model on the other hand just removes a fraction of it. In a situation where constant time-fixed effects are significant; we might prefer using the *RE* model.

The assumptions we make for the model and the nature of the dataset is the key to deciding what model to use. In the *RE* model, we assume that the unobserved heterogeneity α_i, is both random and uncorrelated with the independent variables, however, this is difficult to prove. In a situation where the *RE* assumption is violated, the estimates will be inconsistent and biased.

5.5 Tests Deciding Preferred Regression Model

In this part, we will provide a description of what tests we run to decide what model(s) are best suited for the nature of our data. These tests are necessary to make sure that the results we present are both valid and consistent. The test results themselves will be presented in ***Chapter 6.3 Test Results Deciding Preferred Regression Model***.

5.5.1 F-test

When conducting an *F-test* we check whether the *Pooled OLS* or *Fixed Effects* models are better suited for our data. The *F-test* is similar to the *T-test* checking if a variable has a partial effect on the dependent variable, the *F-test* however checks if this is the case for a set of independent variables. By doing this we can check if there are fixed effects present in the data, and indirectly check for heteroscedasticity. Thus, in the *F-test* check if the regression line of the *Pooled OLS* or *Fixed Effect* model fits the data the best based on the underlying assumptions.

$$H_0: \beta_1 + \cdots + \beta_n = 0 \qquad (34)$$

If there are any partial effects in the model of the independent variables, then we prefer to use the *FE* model over the *Pooled OLS* model. When conducting a *FE* regression in R-studio we also get the F-stat. We reject H_0 if the F-Stat > 2.5 and conclude that at least one of the variables has a nonzero parameter.

5.5.2 Breusch-Pagan (BP) Test

To test for heteroscedasticity directly we use the *Breusch-Pagan Test.* As we have discussed earlier, with the presence of heteroscedasticity we violate one of the assumptions for OLS, and thus the estimates would be biased. This indicates that we need to use one of the more advanced models (*FE* or *RE*) to conduct our analysis. We assume that the variances in the error term for all independent variables are equal. Which sets the precedence for the *BP test*:

$$(35) \qquad H_0: \sigma_\mu^2 = 0$$

If the variance in the error term is not equal to zero, then the assumption is violated, and the null hypothesis is rejected. We then conclude with heteroscedasticity in the data and will prefer to use a more advanced model for our research, as the *Pooled OLS* model would give inconsistent and biased estimates. In the presence of heteroscedastic data, it is also important to use robust standard errors to avoid biased and inefficient estimates of the standard errors.

5.5.3 Hausman Test

If we reject the null hypothesis in the *F-test* and/or the *Breusch-Pagan* test it indicates that our data is heteroscedastic, and we conclude that an *FE* or *RE* model is preferred. *The Hausman Test* is used to decide if the *RE* or *FE* model is best suited for our data. The null hypothesis is that the *RE* model is preferred, however, if we reject this then we conclude with the *FE* model being the preferred one. The null hypothesis in the *Hausman Test* is thus similar to the assumption in the *RE* model.

$$(36) \qquad H_{0:}: Cov(x_{it}, \alpha_i) = 0,$$

$$(37) \qquad H_{1:}: Cov(x_{it}, \alpha_i) \neq 0$$

The test displays the difference in coefficients between the *RE* and *FE* models. The test will in this thesis be conducted in R-studio where we are provided with the P-values of the test. We reject the null hypothesis if the P-value < 0.05 and conclude with there being significant differences in the coefficients between the *RE* and *FE*. If the P-value > 0.05 we fail to reject the null hypothesis, indicating that there are no significant differences.

5.5.4 **Breusch-Godfrey Test**

Autocorrelation in the data can also, similarly to heteroscedasticity disturb the standard errors for the estimates. To test for the presence of autocorrelation we run the *Breusch-Godfrey test*.

Autocorrelation occurs when the residuals at one point are correlated with the residuals at another point in time series data.

(38) $$H_{0:}: Cov(\mu_t, \mu_{t-1}) = 0$$

We reject the null hypothesis in the presence of autocorrelation given by a P-value < 0.05. In the presence of serial correlation, we will have to make sure to use robust standard errors compatible with the chosen model. For the *FE* model *Huber/White-sandwich* standard errors can be used.

6. Data analysis

In this section, we will handle outliers and subsequently proceed to conduct a descriptive analysis. Following that we go into regression analysis, accompanied by an examination of variables and their corresponding findings. Ultimately, we will create two subsets based on the initial debt financing and examine and compare the strategies. This analysis aims to determine if there are any discernible differences between the two approaches to initial debt financing.

6.1 Handling Outliers

After applying our criteria to identify start-ups and excluding firms that do not meet our definition, we are left with a dataset comprising 114,014 observations, representing 20,468 individual firms.

Table 2 Descriptive Statistics

Statistic	N	Mean	St. Dev.	Median	Min	Max
Tangibility	114,014	0.22	0.24	0.14	-0.41	3.27
Growth opportunity	114,014	0.02	0.07	0.00	-0.43	2.33
Payout Ratio	114,014	0.12	2.70	0.00	- 266.67	366.00
NIBOR 3M	114,014	0.02	0.01	0.02	0.01	0.06
Tax shield	114,014	0.05	0.06	0.05	-0.44	7.00
Growth sales	90,071	0.67	6.11	0.10	-1.00	581.67
Size	114,014	3,794.26	15,367.76	1,624.00	1.00	902,035
ROAA	114,014	0.16	0.33	0.13	-34.84	29.00
IBDR	114,014	0.21	0.23	0.14	0.00	1.00
Total STD	114,014	127.51	3,324.06	0.00	0.00	562,728
Total LTD	114,014	955.68	6,346.43	147.00	0.00	394,958
Total IBD	114,014	1,083.18	7,302.14	187.00	0.00	562,728

Table 2 shows the statistics for each independent variable, as well as debt measurements used in our analysis. The table covers N (number of observations), mean, standard deviation, median, minimum and maximum value of each variable. Size, Total STD, Total LTD and Total IBD use absolute numbers while all other variables are ratios.

In the data, there are natural sectoral differences which give us some natural outliers. However, ***Table 2*** reveals the presence of certain variables that potentially exhibit significant outliers, which in turn impact the standard deviation. Notably, *Tangibility*, *Growth Opportunity*, *Payout Ratio, Tax Shield*, *Growth Sales*, and *Return on Average Asset* (ROAA) display substantial ranges between their minimum and maximum values alongside high standard deviations. This can be an indication of natural outliers, or occurrences of accounting errors. For instance, the

Pay-out Ratio exhibits an abnormal range, with a minimum of -266.67 and a maximum of 366.00. These extreme values correspond to a -26,667% and 36,600% *Pay-out Ratio*. Thus, we conclude with there being outliers and most likely due to accounting errors.

To address the presence of outliers and potential accounting errors, we implement a data-trimming approach on our extensive sample set. Systematically, we trim the top and bottom 1% of each independent variable, excluding NIBOR 3m. This trimming process is conducted with consideration for industry and age, meaning that each sector is trimmed individually, accounting for the age of the start-ups. Consequently, our working dataset ***(Table 3)*** consists of ***100,381 observations*** for ***18,923 firms*** after applying the trimming methodology. This process effectively removes the outliers responsible for the wide range between the minimum and maximum values observed in the aforementioned variables. As seen by the new minimum and maximum values of the *Pay-out Ratio*, a notable difference can be observed. The minimum value has increased from -266.67 to -1.02, while the maximum value has decreased from 366.00 to 4.20. These ranges are more sensible than the ones before. Additionally, it results in noticeable changes to the standard deviation of variables such as the *Pay-out Ratio, Growth Sales, Size,* and *ROAA*.

Table 3 Trimmed Descriptive Statistics

Statistic	N	Mean	St. Dev.	Median	Min	Max
Tangibility	100,381	0.22	0.23	0.14	0.00	0.97
Growth opportunity	100,381	0.01	0.05	0.00	0.00	0.84
Payout Ratio	100,381	0.09	0.28	0.00	-1.02	4.20
NIBOR 3M	100,381	0.02	0.01	0.02	0.01	0.06
Tax shield	100,381	0.04	0.05	0.03	0.00	0.33
Growth sales	81,458	0.44	1.49	0.10	-0.93	85.15
Size	100,381	2,990.33	5,657.39	1,653.00	40.00	355,270
ROAA	100,381	0.16	0.22	0.13	-1.20	1.44
IBDR	100,381	0.21	0.23	0.14	0.00	1.00
Total STD	100,381	77.71	473.09	0.00	0.00	29,928
Total LTD	100,381	677.51	2,793.42	152.00	0.00	241,168
Total IBD	100,381	755.22	2,870.47	192.00	0.00	241,168

The Table illustrates statistics for each independent variable, as well as debt measurements used in our analysis after being trimmed. The table covers N (number of observations), mean, standard deviation, median, minimum and maximum value of each variable. Size, Total STD, Total LTD and Total IBD use absolute numbers while all other variables are ratios.

The average *Growth Opportunity* in our dataset is only 1%, indicating that intangible assets constitute only a small portion, approximately 1%, of the overall asset structure of Norwegian start-ups. In contrast, the average *Growth Sales* stand at 44%. The average *Pay-out Ratio* for these start-ups is 9%, indicating the proportion of earnings distributed as dividends. Furthermore, the average *interest-bearing debt ratio* (IBDR) is 0.21, meaning that 21% of the capital structure in start-ups consists of *interest-bearing debt* (IBD). It is worth noting that the majority of the *IBD* comprises *long-term interest-bearing debt* (LTD), with a smaller portion attributed to *short-term interest-bearing debt* (STD). The results from Mjøs (2007) show an average *IBDR* for Norwegian firms of 35%, indicating that larger firms depend more on interest-bearing debt than start-ups.

6.2 Descriptive

Upon dividing the dataset into sectors based on industry, as shown in ***Table 4***, we can observe that the *Construction* and *Retail Wholesale* sectors have the highest number of observations. Collectively, these two industries account for approximately 75,000 observations, making them the most heavily represented in the dataset. On the other hand, the *Offshore Shipping* industry has the fewest observations, with a mere 724 observations. The remaining industries consist of observation counts ranging from 3,000 to 9,000.

Table 4 Descriptive Variables by Industries

Variables	Agriculture	Construction	Manufacturing	Offshore Ship.	Retail & Wholes.	Telecom.IT.Tech	Transport	Overall
	(N=4773)	(N=42871)	(N=7291)	(N=724)	(N=32509)	(N=3636)	(N=8577)	(N=100381)
Years Active								
Mean (SD)	3.36 (2.67)	3.32 (2.67)	3.50 (2.73)	3.45 (2.66)	3.41 (2.73)	3.42 (2.67)	3.36 (2.71)	3.37 (2.70)
Median	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Tangibility								
Mean (SD)	0.404 (0.267)	0.248 (0.226)	0.256 (0.228)	0.392 (0.320)	0.118 (0.157)	0.103 (0.167)	0.345 (0.248)	0.218 (0.227)
Median	0.376	0.185	0.194	0.362	0.0543	0.0160	0.332	0.139
Growth Opportunity								
Mean (SD)	0.0591 (0.144)	0.00595 (0.0187)	0.0135 (0.0401)	0.00932 (0.0318)	0.0161 (0.0458)	0.0535 (0.145)	0.00546 (0.0183)	0.0140 (0.0539)
Median	0	0	0	0	0	0	0	0
Payout Ratio								
Mean (SD)	0.0412 (0.191)	0.108 (0.305)	0.0827 (0.258)	0.0402 (0.172)	0.0853 (0.260)	0.139 (0.337)	0.0795 (0.269)	0.0938 (0.281)
Median	0	0	0	0	0	0	0	0
NIBOR 3M								
Mean (SD)	0.0179 (0.0122)	0.0188 (0.0127)	0.0206 (0.0138)	0.0214 (0.0140)	0.0211 (0.0138)	0.0196 (0.0132)	0.0190 (0.0127)	0.0197 (0.0132)
Median	0.0159	0.0159	0.0170	0.0170	0.0170	0.0159	0.0159	0.0159
Tax shield								
Mean (SD)	0.0625 (0.0494)	0.0482 (0.0454)	0.0469 (0.0406)	0.0530 (0.0499)	0.0272 (0.0319)	0.0317 (0.0468)	0.0772 (0.0607)	0.0439 (0.0456)
Median	0.0513	0.0361	0.0377	0.0420	0.0162	0.00965	0.0683	0.0303
Growth sales								
Mean (SD)	0.380 (1.22)	0.484 (1.56)	0.421 (1.60)	0.649 (3.88)	0.378 (1.30)	0.590 (1.84)	0.376 (1.30)	0.436 (1.49)
Median	0.113	0.142	0.0948	0.0914	0.0741	0.138	0.103	0.104
Missing	868 (18.2%)	8030 (18.7%)	1300 (17.8%)	130 (18.0%)	6298 (19.4%)	664 (18.3%)	1633 (19.0%)	18923 (18.9%)
Size								
Mean (SD)	5640 (12100)	2740 (3540)	3180 (4240)	13600 (40400)	2700 (3200)	3100 (5980)	2780 (3030)	2990 (5660)
Median	2540	1550	1800	3050	1680	1290	1760	1650
ROAA								
Mean (SD)	0.151 (0.212)	0.189 (0.233)	0.150 (0.226)	0.132 (0.219)	0.136 (0.200)	0.196 (0.339)	0.163 (0.198)	0.165 (0.224)
Median	0.109	0.156	0.117	0.0972	0.106	0.166	0.138	0.131
IBDR								
Mean (SD)	0.323 (0.281)	0.179 (0.212)	0.223 (0.230)	0.324 (0.280)	0.220 (0.220)	0.120 (0.185)	0.254 (0.238)	0.207 (0.225)
Median	0.280	0.102	0.158	0.293	0.169	0	0.208	0.139
Total STD								
Mean (SD)	99.9 (771)	58.4 (423)	98.2 (470)	120 (975)	112 (525)	48.3 (339)	24.3 (152)	77.7 (473)
Median	0	0	0	0	0	0	0	0
Total LTD								
Mean (SD)	2360 (7200)	528 (1300)	733 (1550)	5450 (22200)	523 (1070)	368 (1220)	757 (1270)	678 (2790)
Median	465	115	193	565	174	0	281	152
Total IBD								
Mean (SD)	2460 (7340)	587 (1410)	831 (1700)	5570 (22400)	634 (1230)	417 (1330)	782 (1290)	755 (2870)
Median	513	140	234	601	235	0	303	192

Table 4 illustrates statistics for each independent variable, as well as debt measurements used in our analysis, for each sector. The table covers N (number of observations), mean, standard deviation and median. Years Active, Size, Total STD, Total LTD and Total IBD use absolute numbers while other variables use ratios.

When comparing the values presented in ***Table 4***, it becomes apparent that *Offshore Shipping* stands as the largest industry in terms of *Size* among all the industries studied. Notably, it also possesses the highest amount of *interest-bearing debt* (IBD) when compared to other industries. In addition, *Offshore Shipping* boasts the highest *interest-bearing debt ratio* (IBDR) at 0.324. Likewise, the *Agriculture* industry demonstrates a nearly identical *IBDR* to *Offshore Shipping*, with a value of 0.323, albeit with only half of *Offshore Shipping's IBD*. As anticipated, the *Telecom, IT, and Tech* industry, characterized by being less capital-intensive, exhibit the lowest level of debt within their capital structure.

Furthermore, when considering the combined development of *IBDR* for all industries ***(Figure 6-1),*** a general downward trend is observed. However, significant differences exist between the industries.

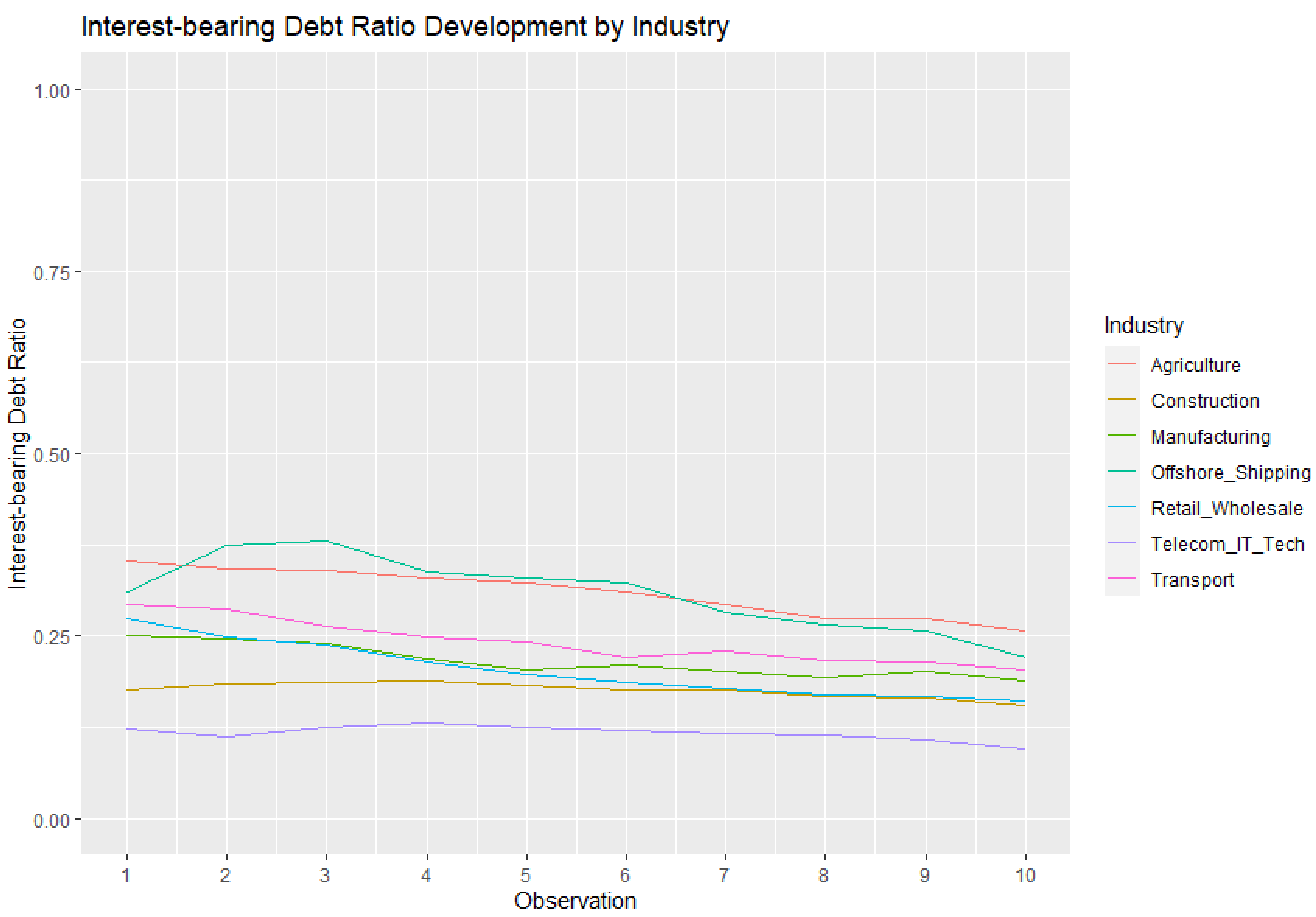

Figure 6-1 Interest-bearing debt ratio development by industry

Figure 6-1 illustrates the interest-bearing debt ratio (IBDR) development for each sector. The Figure demonstrates the average IBDR for each sector through the first 10 years. IBDR is on average somewhere between 0.10 and 0.375 throughout the 10-year span. Each sector is indicated by its own colour.

When examining the first 10-year period of a start-up using ***Tables 5 and 6***, it becomes evident that most variables maintain similar means over the years. However, a few variables exhibit noticeable changes between the years, namely the *Pay-out ratio, Growth Sales,* and *IBDR*. The *Pay-out ratio* demonstrates a consistent increase, starting at its lowest point of 0.0295 in year 1 and progressively rising to 0.175 by year 10. On the other hand, both *Growth Sales* and *IBDR* show a steady decline over the years. *Growth Sales* experiences the most significant growth in the initial years, with a value of 1.70 in year 2 (the first recorded observation for each firm), gradually decreasing to 0.0623 by year 10. Similarly, although not as pronounced as the decline in *Growth Sales*, *IBDR* also decreases over time, ranging from 0.231 in year 1 to 0.167 in year 10.

Table 5 Descriptive Variables by observation, for observations 1 - 5

Observations	1	2	3	4	5
	(N=18923)	(N=14232)	(N=13366)	(N=11729)	(N=10346)
Tangibility					
Mean (SD)	0.214 (0.232)	0.229 (0.228)	0.228 (0.226)	0.224 (0.224)	0.218 (0.226)
Median	0.133	0.157	0.156	0.149	0.138
Growth Opportunity					
Mean (SD)	0.0153 (0.0595)	0.0146 (0.0561)	0.0149 (0.0576)	0.0140 (0.0537)	0.0134 (0.0525)
Median	0	0	0	0	0
Payout Ratio					
Mean (SD)	0.0295 (0.135)	0.0821 (0.248)	0.0771 (0.242)	0.0921 (0.269)	0.112 (0.308)
Median	0	0	0	0	0
NIBOR 3M					
Mean (SD)	0.0239 (0.0149)	0.0218 (0.0142)	0.0214 (0.0151)	0.0200 (0.0139)	0.0184 (0.0114)
Median	0.0227	0.0175	0.0170	0.0159	0.0159
Tax shield					
Mean (SD)	0.0278 (0.0355)	0.0441 (0.0437)	0.0495 (0.0477)	0.0518 (0.0487)	0.0523 (0.0500)
Median	0.0141	0.0322	0.0366	0.0388	0.0383
Growth sales					
Mean (SD)	NA (NA)	1.70 (3.08)	0.326 (0.810)	0.204 (0.553)	0.160 (0.457)
Median	NA [NA, NA]	0.673	0.129	0.0871	0.0756
Missing	18923 (100%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Size					
Mean (SD)	1520 (2690)	2130 (3900)	2580 (4740)	2960 (5080)	3420 (7270)
Median	891	1310	1550	1780	1980
ROAA					
Mean (SD)	0.154 (0.213)	0.172 (0.229)	0.174 (0.229)	0.167 (0.230)	0.166 (0.230)
Median	0.122	0.139	0.140	0.133	0.132
IBDR					
Mean (SD)	0.231 (0.254)	0.225 (0.229)	0.220 (0.224)	0.210 (0.217)	0.200 (0.215)
Median	0.152	0.168	0.161	0.150	0.134
Total STD					
Mean (SD)	41.9 (254)	54.3 (303)	72.8 (435)	81.8 (470)	96.0 (592)
Median	0	0	0	0	0
Total LTD					
Mean (SD)	423 (1380)	543 (1910)	625 (2480)	685 (2610)	787 (4090)
Median	83.0	156	175	180	174
Total IBD					
Mean (SD)	465 (1410)	597 (1950)	698 (2540)	767 (2730)	883 (4160)
Median	123	189	209	217	219

Table 5 illustrates statistics for each independent variable, as well as debt measurements used in our analysis, based on years 1-5. The table covers N (number of observations), mean, standard deviation and median. Size, Total STD, Total LTD and Total IBD use absolute numbers while other variables use ratios.

Table 6 Descriptive Variables by observation for observation 6 - 10 and overall

Observations	6	7	8	9	10	Overall
	(N=8848)	(N=7545)	(N=6183)	(N=5305)	(N=3904)	(N=100381)
Tangibility						
Mean (SD)	0.215 (0.226)	0.212 (0.225)	0.210 (0.225)	0.206 (0.224)	0.193 (0.216)	0.218 (0.227)
Median	0.132	0.126	0.126	0.121	0.107	0.139
Growth Opportunity						
Mean (SD)	0.0132 (0.0505)	0.0128 (0.0486)	0.0128 (0.0467)	0.0124 (0.0470)	0.0125 (0.0451)	0.0140 (0.0539)
Median	0	0	0	0	0	0
Payout Ratio						
Mean (SD)	0.126 (0.334)	0.125 (0.320)	0.143 (0.355)	0.151 (0.365)	0.175 (0.424)	0.0938 (0.281)
Median	0	0	0	0	0	0
NIBOR 3M						
Mean (SD)	0.0187 (0.0142)	0.0156 (0.00687)	0.0152 (0.00545)	0.0138 (0.00650)	0.0132 (0.00493)	0.0197 (0.0132)
Median	0.0159	0.0159	0.0159	0.0129	0.0129	0.0159
Tax shield						
Mean (SD)	0.0496 (0.0487)	0.0455 (0.0458)	0.0446 (0.0451)	0.0423 (0.0434)	0.0405 (0.0414)	0.0439 (0.0456)
Median	0.0354	0.0320	0.0313	0.0298	0.0281	0.0303
Growth sales						
Mean (SD)	0.120 (0.387)	0.101 (0.359)	0.0874 (0.340)	0.0673 (0.319)	0.0623 (0.310)	0.436 (1.49)
Median	0.0589	0.0466	0.0400	0.0360	0.0321	0.104
Missing	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	18923 (18.9%)
Size						
Mean (SD)	3840 (7810)	3990 (5650)	4370 (7080)	4850 (7670)	5070 (7000)	2990 (5660)
Median	2180	2380	2620	2840	3110	1650
ROAA						
Mean (SD)	0.163 (0.229)	0.166 (0.226)	0.161 (0.219)	0.165 (0.220)	0.158 (0.213)	0.165 (0.224)
Median	0.128	0.128	0.125	0.129	0.124	0.131
IBDR						
Mean (SD)	0.191 (0.212)	0.188 (0.211)	0.178 (0.205)	0.177 (0.208)	0.167 (0.198)	0.207 (0.225)
Median	0.123	0.115	0.109	0.101	0.0874	0.139
Total STD						
Mean (SD)	98.2 (619)	102 (620)	96.5 (501)	112 (568)	123 (637)	77.7 (473)
Median	0	0	0	0	0	0
Total LTD						
Mean (SD)	861 (4100)	835 (2730)	850 (3070)	978 (3800)	871 (2140)	678 (2790)
Median	167	166	160	156	150	152
Total IBD						
Mean (SD)	960 (4200)	936 (2860)	946 (3130)	1090 (3890)	994 (2300)	755 (2870)
Median	208	212	215	214	220	192

Table 6 shows us statistics for each independent variable, as well as debt measurements used in our analysis, based on years 6-10. The table covers N (number of observations), mean, standard deviation and median. Size, Total STD, Total LTD and Total IBD use absolute numbers while other variables use ratios.

Examining the development of *interest-bearing debt* (IBD), it becomes apparent that it generally increases annually, except for years 7 and 10. Initially, the rate of increase is the largest, but gradually diminishes around year 6 ***(Figure 6-2)***. However, when assessing the trend of the *interest-bearing debt ratio* (IBDR) over the first 10-year period, it becomes evident that the ratio declines each year ***(Figure 6-3)***. This pattern aligns with the principles of the *Pecking Order Theory*, which suggests that as firms accumulate more retained earnings, they reduce their dependency on debt within the firm. This transition is evident in the rising equity ratio and the declining *IBDR* ***(Figure 6-3)***, indicating the accumulation of retained earnings by the firms.

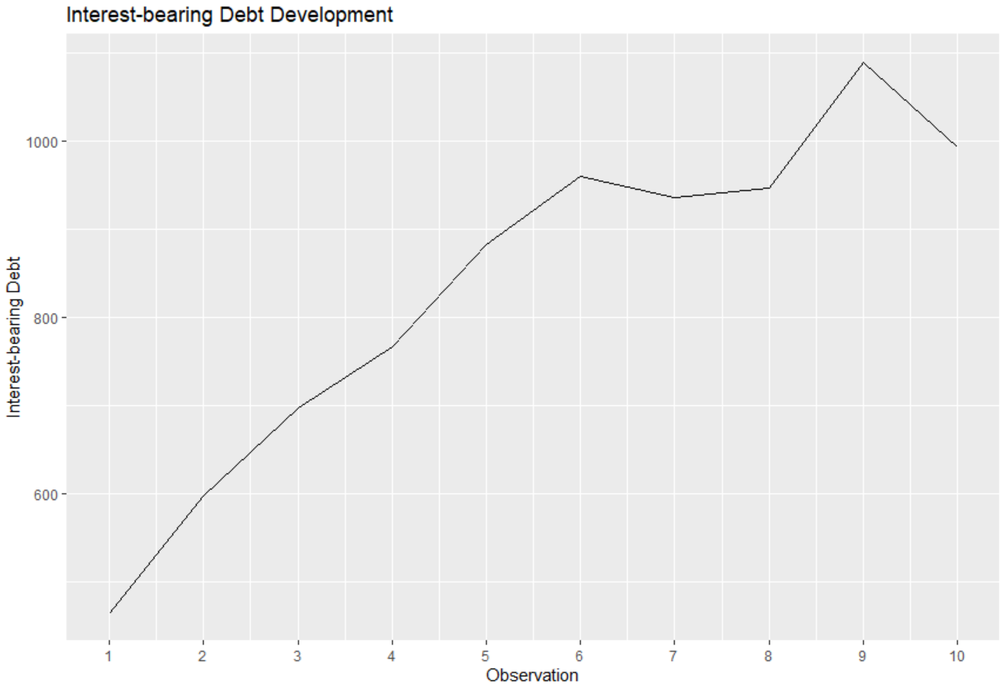

Figure 6-2 Interest-bearing debt development

The Figure shows us interest-bearing debt (IBD) development over the first 10 years. The Figure demonstrates how IBD steadily increases over the years, going from roughly 500 to about 1,000.

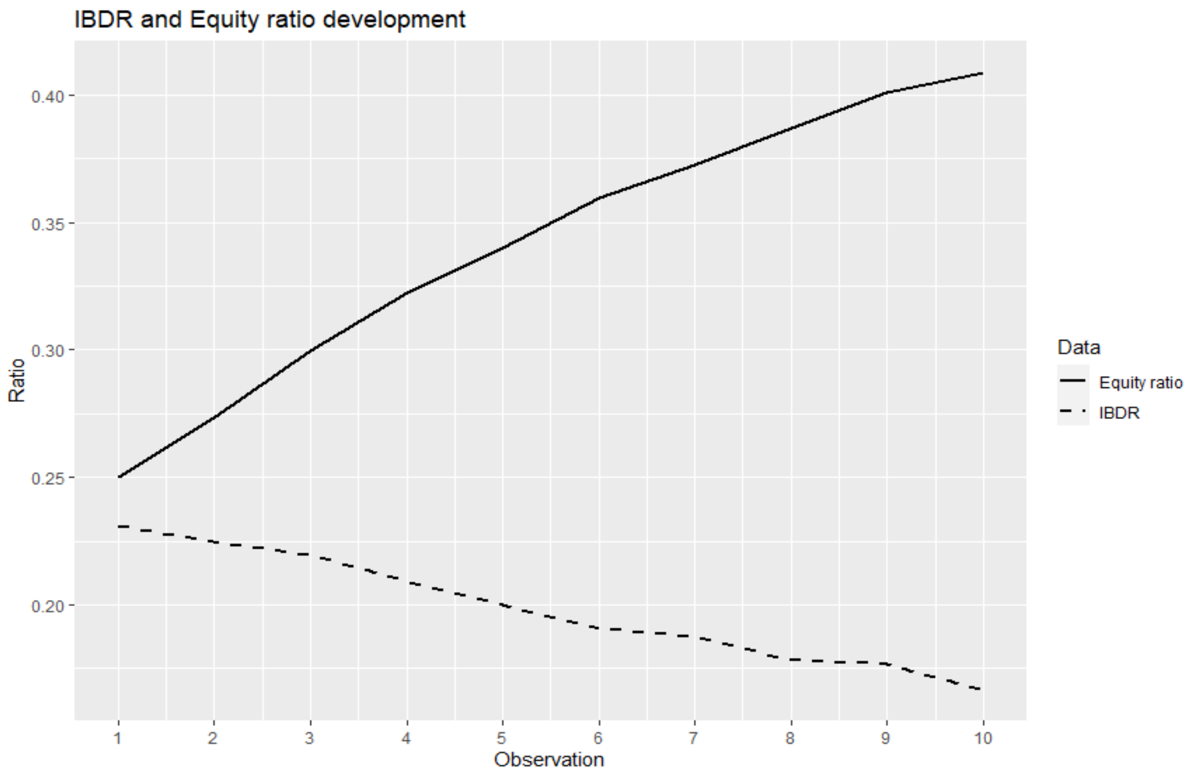

Figure 6-3 IBDR and Equity ratio development

The Figure compares interest-bearing debt ratio (IBDR) development and equity ratio development over the first 10 years. The Figure demonstrates how the equity ratio steadily increases over the years, going from roughly 0.25 and up to about 0.40. While IBDR steadily decreases going from about 0.23 down to 0.17.

We also examine the trends for both *short-term interest-bearing debt ratio* (STDR) and *long-term interest-bearing debt ratio* (LTDR). Results show that *LTDR* displayed a similar downward trajectory as *IBDR*, exhibiting nearly identical ratios ***(Figure A-2)***. On the other hand, *STDR* does not exhibit any clear trend in its development, with a considerably lower ratio ***(Figure A-1)***.

We adjusted the *interest-bearing debt ratio* (IBDR) in order to examine any changes in the utilization of *interest-bearing debt* for financing purposes ***(Figure 6-4)***. This involved dividing *interest-bearing debt* (IBD) by *invested capital* to derive the adjusted ratio ***(Figure 6-4)***. Notably, the adjusted ratio follows a similar trend as the *IBDR* ***(Figure 6-3)***, initially high and gradually decreasing over the years. This observation reinforces the earlier assertion that start-ups typically opt for debt when available and then shift towards utilizing retained earnings, aligning with the principles outlined in Berger and Udell's (1998) *Financial Growth Cycle theory*.

A comparison between the adjusted and non-adjusted *IBDR* reveals a noticeable difference, primarily in the higher ratio exhibited by the adjusted *IBDR*. The adjusted *IBDR* ranges from approximately 38% to 27.5%, whereas the non-adjusted *IBDR* ranges from around 23.5% to 17%. This discrepancy indicates that start-ups prefer using an overweight of equity as their invested capital in financing new positive NPV projects.

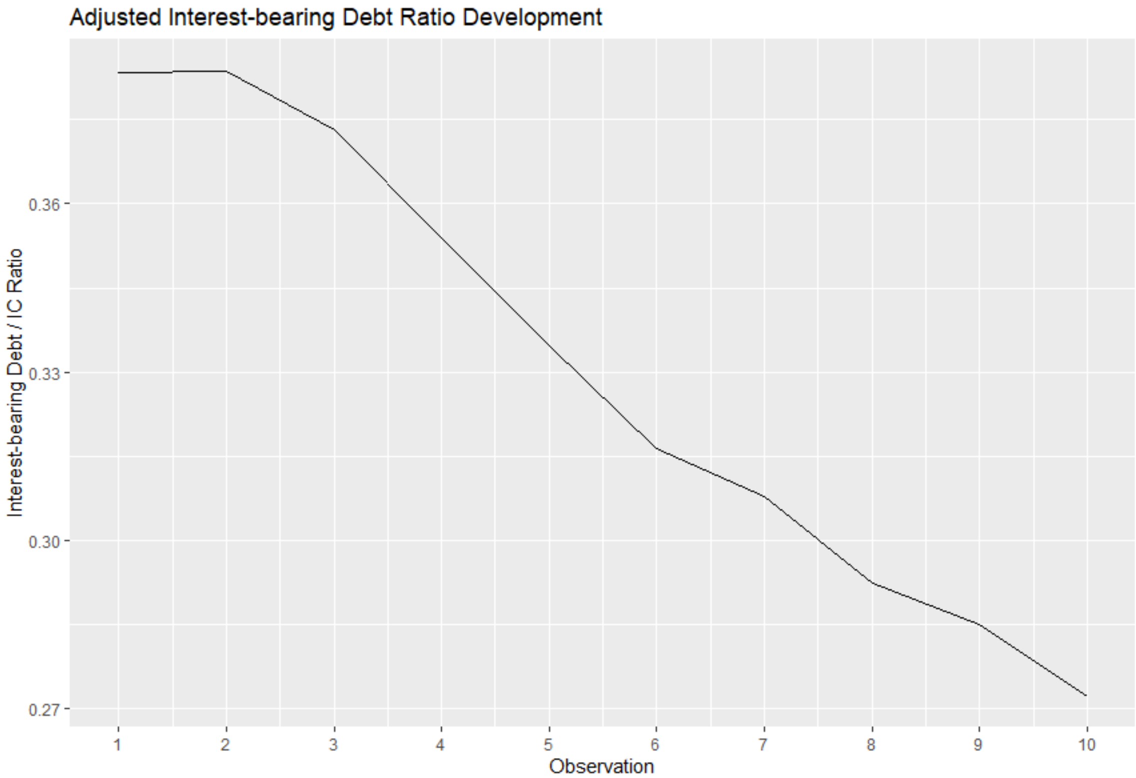

Figure 6-4 Adjusted interest-bearing debt ratio development

Figure 6-4 presents adjusted interest-bearing debt ratio (IBDR) development over the first 10 years. The Figure demonstrates how adjusted IBDR steadily decreases over the 10-year span going from roughly 0.38 down to 0.27.

6.3 Test Results Deciding Preferred Regression Model

In order to determine the appropriate regression models to address our research question we perform a set of statistical and econometrical tests. In this part, we present the results of the tests described in ***Chapter 5.5 Tests Deciding Preferred Regression Model***. It is worth noting that the OLS assumptions not presented in this part have been tested and found satisfactory.

6.3.1 Multicollinearity

We use a correlation matrix and VIF test to investigate if our data has evidence of multicollinearity and thus a violation of the assumption of no perfect multicollinearity. In the correlation matrix, represented in ***Table 7,*** we can see that none of the variables included in the same model are severely correlated. *Tangibility* and *long-term interest-bearing debt ratio* (LTDR) have the highest correlation value, however not at an unacceptable level. *IBDR, LTDR* and *short-term interest-bearing debt ratio* (STDR) will never be included in the same model and the correlation levels are thus not relevant to this matrix.

Table 7 Correlation matrix

	IBDR	LTDR	STDR	Size	Growth Opportunity	Tangibility	NIBOR3m	Payout Ratio	Growth	ROAA	Tax Shield
IBDR	1										
LTDR	0.941	1									
STDR	0.254	-0.086	1								
Size	0.106	0.098	0.033	1							
Growth Opportunity	0.131	0.127	0.023	0.098	1						
Tangibility	0.487	0.528	-0.074	0.090	-0.038	1					
NIBOR3m	0.029	0.013	0.049	-0.022	0.032	-0.038	1				
Payout Ratio	-0.138	-0.123	-0.054	0.073	-0.051	-0.076	0.001	1			
Growth	0.016	0.019	-0.006	-0.024	-0.004	-0.003	0.0001	-0.026	1		
ROAA	-0.249	-0.214	-0.121	0.047	-0.146	-0.106	-0.049	0.251	0.131	1	
Tax Shield	0.207	0.240	-0.075	-0.026	0.071	0.574	-0.040	-0.039	-0.058	-0.133	1

Table 7 illustrate the correlation coefficients for all our dependent and independent variables. Values range between 1 and -1. Values equal to 1 and -1 indicate a perfect relationship.

However, a correlation matrix is only used to find correlation in bivariate relationships, meaning between two variables. Given the nature of our data, we also check for multivariate relationships, investigating if variables are a linear function of multiple variables. To further the investigation of our data structure and patterns we conduct a VIF test. VIF values around 10 are roughly the threshold for multicollinearity. We can see in ***Table 8*** that all our variables are in and around 1, with an average VIF of 1.213. Thus, we conclude with no evidence of multicollinearity in our data.

Table 8 VIF test

Variable	**VIF**
Size	1.119
Tangibility	1.629
Growth Opportunity	1.050
Payout Ratio	1.097
NIBOR 3m	1.005
Tax Shield	1.616
ROAA	1.156
Growth Sales	1.033
Average VIF	1.213

Table 8 illustrate the Variance Inflation Factor (VIF) values for all independent variables in our analysis as well as the average VIF value.

6.3.2 F-Test

Table 9 F-Test

Model	F-stat	P-value
IBDR	3649.10	0.000
LTDR	3791.42	0.000
STDR	118.39	0.000

Table 9 illustrates the F-statistic and P-value after conducting a Fixed Effects regression with IBDR, LTDR and STDR as the dependent variables.

We conduct an *F-test* to check if there is significant individual heterogenicity in our data. A violation of the assumption of homogeneity would mean that an *FE* model fits our data better as the *FE* model controls for individual heterogenicity. We can see that the p-value < 0.05 and is thus significant in all our models as the p-value is very close to zero. We can then reject the null hypothesis and conclude with the presence of heteroscedasticity in our data.

6.3.3 Breusch-Pagan test

Table 10 Breusch-Pagan test

Model	BP-stat	P-value
IBDR	3295.2	0.000
LTDR	3213.4	0.000
STDR	1096.2	0.000

Table 10 illustrates the Breusch-Pagan statistic and P-value after conducting a multiple regression with IBDR, LTDR and STDR as the dependent variables.

Similarly, to the *F-test,* we check whether or not the *Pooled OLS* is a good fit for our data by checking for individual heteroscedasticity. In the *Breusch-Pagan test* (BP) we see that the p-value < 0.05, and thus we reject the null hypothesis. We conclude in this test that the *RE* model is a better fit than the *Pooled OLS*, as the assumption of homoscedasticity is violated.

6.3.4 The Hausman Test

Table 11 Hausman Test

	Coefficients			
	Fixed Effects	Random Effects	Difference	Std. Error
	(b)	(B)	(b-B)	$\text{sqrt}(\text{diag}(V_b - V_B))$
Size	0.530	0.044	0.486	0.001
Tangibility	0.469	0.523	-0.054	0.006
Growth Opportunity	-0.020	0.456	-0.476	0.023
Payout Ratio	1.063	-0.028	1.091	0.002
NIBOR 3m	-0.048	0.829	-0.877	0.057
Tax Shield	-0.098	-0.229	0.132	0.024
ROAA	0.005	-0.111	0.115	0.003
Growth Sales	0.067	0.004	0.063	0.0004

(b) = Consistent under H_0 and H_1
(B) = Inconsistent under H_1, efficient under H_0
H_0: Difference in coefficients not systematic

chi2(8) = 2768.6
P-Value = 0.000

Table 11 shows the coefficients from a Fixed Effects model and Random Effects Model conducted with IBDR as the dependent variable, the difference in the coefficients (b-B), and the standard error of the difference in coefficient (b-B).

As the results in our previous tests have shown, we conclude that the *Pooled OLS* can be discarded for the more advanced *FE* or *RE* model. To check which model to use we conduct the *Hausman test*. The null hypothesis of this test assumes that the error terms in the variables are random and not correlated with the independent variables. We can see that the p-value is very low and the p-value < 0.05. Thus, we reject the null hypothesis and conclude that the error terms correlate with the independent variables. To control for this, we use the *FE* model to get consistent and valid estimates.

6.3.5 Breusch-Godfrey test

Table 12 Breusch-Godfrey test

Model	Chi2	P-value
IBDR	2162.20	0.000
LTDR	2322.80	0.000
STDR	76.95	0.000

Table 12 illustrates the chi2 statistic and P-value after conducting a Fixed Effects model with IBDR, LTDR and STDR as the dependent variables.

We have shown that the error terms are correlated with the independent variables and controlled for this by selecting the *FE* model, however serial correlation in the error terms can produce invalid estimates. We run the Breusch-Godfrey test to check for serial correlation in the error terms. By the p-value in the results we reject the null hypothesis and conclude with serial correlation in the error terms. To control for this, we use the *Huber/White-sandwich estimator*, also called *Huber-White standard errors*.

6.4 Regression Models

To showcase the impact of both time and firm-specific effects on debt ratios we will present regression models on *IBDR*, *LTDR* and *STDR* respectively. Column 1 showcases a *Pooled OLS* regression, with no specific effects. Based on the tests conducted earlier we can conclude with firm-specific effects in the data and thus control for this by running a *Fixed Effects* model, which is shown in column 2. When looking at start-ups and young firms in general there is reason to believe that age is a significant factor. We also assume that the difficulties of obtaining external financing in the earlier years occur in all industries. Thus, in column 3 we investigate what age-specific effects (time effects) will have on the *Fixed Effects* model as well. In column 4 we add *Growth Sales* as we expect growth to be a factor in the financial structure choices of start-up managers. By doing this we remove the first observation of every firm due to the nature of the variable construction, notably, this also adds some survivorship bias to our sample.

6.4.1 IBDR Model

Table 13 IBDR Models

	Dependent variable:			
	IBDR			
Independent variables	Pooled OLS	FE	FE	FE
Size	0.027***	0.055***	0.036***	0.031***
	(0.001)	(0.001)	(0.001)	(0.001)
Tangibility	0.520***	0.539***	0.498***	0.512***
	(0.003)	(0.004)	(0.003)	(0.004)
Growth Opportunity	0.497***	0.503***	0.466***	0.451***
	(0.011)	(0.015)	(0.011)	(0.012)
Payout Ratio	−0.056***	−0.027***	−0.048***	−0.048***
	(0.002)	(0.002)	(0.002)	(0.002)
NIBOR 3m	0.536***	1.110***	0.060	0.264***
	(0.044)	(0.043)	(0.046)	(0.051)
Tax Shield	−0.629***	−0.186***	−0.521***	−0.555***
	(0.016)	(0.016)	(0.016)	(0.017)
ROAA	−0.190***	−0.105***	−0.200***	−0.180***
	(0.003)	(0.002)	(0.003)	(0.003)
Growth Sales				0.003***
				(0.0005)
Constant	−0.062***			
	(0.004)			
Observations	100,381	100,381	100,381	81,458
Firm Effects	No	Yes	Yes	Yes
Age Effects	No	No	Yes	Yes
R^2	0.324	0.317	0.329	0.334
Adjusted R^2	0.324	0.122	0.329	0.333
F Statistic	6,871.899***	5,172.229***	7,028.197***	5,094.025***
Note:				*p<0.1; **p<0.05; ***p<0.01

Table 13 illustrates the regression results with IBDR as the dependent variable. Column 1 is a Pooled OLS model. Column 2 is a fixed effects model with firm-specific effects. Column 3 is a fixed effects model with firm-specific and age effects. Column 4 is a fixed effects model with firms specific and age effects also including Growth Sales as an independent variable. Huber-White standard errors are shown in parentheses.

Results in the *Pooled OLS* model indicate that every variable is significantly affecting the *IBDR*. *Size*, *Tangibility*, *Growth Opportunity* and *NIBOR 3m* are all positively correlated at the 1% level. On the other hand, we can see that *Pay-out Ratio, Tax Shield* and *ROAA* are all negatively significant at the 1% level. The explanatory level of the model is 32.4%, as shown by the R^2. The explanatory value decreases to 31.7% (column 2) before it increases to 32.9% (column 3) and 33.4% (column 4). Our explanatory variables are thus explaining roughly 33% of the variation in the *IBDR* for Norwegian start-ups, 10 years or younger since 2003. However, ignoring the firm-specific effects in our panel data can lead to inconsistent and negligible results by introducing omitted variable bias (Boldea et al., 2020). In columns 2, 3 and 4 we use a *Fixed Effects* model to control for the firm-specific effects and in columns 3 and 4 we additionally control for Age-specific effects as well. The explanatory value of the models changes when controlling for firm-specific effects, and again when controlling for age-specific effects. This would indicate that there is some evidence of individual heteroscedasticity in the data, however, there is not much discrepancy between the reported values (Kunst, 2009).

In columns 3 and 4 we control for both firm and age-specific effects. *Tax shield* is the strongest explanatory value in both models with a coefficient of -0.521, and -0.555 respectively, significant at the 1% level. Followed by *Tangibility* as the second-highest explanatory value, and *Growth Opportunity* as the third-highest. This indicates that the asset size and structure are the best explanatory determinants for the overall *interest-bearing debt ratio* in Norwegian start-ups. The addition of *Growth Sales* also shows to be successful as it is significantly positively correlated with the *IBDR* at the 1% level. Also worth noting is the *NIBOR 3m* which in column 3 is insignificant with a coefficient of 0.060, turns significant at the 1% level with a coefficient of 0.264 in column 4. Interestingly, in column 4 we remove the first observations for each start-up, decreasing the sample size to 81,458 from 100,381, and by doing this we add some survivorship bias into the sample. The change in significance for *NIBOR 3m* can thus indicate that there is significant survivorship bias, especially in the availability of external debt.

Summarizing the results in column 4 we can see that all factors are significant at the 1% level. *Size*, *Tangibility*, *Growth Opportunity* and *NIBOR 3m* positively affect the *IBDR*, and *Pay-out ratio, Tax Shield,* and *ROAA* negatively affect the *IBDR* levels of Norwegian start-ups.

6.4.2 LTDR Model

The results in the *Pooled OLS* model in ***Table 14*** indicate that *Size, Tangibility, Growth Opportunity and NIBOR 3m* are all significantly positively correlated with *long-term interest-bearing debt ratio* (LTDR) at the 1% level. *Pay-out Ratio, Tax Shield* and *ROAA* are all significantly negatively correlated with *LTDR* at the 1% level. When controlling for both age and firm-specific effects in column 3 we can see that the explanatory level of the model increases to 34.7%. Similar to our findings in ***Table 13***, *Tangibility, Growth Opportunity,* and *Tax Shield* are for *LTDR* the strongest explanatory factors. However, for *LTDR* we see that *Tangibility* is the strongest explanatory variable. Indicating that the available collateral is the most important factor for obtaining *long-term interest-bearing debt*.

Table 14 LTDR Models

	Dependent variable:			
	LTDR			
Independent variables	Pooled OLS	FE	FE	FE
Size	0.021***	0.048***	0.030***	0.025***
	(0.001)	(0.001)	(0.001)	(0.001)
Tangibility	0.544***	0.550***	0.523***	0.537***
	(0.003)	(0.004)	(0.003)	(0.003)
Growth Opportunity	0.505***	0.465***	0.475***	0.458***
	(0.011)	(0.014)	(0.011)	(0.011)
Payout Ratio	−0.045***	−0.022***	−0.037***	−0.036***
	(0.002)	(0.002)	(0.002)	(0.002)
NIBOR 3m	0.319***	1.083***	−0.140***	0.052
	(0.043)	(0.041)	(0.044)	(0.048)
Tax Shield	−0.544***	−0.170***	−0.438***	−0.467***
	(0.015)	(0.016)	(0.016)	(0.016)
ROAA	−0.144***	−0.076***	−0.153***	−0.137***
	(0.003)	(0.002)	(0.003)	(0.003)
Growth Sales				0.003***
				(0.0004)
Constant	−0.051***			
	(0.004)			
Observations	100,381	100,381	100,381	81,458
Firm Effects	No	Yes	Yes	Yes
Age Effects	No	No	Yes	Yes
R^2	0.342	0.321	0.346	0.360
Adjusted R^2	0.342	0.127	0.346	0.360
F Statistic	7,446.381***	5,265.268***	7,596.597***	5,717.464***
Note:			*p<0.1; **p<0.05; ***p<0.01	

Table 14 illustrates the regression results with LTDR as the dependent variable. Column 1 is a Pooled OLS model. Column 2 is a fixed effects model with firm-specific effects. Column 3 is a fixed effects model with firm-specific and age effects. Column 4 is a fixed effects model with firm-specific and age effects also including Growth Sales as an independent variable. Huber-White standard errors are shown in parentheses.

Interestingly we can see that *NIBOR 3m* changes from being positively correlated at the 1% level to being significantly negatively correlated at the 1% level in column 3. As in the *IBDR* model this gives even stronger evidence to question the robustness of this as an independent variable. The negative significant value when controlling for both firm- and age-specific effects indicate that long-term external debt is less accessible when the market interest rate increases, explaining the negative relationship. However, in column 4 when we introduce

Growth Sales and consequently add some survivorship bias, *NIBOR 3m* turns positive but not at a significant level. The remaining variables follow the same causality as in ***Table 13*** and throughout the models in ***Table 14***. Results show that the asset size- and structure are factors explaining increasing long-term debt ratios. Growing start-ups also tend to take on long-term *interest-bearing debt*, as indicated by the positive *Growth Opportunity* and *Growth Sales* coefficient. An increased non-debt *Tax Shield* reduces the incentive to take on debt, as seen by the negative coefficient. Profitable firms also tend to not increase the *long-term interest-bearing debt ratio* as seen by the negative *Pay-out ratio* and *ROAA*.

6.4.3 STDR Model

Explaining *the short-term interest-bearing debt ratio* has shown to be a difficult task in this heteroskedastic selection of data. In columns 3 and 4 of ***Table 15,*** we can see an explanatory power of only 3.4% and 3.5% which is surprisingly low compared to the *IBDR* and *LTDR* models. Interestingly, when looking at the causality of the model we can see that *Tangibility* and *Growth Opportunity* which have been the strongest explanators of the *IBDR* and *LTDR* models, have a significant negative effect on the *short-term interest-bearing debt ratio* (STDR). This indicates that Norwegian start-ups with significant tangible- and intangible asset structures prefer to stay away from short-term *interest-bearing debt*.

Table 15 STDR Models

	Dependent variable:			
	STDR			
Independent variables	Pooled OLS	FE	FE	FE
Size	0.006***	0.008***	0.006***	0.006***
	(0.0002)	(0.0004)	(0.0003)	(0.0003)
Tangibility	−0.024***	−0.011***	−0.025***	−0.025***
	(0.001)	(0.002)	(0.001)	(0.001)
Growth Opportunity	−0.008*	0.038***	−0.009*	−0.007
	(0.004)	(0.006)	(0.005)	(0.005)
Payout Ratio	−0.011***	−0.005***	−0.011***	−0.011***
	(0.001)	(0.001)	(0.001)	(0.001)
NIBOR 3m	0.217***	0.027	0.199***	0.212***
	(0.018)	(0.019)	(0.019)	(0.021)
Tax Shield	−0.084***	−0.016**	−0.083***	−0.089***
	(0.006)	(0.007)	(0.007)	(0.007)
ROAA	−0.046***	−0.029***	−0.046***	−0.044***
	(0.001)	(0.001)	(0.001)	(0.001)
Growth Sales				0.001***
				(0.0002)
Constant	−0.011***			
	(0.002)			
Observations	100,381	100,381	100,381	81,458
Firm Effects	No	Yes	Yes	Yes
Age Effects	No	No	Yes	Yes
R^2	0.034	0.015	0.034	0.035
Adjusted R^2	0.034	−0.266	0.034	0.035
F Statistic	504.839***	167.946***	507.714***	371.155***
Note:				*p<0.1; **p<0.05; ***p<0.01

Table 15 illustrates the regression results with STDR as the dependent variable. Column 1 is a Pooled OLS model. Column 2 is a fixed effects model with firm-specific effects. Column 3 is a fixed effects model with firm-specific and age effects. Column 4 is a fixed effects model with firm-specific and age effects also including Growth Sales as an independent variable. Huber-White standard errors are shown in parentheses.

Furthermore, we can see that *NIBOR 3m* is the strongest explanatory variable with a coefficient of 0.199 and 0.212 in columns 3 and 4 respectively. As expected, this positive relationship is indicating that when long-term financing becomes less available, firms increase their dependency on *short-term interest-bearing debt*. *Size* also has a positive relationship with *STDR*, indicating that firms with less bankruptcy risk also tend to use short-term debt financing. *Growth Sales* also positively affect the *STDR*, indicating that growing firms increase short-term debt levels, as well as long-term debt levels. In addition to *Tangibility* and *Growth Opportunity*, the factors *Pay-out ratio*, *Tax Shield* and *ROAA* are also negatively correlated with the *STDR*. In ***Table 13*** and ***Table 14,*** we have found evidence of survivorship bias, however, this does not seem to disturb the determinants of the *STDR* models.

6.5 Variable Discussion and Findings

In this part, we will go more in-depth into interpreting the different independent variables used in our models. We will base the description on column 4 for our *IBDR, LTDR* and *STDR* models to give an economical explanation as well as compare our results to relevant empiricism.

6.5.1 Size

The *Size* variable is significantly positively correlated in all our models for *IBDR, LTDR* and *STDR*. This is indicating that the *Size* of the firm has a significant effect on the manager's decisions to take on all types of *interest-bearing debt*. An alternative explanation is that the *Size* of the firm makes *interest-bearing debt* more accessible as banks would demand more collateral due to the risk and lack of accounting history for start-ups. An increase in *Size* also has a natural positive relationship with all debt levels, as successful firms should over time increase their assets. Either by retained earnings or by showing profitable results which make debt more accessible for start-ups.

Increased potential collateral and profitable financial history both drastically reduce the informational opaqueness and can explain the positive relationship. This is in line with the *Trade-Off Theory*, as larger firms tend to be more diversified and have a lowered default risk (Eckbo, B. E., 2008). This is also supported by Frank & Goyal (2009) and in line with results from studies by Mjøs (2007) and partly Antoniou et al. (2002), as well as Cessar looking at start-ups specifically (Cassar, 2004). This is however in contrast to the findings of Öhman and Yazdanfar who report a negative relationship between the total long-term debt and *Size* in Swedish SMEs (Öhman, P. and Yazdanfar, D., 2017). The negative relationship is also partly supported by the study of Antoniou et al (2002), where the total debt ratio is negatively correlated with the *Size* of German firms.

The *Financial Growth Cycle* is also supporting this notion as increased *Size* reduces the informational opaqueness and thus predicts this to be positively correlated. The result is also in line with our predictions for *Size* being positively correlated in all models, *IBDR, LTDR* and *STDR*

6.5.2 Tangibility

For both the *IBDR* and *LTDR* models, the *Tangibility* variable is one of the strongest explanatory factors for the manager's decision to take on *interest-bearing debt*. An explanation is the accessibility of external debt, due to available collateral. As the start-ups have limited accounting data, the amount of tangible assets is therefore expected to have a positive effect on the *long-term interest-bearing debt ratio*, and thus on the *IBDR* as well.

For the *IBDR* and *LTDR* models, *Tangibility* has a coefficient of 0.512 and 0.538 respectively. We can interpret this as a 1 percentage point increase in the *Tangibility* would lead to an increase in the *IBDR* and *LTDR* of 0.512% and 0.538% respectively. Underlining the results already discussed for the *Size* variable, firms with a larger asset class and especially a more tangible asset structure tend to have more long-term external debt. Due to tangible assets being easier to evaluate for banks and financial institutions and preferred as collateral over intangible assets. This is supported by both the *Pecking Order Theory* and the *Trade-Off Theory,* as tangibility works as a proxy for available collateral and reduces information asymmetry. Mjøs (2007) reported a *Tangibility* coefficient of 0.277 in his *IBDR* model looking at Norwegian Firms. This is somewhat lower than our reported coefficient, indicating that *Tangibility* and available collateral is more important when taking on *interest-bearing debt* for a Norwegian start-up. Cassar (2004) on the other hand reports a higher coefficient for *LTDR* than Mjøs, at 0.336.

As *Tangibility* has shown to be positively correlated for both *IBDR* and *LTDR*, we can see that it has the opposite effect on the manager's decision to take on *short-term interest-bearing debt*. We can interpret the coefficient -0.025 as a 1 percentage point increase in *Tangibility* will result in a 0.025% decrease in the *STDR*. This supports the argument made earlier as firms with a larger asset class, and especially a more tangible asset structure favour long-term financing when it becomes available. This is in line with the findings of Swedish SMEs on *short-term interest-bearing debt* with a reported coefficient of -0.093 (Öhman & Yazdanfar, 2017). The results are also in line with our predictions as *Tangibility* is positively affecting *IBDR* and *LTDR*, but negatively affecting *STDR*.

6.5.3 Growth Opportunity

The *Growth Opportunity* variable is alongside *Tangibility* the strongest explanatory factor of *LTDR* and *IBDR*. Interestingly, the results indicate that the higher degree of a firm's total intangible assets the more *interest-bearing debt* they take on. The result can be interpreted as such that firms with greater future growth possibilities actually prefer to take on long-term *interest-bearing debt*.

For the *IBDR* and *LTDR,* the *Growth Opportunity* variable has a coefficient of 0.451 and 0.458, indicating that a 1 percentage point increase in the degree of intangible assets of total assets results in an increase in *IBDR* and *LTDR* of respectively 0.451 and 0.458 percentage points. The ability to show external debt providers that there is a successful business plan in place and a coinciding strategy for future growth will reduce informational opaqueness. Thus, our results can also indicate that start-ups without patents and R&D funds et cetera, struggle to persuade banks and financial institutions to give them long-term financing. Overall, these results are in contrast to the *Pecking Order Theory* as it predicts firms prefer equity financing when *Growth Opportunities* are high, but shows support for the *Trade-Off Theory* as debt should accumulate over time. Teixeira and Coutinho dos Santos (2005), La Rocca et al (2009), and Hanssens et al (2016) all find similar results in their studies.

The *STDR* is negatively affected by the *Growth Opportunity* variable, with a statistically significant coefficient of -0.007. This indicates a 1 percentage point increase in *Growth Opportunity* will result in a 0.007 percentage points decrease in the *STDR.* The higher degree of intangible assets in the total asset seems to show that firms tend to favour financing R&D projects with long-term debt compared to short-term debt. When controlling for age-specific effects in columns 3 and 4, we can see that the coefficient turns negative for the *STDR* model. This can also indicate that as start-ups become less informational opaque and long-term debt becomes more accessible, they prefer to use long-term debt regardless of the intangibility of the asset class. All these results are also in line with our initial predictions given the positive relationship for *IBDR* and *LTDR*, but negative for *STDR*.

6.5.4 Pay-out Ratio

The degree of dividends has shown a significant negative effect on the *IBDR, LTDR* and *STDR.* This can be interpreted as the more a firm pays out in dividends, the less *interest-bearing debt* it has across the board. This is aligned with the fact that profitable firms tend to pay out dividends, and as results have shown, *ROAA* is also negatively correlated with debt levels for Norwegian start-ups.

Our findings show a coefficient for *Pay-out ratio* in our models of, -0.048, -0.036, and -0.012 for *IBDR, LTDR* and *STDR* respectively. With all coefficients being significant at the 1% level. Paying out dividends can also in addition to being a performance proxy, indicate the intentions for future growth. Paying out dividends this early indicates that the shareholders' profitability is more important than funding further growth. This also adds to the argument for why dividend-paying firms tend to stay away from all types of debt, as it reduces the business surplus. Furthermore, these results support our initial hypothesises with a negative relationship across the board for all debt levels.

6.5.5 NIBOR 3m

The *NIBOR 3m* has shown in our research to be somewhat difficult to interpret. Our *interest-bearing debt ratio* (IBDR) model is significantly positively correlated at the 1% level with a coefficient of 0.262 and thus the fourth strongest explanatory variable in the model. We can interpret this as a 1 percentage point increase in the *NIBOR 3m* results in an increase of 0.262 percentage points in the total *IBDR*. Subsequently, we can see that the *NIBOR 3m* is affecting the *long-term interest-bearing debt ratio* (LTDR) with a coefficient of 0.051, however not at a statistically significant level. Arguing our hypotheses for both the *IBDR* and *LTDR* models we state that the market interest rate indicates the accessibility of external debt. By increasing the market interest rate, start-ups should find it tougher to obtain external long-term debt. Our results, however, indicate the opposite. An explanation can be that as firms grow, the need for external capital is so great that the level of the market interest rate does not matter. Thus, explaining the significant positive coefficient for the *IBDR* model. Another argument is that the interest rates have not fluctuated sufficiently enough during our research period to make external debt unobtainable for successful start-ups.

The *short-term interest-bearing debt ratio* (STDR) is on the other hand significantly positively affected by increased *NIBOR 3m* with the variable showing a coefficient of 0.211. In the *STDR* model, *NIBOR 3m* is the variable with the highest explanatory value, as well as being significant at the 1% level. This indicates that a 1 percentage point increase in the market interest rate increases the *STDR* by 0.211 percentage points. The results could indicate that with increasing interest rates Norwegian start-ups find *long-term interest-bearing debt* less accessible or less attractive in funding new positive NPV projects. Thus, settling for taking on more accessible, but costlier short-term loans.

Our findings are contradictory to our initial predictions as the *IBDR* and *LTDR* are positively correlated with increasing interest rates. The coefficients reported have however changed sign and significant levels throughout all our models, indicating that the *NIBOR 3m* is less robust as an independent variable.

6.5.6 Tax Shield

The *Tax Shield* measures the non-debt tax shield in the firms and has a negative significant coefficient for all our models at the 1% level. Our findings suggest a coefficient of -0.557, -0.468, and -0.089 which are aligned with both the *Pecking Order Theory* and *Trade-off Theory*. An increase in tax deductions reduces the interest-cost tax-shield value, and as argued by Frydenberg (2004) reduces the incentive to maintain short-term debt for tax purposes. Non-debt tax shields are important when the firm is profitable, meaning that profitable firms have incentives to keep investing. However, we have also seen that start-ups tend to favour retained earnings as their preferred financing source. This explains the negative relationship with long-term external debt when tax deductions increase as it limits the value of debt tax shields. We also find support in previous empiricism by Öhman, P. and Yazdanfar (2017) who report coefficients of -0.026 and -0.027 for long-term debt and short-term debt respectively. Frydenberg (2004) report a negative relationship between *IBDR*, however, in contrast, shows a positive relationship to *long-term interest-bearing debt ratio* (LTDR). As argued in his research, this could be because of potential bias as capital-intensive firms have more fixed assets and thus more non-debt tax shields. Our reported findings support our initial predictions, which also show support for both the *Pecking Order Theory* and the *Trade-Off Theory*.

6.5.7 ROAA

Return on Average Assets (ROAA) as a measure of profitability is frequently used in empirical studies on capital structure. The result in our model indicates a negative relationship between the performance of a firm and all debt ratios, showing that Norwegian start-ups tend to prefer retained earnings compared to external debt. The coefficients of -0.180, -0.136 and -0.044 for the *IBDR, LTDR and STDR* models respectively are all significant at the 1% level. We can interpret this as a 1 percentage point increase in *ROAA* decreases the *IBDR* by 0.180 percentage points, the *LTDR* by 0.136 percentage points, and the *STDR* by 0.044 percentage points.

The retained earnings from well-performing firms increase the total equity of the firm, explaining the natural negative relationship for all debt ratios. This can indicate that firms prefer to use retained earnings to finance new projects. With the firms not maintaining the same debt ratios can also be an indicator that there are fewer growth opportunities for start-ups as they mature and scale up. This follows the argument that firms only take on external debt when they need capital for new positive NPV projects. This is supported by the *Financial Growth Cycle Theory,* as well as by the *Pecking Order Theory*. This is partly supported by the *Trade-Off Theory*, stating that profitable firms have incentives to increase the value of their interest tax shields.

As discussed in ***Chapter 6.5.6 Tax-Shield***, profitable firms have incentives to keep investing, as it accumulates more tax deductibles. Our results for the *ROAA* variable indicate that start-ups prefer using retained earnings over external debt to fund new projects, as seen by the negative coefficients for *short-* and *long-term interest-bearing debt ratios*. However, coinciding with the results in ***Chapter 6.5.3 Growth Opportunity***, increased growth opportunities positively affect the *LTDR* which implies that start-ups actually prefer financing new projects with long-term external debt. These contradictory results may suggest that profitable Norwegian start-ups on average struggle to scale up and grow their business, given by the accumulation of equity. Whereas start-ups with available positive NPV projects prefer using long-term external debt.

There is little to no evidence of a positive relationship between *ROAA* and any debt levels as far as our sources are concerned. Mjøs (2007) and Frydenberg (2004) report negative coefficients for Norwegian firms. Öhman and Yazdanfar (2017), La Rocca et al. (2009) and Hanssens et al. (2016) all report negative coefficients when investigating debt determinants in SMEs and start-ups. Given the relatively short time frame of our study, there could be an argument made that *ROAA* should be positively correlated with *LTDR*. As argued by the *Financial Growth Cycle theory*, the most informational opaque firms need to show good financial results to obtain external debt. However, this was not the case in our findings.

6.5.8 Growth Sales

Adding the *Growth Sales* variable to the models has been shown to add explanatory power for the development of debt levels for Norwegian start-ups. In column 4 of all models, we can see that the variable is significant at the 1% level with a coefficient of 0.003, 0.002, and 0.0005 for *IBDR, LTDR* and *STDR*. Assuming the managers of firms know more about the situation in the firm than the outside world one could argue that they only take on *interest-bearing debt* to fund a positive NPV project. Thus, expecting a positive relationship between the dependent variables and the independent variable. The positive relationship also adds to the argument that growing firms tend to finance growth with external capital. This can also suggest that there is a need for capital among Norwegian start-ups, as younger firms tend to be predominantly internally financed. Hence, explaining the need for additional short- and long-term external bank loans.

Contrary, the *Trade-Off Theory* argues that growth increases the financial distress of the firm and subsequently lowers the optimal debt level, predicting a negative relationship. The *Trade-Off Theory* argues that equity is cheaper than debt for growing firms, but firms over time accumulate more debt. The *Financial Growth Cycle Theory* indicates that growing firms initially have a negative relationship with *IBDR* but take on external debt when it becomes accessible. Predominantly because of the need for additional capital to scale up the business for younger firms.

Empirical studies report mostly a significant positive relationship between growth and debt levels. Frydenberg (2004), Hanssens et al. (2016), and Öhman and Yazdanfar (2017) reports a significant positive correlation. Contrary, Mjøs (2007) reports a negative coefficient very close to zero and Teixeira and Coutinho dos Santos (2014) report an insignificant positive coefficient value. However, our predictions coincide with the findings, as *Growth Sales* are positively correlated with *IBDR, LTDR* and *STDR* for Norwegian start-ups.

6.6 Summary of Empirical Findings

Table 16 Summary of empirical findings

	Predictions and Results		
	Dependent variables		
Independent variables	IBDR	LTDR	STDR
Size			
Prediction	+	+	-
Result	+	+	+
	(***)	(***)	(***)
Tangibility			
Prediction	+	+	-
Result	+	+	-
	(***)	(***)	(***)
Growth Opportunity			
Prediction	+	+	-
Result	+	+	-
	(***)	(***)	
Payout Ratio			
Prediction	-	-	-
Result	-	-	-
	(***)	(***)	(***)
NIBOR 3m			
Prediction	-	-	+
Result	+	+	+
	(***)		(***)
Tax Shield			
Prediction	-	-	-
Result	-	-	-
	(***)	(***)	(***)
ROAA			
Prediction	-	-	-
Result	-	-	-
	(***)	(***)	(***)
Growth Sales			
Prediction	+	+	+
Result	+	+	+
	(***)	(***)	(***)

*Table 16 illustrates the summary of empirical findings. Use of +/- to indicate positive and negative relationships, and *** to indicate the significance of the relationship between the independent and dependent variables. * (10%), ** (5%), *** (1%)*

Table 16 summarizes our findings on the whole dataset compared to our predictions. For the *IBDR* model, we can see that *Size, Tangibility, Growth Opportunity, NIBOR 3m,* and *Growth Sales* are all positively significant at the 1% level, while *ROAA, Tax Shield* and *Pay-out Ratio* are all negatively significant at the 1% level. The independent variables follow the same trend for the *LTDR* model, however, *NIBOR 3m* is the only variable not significant at any level. For the *STDR* model, we can see that *Size, NIBOR 3m,* and *Growth Opportunity* are positively significant at the 1% level. *Tangibility, Pay-out Ratio, Tax Shield*, and *ROAA* are all negatively significant at the 1% level, whereas *Growth Opportunity* is negative but not at a significant level.

For both *IBDR* and *LTDR,* the findings are consistent with our predictions, excluding *NIBOR 3m* which surprisingly shows the opposite effect. For *STDR*, *Size* is the only result not consistent with our predictions. Our results indicate that there is a need for external capital for growing start-ups as the size and growth are positively correlated with both long-and short-term *interest-bearing debt* ratios. Start-ups with more growth opportunities tend to favour financing their growth with long-term external debt as opposed to short-term external debt. Profitable start-ups also seem to either, prefer financing further growth with retained earnings, or struggle to scale up and continue growing given profitability's negative coefficient for all debt ratios.

Interestingly, the results of ***Figure 6-4*** show an *interest-bearing debt / invested capital ratio* (IBD/IC) of 0.38. This indicates that external *interest-bearing debt* might be more accessible at start-ups than first assumed for Norwegian start-ups. Fascinatingly, the market interest rate has shown to be positively correlated with debt levels, whereas we expect higher interest rates to reduce the availability of external debt. Given the positive relationship, a macro factor such as the market interest rate does not seem to negatively affect the debt usage for Norwegian start-ups on average. Indicating that there might be less informational opaqueness in Norwegian start-ups as well, given the availability of external debt in times of increasing interest rates.

6.7 Effects of Initial Debt Strategy

Given our results in the descriptive analysis and the regressions, we can see that the *Size*, *Tangibility, NIBOR 3m, Tax Shield, ROAA, Growth Sales, Pay-out Ratio* and *Growth Opportunity* are all significant factors in describing the debt choices made by firm managers. We recognize that individual entrepreneurial characteristics such as experience, prior relationship with banks, and initial shareholders' equity can affect the availability of external financing. Supported by the *Financial Growth Cycle* theory, a firm's maturity relies on qualitative factors such as growth, profitability, access to outside capital and the overall informational opaqueness of the firm. Hence, highly initial debt-financed start-ups will both look and act as more mature firm from day one. If this is the case, then the debt determinants and financing choices should differ based on the initial informational opaqueness. Arguing this, we believe that given the short time span in our data of 10 years, there are significant individual start-up differences. Hanssens et al. (2016), find in their study that the debt policy in the first year is a "very important determinant of future debt policies", with *Initial Debt Policy* being positively correlated with total debt ratio and debt maturity. All of this supports the suspicion that there are individual entrepreneurial differences and thus the accessibility of external debt differs at start-up.

To investigate these individual differences depending on the initial financing strategy, we create two subsets: *Low Initial IBDR* and *High Initial IBDR.* We want to investigate if the debt determinants and development of debt financing differ depending on the initial start-up capital structure. All firms with an *IBDR* higher than the reported industry mean for observation 1 are in the *High Initial IBDR* and all firms at or below the mean are in the *Low Initial IBDR* subset.

6.7.1 Predictions

Based on our analysis so far and the groundwork of the *Financial Growth Theory*, we believe that there is evidence of individual differences and that the perceived maturity of a start-up sways the debt development and determinants. Thus, we make another set of predictions based on the *Low Initial IBDR* and *High Initial IBDR* subsets.

1. *High Initial IBDR* firms are less informational opaque given the asset structure of the firm. Indicating that they have a higher *Tangibility* value. We believe *Low Initial IBDR* firms are more intangible, and thus have more *Growth Opportunities*. Hence, we predict *Low Initial IBDR* firms to have an on average higher growth rate (*Growth Sales)*.

2. Given the informational opaqueness of *Low Initial IBDR* start-ups, we believe the performance-related variables *ROAA* and *Growth Sales* to be important factors for obtaining external debt. Thus, given the short time frame of our data, we predict *ROAA* and *Growth Sales* to be positively correlated with *IBDR* and *LTDR* for the *Low Initial IBDR* subset.

3. *Low Initial IBDR* firms are more informational opaque, thus when the market interest rate increases the access to external debt limits. Hence, we believe *NIBOR 3m* for *Low Initial IBDR* firms to be negatively correlated to *IBDR* and *LTDR*, but positive to *STDR*.

4. The *Financial Growth Cycle* theory states that firms tend to take on external debt when it is accessible and then start to pay down the debt with retained earnings. We believe *High Initial IBDR* firms seem more mature at start-ups. Thus, paying down the debt earlier, whereas *Low Initial IBDR* firms take on debt before starting to pay it down. Hence, we believe the *interest-bearing debt ratio* for both subsets will return towards an overall combined mean value over time.

6.7.2 Descriptive Statistics

Table 17 Descriptive table High Initial IBDR start-ups

High IBDR				
Statistic	N	Mean	St. Dev.	Median
Tangibility	35,088	0.27	0.25	0.20
Growth opportunity	35,088	0.02	0.06	0.00
Payout Ratio	35,088	0.08	0.25	0.00
NIBOR 3M	35,088	0.02	0.01	0.02
Tax shield	35,088	0.05	0.05	0.04
Growth sales	27,066	0.41	1.40	0.10
Size	35,088	3,034.13	4,199.29	1,823
ROAA	35,088	0.14	0.19	0.11
IBDR	35,088	0.33	0.23	0.32
Total STD	35,088	99.71	513.11	0.00
Total LBD	35,088	988.63	2,301.34	400
Total IBD	35,088	1,088.35	2,378.61	455

Table 17 illustrates statistics for each independent variable used in our analysis for High Initial IBDR. The Table covers N (number of observations), mean, standard deviation and median of each variable.

Table 18 Descriptive table Low Initial IBDR start-ups

Low IBDR				
Statistic	N	Mean	St. Dev.	Median
Tangibility	65,293	0.19	0.21	0.12
Growth opportunity	65,293	0.01	0.05	0.00
Payout Ratio	65,293	0.10	0.30	0.00
NIBOR 3M	65,293	0.02	0.01	0.02
Tax shield	65,293	0.04	0.04	0.03
Growth sales	54,392	0.45	1.54	0.11
Size	65,293	2,966.80	6,303.03	1,560
ROAA	65,293	0.18	0.24	0.15
IBDR	65,293	0.14	0.19	0.06
Total STD	65,293	65.89	449.68	0.00
Total LBD	65,293	510.32	3,011.74	34
Total IBD	65,293	576.20	3,087.96	79

Table 18 illustrates statistics for each independent variable used in our analysis for Low Initial IBDR. The Table covers N (number of observations), mean, standard deviation and median of each variable.

When comparing start-ups with a *High Initial interest-bearing debt ratio* (IBDR) in ***Table 17*** to those with a *Low Initial IBDR* in ***Table 18***, several differences become apparent between the two subsets. Notably, start-ups with a *Low Initial IBDR* exhibit significantly higher averages in terms of *Pay-out Ratio*, *Sales Growth*, and *Return on Average Assets* (ROAA). The difference between *High- and Low Initial IBDR* start-ups ranges from 2% to 5%. This confirms our initial prediction that *Low Initial IBDR* start-ups would have higher *Sales Growth* compared to *High Initial IBDR* start-ups. However, *High Initial IBDR* start-ups demonstrate higher *Tangibility* and *Size*. On the other hand, there are no major differences in the averages of *Growth Opportunity* and *Tax Shield* between the *High* and *Low Initial IBDR* subsets.

6.7.3 Regression Model on Subsets

We run the new subsets on the preferred *Fixed Effects* regression model illustrated previously in column 4 in ***Chapters 6.4.1, 6.4.2*** and ***6.4.3***

Table 19 Regression model for High- and Low Initial IBDR

	Dependent variable:					
	IBDR		LTDR		STDR	
	Low	High	Low	High	Low	High
Size	0.022***	0.036***	0.018***	0.028***	0.005***	0.008***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.0003)	(0.001)
Tangibility	0.524***	0.451***	0.542***	0.492***	−0.018***	−0.041***
	(0.004)	(0.006)	(0.004)	(0.006)	(0.002)	(0.003)
Growth Opportunity	0.345***	0.506***	0.335***	0.546***	0.009	−0.040***
	(0.014)	(0.019)	(0.014)	(0.019)	(0.006)	(0.009)
Payout Ratio	−0.036***	−0.058***	−0.025***	−0.047***	−0.011***	−0.011***
	(0.002)	(0.004)	(0.002)	(0.004)	(0.001)	(0.002)
NIBOR 3m	−0.104*	0.402***	−0.312***	0.225***	0.208***	0.178***
	(0.059)	(0.086)	(0.055)	(0.084)	(0.025)	(0.039)
Tax Shield	−0.626***	−0.747***	−0.542***	−0.628***	−0.084***	−0.119***
	(0.020)	(0.028)	(0.019)	(0.027)	(0.008)	(0.013)
ROAA	−0.131***	−0.306***	−0.095***	−0.240***	−0.036***	−0.066***
	(0.003)	(0.006)	(0.003)	(0.006)	(0.001)	(0.003)
Growth Sales	0.005***	0.003***	0.004***	0.003***	0.001***	0.0002
	(0.0005)	(0.001)	(0.0005)	(0.001)	(0.0002)	(0.0004)
Observations	54,392	27,066	54,392	27,066	54,392	27,066
Firm Effects	Yes	Yes	Yes	Yes	Yes	Yes
Age Effects	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.326	0.346	0.357	0.361	0.030	0.049
Adjusted R^2	0.326	0.346	0.357	0.360	0.030	0.048
F Statistic	3,293.126***	1,788.176***	3,779.806***	1,906.806***	212.675***	173.985***
Note:						*p<0.1; **p<0.05; ***p<0.01

Table 19 illustrates the regression results with IBDR, LTDR and STDR as the dependent variables. All models are fixed effects models with firm-specific and age-specific effects. Column 1, 3 and 5 uses the Low Initial IBDR subset, and columns 2, 4 and 6 use the High Initial IBDR subset. Huber-White standard errors are shown in parentheses.

After running the different subsets through our models, we can see that there are some changes from the results shown previously, as well as the coefficients levels differ for both subsets. For the *IBDR* and *LTDR* models, the strongest explanatory variables are *Tangibility, Growth Opportunity,* and *Tax Shield*. Interestingly, as we predicted *NIBOR 3m* behaves differently for the *Low Initial IBDR* and *High Initial IBDR* subsets. For start-ups relying more on internal funding, an increase in the market interest rate makes long-term external debt less obtainable as exhibited by the negative coefficient of -0.104 (IBDR) and -0.312 (LTDR). Results also illustrate that *Low Initial IBDR* start-ups increase the *short-term interest-bearing debt ratio* (STDR) as a substitute for long-term debt. For *High Initial IBDR* start-ups, however, the market interest rate is significantly positive with coefficients of 0.402 (IBDR) and 0.225 (LTDR), indicating the opposite. The results illustrate that firms with access to external debt take on more debt when long-term debt becomes less accessible, whereas less mature firms do not.

We also predicted the performance-related variables *ROAA* and *Growth Sales* to be positively associated with *IBDR* and *LTDR* for *Low Initial IBDR* start-ups. As seen with the *NIBOR 3m* having a negative coefficient, profitability and growth should be increasing the accessibility of long-term debt. *Growth Sales* are still positively correlated, as in all our models so far. However, profitability is still negatively correlated with long-term and total debt ratios. Indicating, as argued in ***Chapter 6.5.7 ROAA***, that Norwegian start-ups tend to prefer internal funds over external capital when available. This can also indicate that profitable start-ups struggle to find enough new projects, given that firms do not obtain the same *long-term interest-bearing debt ratios*.

6.7.4 Descriptive Analysis

As our findings in ***Chapters 6.7.2*** and ***6.7.3*** have shown we find reason to believe that the debt ratios and debt determinants behave differently for *High* -and *Low Initial IBDR* start-ups. To further our analysis, we perform a trend analysis to visualize the development and trends for debt usage and debt determinants in Norwegian start-ups.

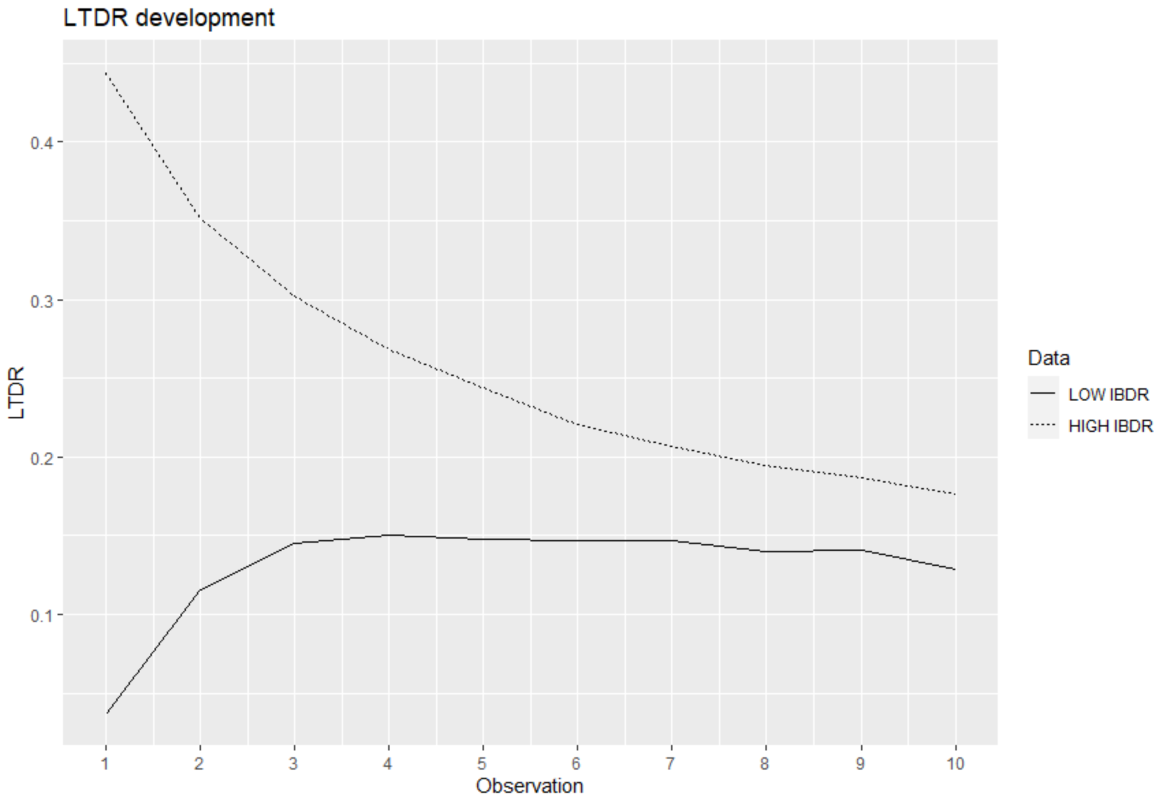

Figure 6-5 LTDR development High- vs Low initial IBDR

Figure 6-5 illustrates LTDR development for high- and low-initial IBDR firms. LTDR variable is measured as a ratio. LTDR development for both high- and low-initial IBDR firms return to the mean over the 10-year span. LTDR for high initial IBDR decreased over the years, going from about 0.45 down to about 0.18, while LTDR for low initial IBDR firms increase over the years, going from about 0.04 up to about 0.15.

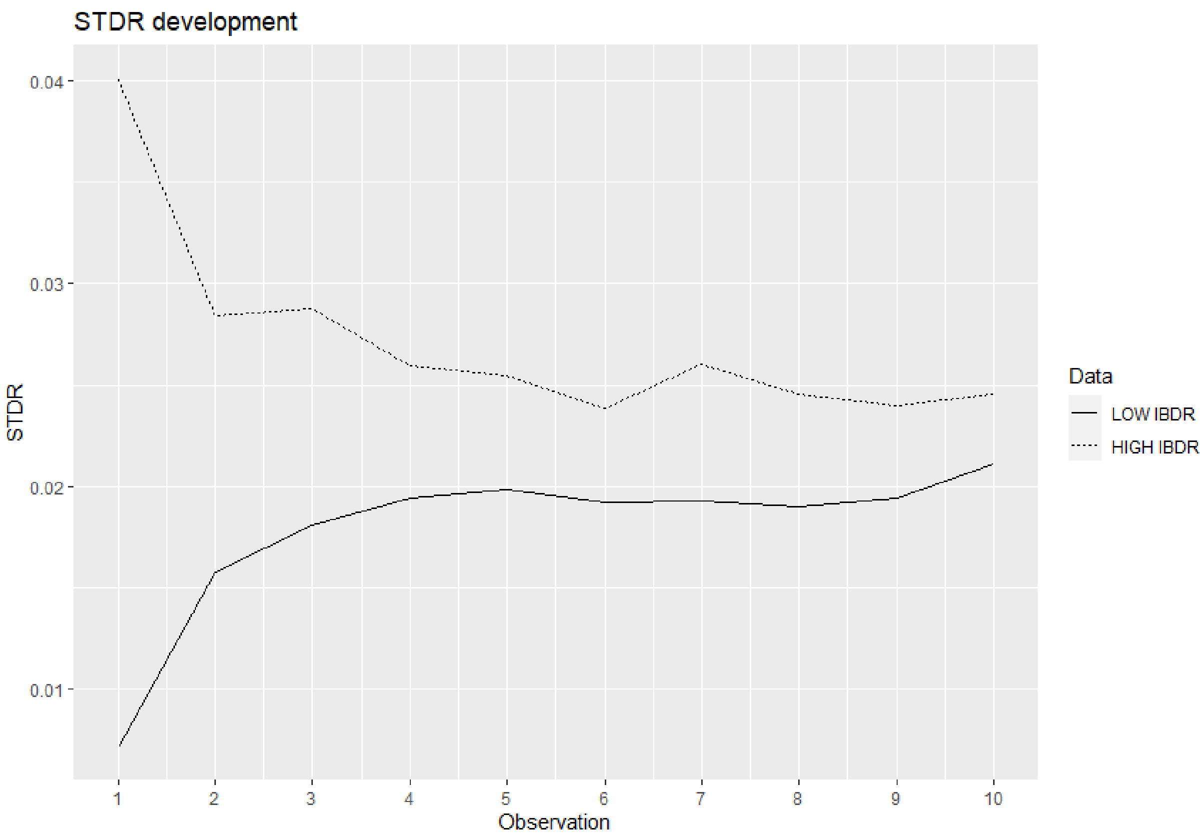

Figure 6-6 STDR development High- vs Low initial IBDR

Figure 6-6 illustrates STDR development for high- and low-initial IBDR firms. STDR variable is measured as a ratio. STDR development for both high- and low-initial IBDR firms return to the mean over the 10-year span. STDR for high initial IBDR decreased over the years, going from about 0.04 down to about 0.025, while STDR for low initial IBDR firms increase over the years, going from about 0.005 up to about 0.02.

Figure 6-5 shows us the development of the total *long-term interest-bearing debt ratio* (LTDR) for both the *High- and Low Initial IBDR* start-ups. We can see how there is a downward curve in *LTDR* for the *High Initial IBDR* start-ups and an upwards curve in *LTDR* for the *Low Initial IBDR* start-ups in the first years. Our results show that the *LTDR* of start-ups seem to move towards an overall average as they mature, no matter the initial financing. We see the same trend in ***Figure 6-6*** for the total *short-term interest-bearing debt ratio* (STDR) with an even steeper decline and increase in the first years bridging the gap even quicker than for the *LTDR*. These trends are the same as the trend for the total *interest-bearing debt ratio* (IBDR) ***(Figure B-1)***. By looking at the *LTDR* and *STDR* we see how both ratios are returning to the mean, similar to what our 4th prediction stated.

As indicated earlier, start-ups should take on more debt as it becomes available given their initial informational opaqueness. The *Financial Growth Cycle* theory also argues that firms start to decrease all debt ratios over time when they obtain retained earnings. This prediction seems to fit a lot better for the *Low Initial IBDR* subset, whereas the *High Initial IBDR* subset starts to reduce the debt ratios immediately.

Upon examining *Size*, we observed a consistent growth pattern for both *High- and Low initial IBDR* start-ups. Initially, *High Initial IBDR* start-ups exhibited larger *Size* during the first four years, but by years 5 and 6, their values became comparable. However, a shift occurred around year 7, with *Low Initial IBDR* start-ups surpassing *High Initial IBDR* start-ups in *Size*. Consequently, the average *Size* of firms remained consistent between *High- and Low Initial IBDR* over the course of ten years ***(Figure B-2)***.

Figure 6-7 shows us that *ROAA,* similarly to *LTDR* and *STDR,* moves closer to the average over time. The big difference is that *Low Initial IBDR* start-ups seem to have no drastic downward curve or spike as we can see in the *LTDR* and *STDR* graphs. *High Initial IBDR* start-ups have a large increase in the curve over the first years before it turns downward for later years. After stabilizing, both subsets seem to follow the same trend from roughly observation 6. Interestingly, if *High Initial IBDR* firms appear more mature at start-up we would also expect them to be more profitable. Our results, however, show the opposite as *Low Initial IBDR* firms are more profitable throughout the whole 10-year period. Naturally, the additional debt reduces the profitability of the firms through interest costs. Nonetheless, given the apparent maturity of *High Initial IBDR* start-ups, we expect them to be profitable from the start, whereas *Low Initial IBDR* firms need some more time to turn profitable. Our results however do not give any support to this argument, as *Low Initial IBDR* firms are more profitable than *High Initial IBDR* firms. Further, the result shows that the *ROAA* level returns towards a mean at the same speed as the debt ratios do. Indicating that there is little to no difference in the performance given the initial capital structure. As shown by the increase in average returns when debt levels decrease and vice versa.

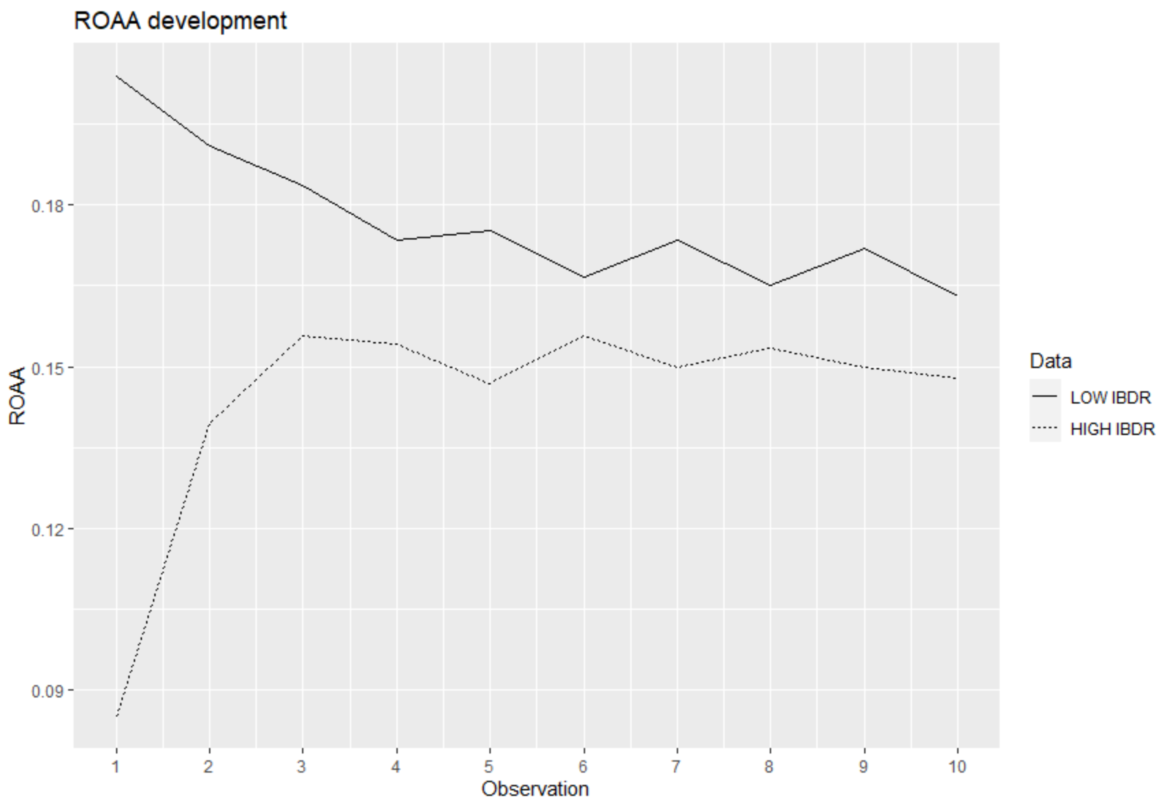

Figure 6-7 ROAA development High- vs Low initial IBDR

Figure 6-7 illustrates ROAA development for high- and low-initial IBDR firms. ROAA variable is measured as a ratio. It shows how the ROAA for both types of firms goes towards a mean. High initial IBDR firms have rapid growth in the first years and then stabilize, ranging from about 0.09 to about 0.15. While low initial IBDR firms steadily decrease over the 10-year span, ranging from about 0.20 down to about 0.165

Growth Sales are constantly higher for *Low Initial IBDR* firms until observation 8 as seen in ***Figure 6-8***. Supporting our previous results as *Low Initial IBDR* start-ups are less *Tangible*. However, we also find that *High Initial IBDR* start-ups have on average a higher *Growth Opportunity* value, giving us contradictory results. The results reported are however in line with our initial predictions and support the *Financial Growth Cycle* theory. As more mature firms should on average grow less than more informational opaque firms given a more intangible asset structure.

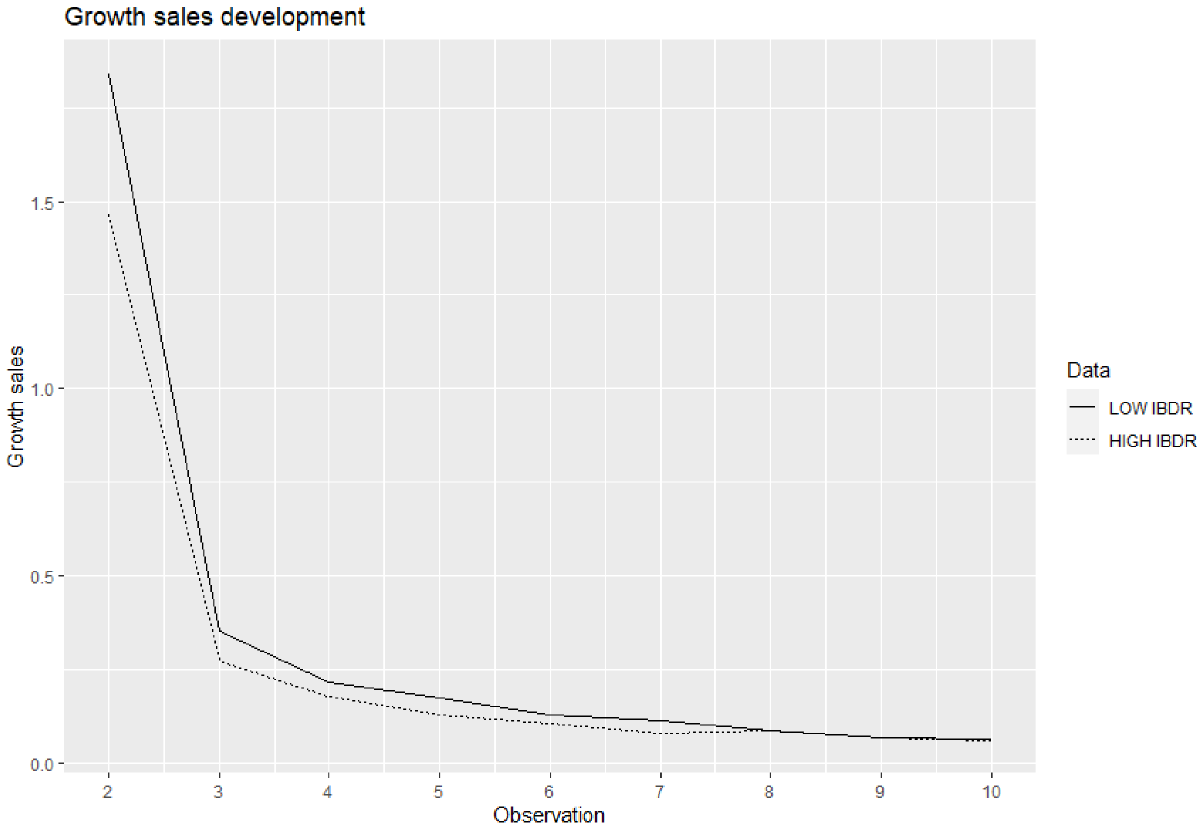

Figure 6-8 Growth sales development High- vs Low initial IBDR

Figure 6-8 illustrates the development of Growth Sales between high- and low-initial IBDR firms over the 10-year span. Growth Sales are measured as a ratio. The development for both types follows the same trend, with low initial IBDR firms having on average more Growth Sales in the first 7 years, until there is no real difference. Both downward curves range from about 1.5 down to about 0.1.

6.7.5 Summary of Empirical Findings for Initial Debt Financing

After analyzing the *Low Initial IBDR* and *High Initial IBDR* subsets, we have discovered certain findings that provide support for our predictions. On average, the *Growth Sales* value is higher for *Low Initial IBDR* start-ups, aligning with our initial hypothesis. Additionally, we observed a positive correlation between *Growth Sales* and both *Low Initial IBDR* and *High Initial IBDR*, although the coefficient is higher for the *Low Initial IBDR* subset. However, contrary to our expectations, *ROAA* continues to significantly affect *IBDR* and *LTDR* in a negative way. Notably, the coefficient is considerably closer to zero, indicating a less pronounced impact.

Our prediction regarding *NIBOR 3m* turning negative for *Low Initial IBDR* firms is correct, with significant results observed at the 10% level for *IBDR* and the 1% level for *LTDR*. Moreover, our findings support the notion that the overall *interest-bearing debt ratio* behaves as described in the *Financial Growth Cycle theory*. Specifically, *Low Initial IBDR* firms tend to take on more debt as they become less informationally opaque, while *High Initial IBDR* firms prefer relying on retained earnings. As a result, the *IBDR* tends to regress toward the mean, implying that the initial debt policy may not have a substantial impact on overall debt development. The graphs further indicate that both *High- and Low Initial IBDR* start-ups gradually converge toward the mean over time, resulting in similar debt ratios for both *long-* and *short-term interest-bearing debt*.

Examining the findings through the lens of the *Financial Growth Cycle Theory*, the results suggest that start-ups with higher initial debt levels exhibit a greater degree of maturity compared to those primarily financed by equity. As evidenced by our findings, *Low Initial IBDR* start-ups experience rapid growth and accumulate debt as they mature, eventually transitioning to using internal funds. In contrast, *High Initial IBDR* start-ups decrease their debt ratios right from the start. The *Return on Average Assets* (ROAA) for both subsets returns toward a mean at a similar pace as the *Long-Term Debt Ratio* (LTDR) and *Short-Term Debt Ratio* (STDR). Notably, *Low Initial IBDR* start-ups demonstrate higher profitability in the initial stages. This suggests that there are no inherent performance advantages for successful start-ups based on their initial debt strategy, as metrics such as *Size*, *ROAA*, and *Growth Sales* regress towards an overall mean over the 10-year research period.

7. Conclusion

The goal of this master thesis is to identify factors which determine the debt levels of Norwegian start-ups and how debt financing develops as firms mature. To do this we look at relevant factors which contribute to the variation in debt ratios and analyse how debt financing develops as start-ups mature. Additionally, we investigate if the initial *IBDR* has an impact on the development of debt financing for start-ups. Based on both a descriptive and comprehensive regression analysis we provide insight into the development of debt financing as firms mature, as well as uncover a number of significant factors affecting the debt financing choices in Norwegian start-ups. In this quantitative approach, we have conducted a panel data analysis, observing start-ups founded between 2003-2020 for a maximum of 10 years. With the data from Regnskapsdatabasen (Mjøs & Flatebø, 2022) our working dataset includes a total of 100.381 observations on 18.923 individual start-up firms.

Our findings show that debt ratios follow the same trend across industries, even though we find signs of significant differences in debt ratios between industries. Start-ups tend to take on more *interest-bearing debt* as they mature, although prefer using internal funds as all debt ratios decrease over time. Five factors have shown to be significantly robust determinators across all of our regression models by showing the same causal effect for all debt ratios examined. *Growth Sales* (+), *Size* (+), *Tax Shield* (-), *Pay-out Ratio* (-), and *Return on Average Asset* (-) have been significant at the 1% level in our *interest-bearing debt ratio* (IBDR), *long-term interest-bearing debt ratio* (LTDR), and *short-term interest-bearing debt ratio* (STDR) models. Showing that larger and growing firms have greater access- and prefer to use both short-and long-term external debt funding. Profitable and dividend-paying start-ups tend to favour internal funding, while non-debt deductibles reduce the incentive for interest-tax shields. *Tangibility* and *Growth Opportunity* are both positively correlated with *LTDR* and *IBDR*, but negatively affect the *STDR*, showing that the asset structure of firms determines the accessibility of external debt for start-ups. Indicating that start-ups with available collateral and future growth opportunities favour taking on external debt financing. Our findings show similar results to previous capital structure research, as revealed in ***Chapter 6.5 Variable Discussion and Findings***, with profitability, growth, and asset structure being important determinators of debt financing.

Further, our findings show that the perceived maturity of start-ups affects the accessibility and development of external debt financing. Start-ups with a higher *IBDR* (interest-bearing debt ratio) in the first year appear more mature and less informational opaque, as shown by a higher *Tangibility* and *Growth Opportunity* ratio. The increased accessibility of external debt financing is shown by the *NIBOR 3m* being positively correlated with *LTDR* for *High Initial IBDR* start-ups, however, it is negatively correlated with *Low Initial IBDR* start-ups. Indicating that informational opaque firms do not have access to long-term debt financing when the market interest rate increases, consequently using short-term debt as a substitute.

In contrast to Hanssens et al.'s (2016) study, our findings suggest that the initial debt financing strategy has little impact on long-term financing decisions in Norwegian start-ups. *High Initial IBDR* start-ups tend to reduce their debt ratios while *Low Initial IBDR* start-ups increase theirs. Making the debt ratios move towards an overall mean before it follows the same downward trend from roughly observation 6. The perceived maturity of start-ups at commencement does not either show any signs of performance-related advantages as profitability, size, and growth, all move towards an overall mean. Making the initial debt financing strategy in Norwegian start-ups appear inconsequential for successful start-ups.

8. Limitations and Future Research

This thesis analyses factors which determine the debt levels of Norwegian start-ups and how debt financing develops as firms mature. The absence of a universal definition for start-ups leads to the existence of multiple both broad and specific definitions for what qualifies as a start-up. Consequently, applying a different definition than the one used in this thesis may show different results.

Start-up financing differs from financing of larger firms, because of higher dependency on the entrepreneur. The limited financial record of a start-up reduces the accessibility of external debt which makes financing tougher. In our data, we have no way to map out the dependency or importance of the entrepreneur personally being liable for loans or providing collateral. These are individual factors we believe to be significantly relevant for the development of debt levels, especially initial debt financing. We also believe there to be other individual entrepreneurial differences which reduce the informational opaqueness of start-ups. Such as prior experience and relationships with banks etc. are factors which differentiate start-ups and affect the accessibility of external debt. For future research, we believe a more qualitative approach to investigate the individual differences of start-ups. As well as the dependency of the entrepreneur being personally liable for loans and collateral will provide great additional insight into the debt financing of start-ups.

We also recognise that debt levels and debt determinants differ between industries. Hence, an investigation of debt determinants, and the development of debt financing in specific industries would provide helpful insight. Ultimately, we also believe a study on the new and innovative financing methods, such as venture debt and crowdfunding, particularly interesting in the context of start-up financing.

References

Adam, T. R., & Goyal, V. K. (2008). The Investment Opportunity Set and its Proxy Variables: Theory and Evidence. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.298048

Antoniou, A., Guney, Y., & Paudyal, K. N. (2002). Determinants of Corporate Capital Structure: Evidence from European Countries. *SSRN Electronic Journal*. Available at: https://www.researchgate.net/publication/239504636_Determinants_of_Corpo-rate_Capital_Structure_Evidence_from_European_Countries/link/5c3c7254458515a-4c724a393/download or https://doi.org/10.2139/ssrn.302833

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 and Finance*, *22*(6-8), 613–673. https://doi.org/10.1016/s0378-4266(98)00038-7

Berk, J., & DeMarzo, P. (2020). *Corporate finance* (5th ed., global ed.). Harlow: Pearson Education.

Blank, S. (2020). *The startup owner's manual: The step-by-step guide for building a great company*. John Wiley & Sons.

Boldea, O., Drepper, B., & Gan, Z. (2020). Change point estimation in panel data with time-varying individual effects. *Journal of Applied Econometrics*, *35*(6), 712–727. https://doi.org/10.1002/jae.2769

Cassar, G. (2004). The financing of business start-ups. *Journal of Business Venturing*, *19*(2), 261–283. https://doi.org/10.1016/s0883-9026(03)00029-6

CB Insights. (2021, August 3). *Why Startups Fail: Top 12 Reasons l CB Insights*. CB Insights Research. https://www.cbinsights.com/research/report/startup-failure-reasons-top/

Davila, A., & Foster, G. (2005). Management accounting systems adoption decisions: evidence and performance implications from early-stage/startup companies. *The Accounting Review*, *80*(4), 1039-1068. https://doi.org/10.2308/accr.2005.80.4.1039

DNB. (2013, May 9). *Applying for a business loan*. Www.dnb.no. https://www.dnb.no/en/about-us/global-network/baltics/applying-for-business-loan.html

Eckbo, B. E. (Ed.). (2008). *Handbook of empirical corporate finance set*. Elsevier Science & Technology.

Frank, M. Z., & Goyal, V. K. (2007). Chapter 12 - Trade-Off and Pecking Order Theories of Debt. *In Handbook of Empirical Corporate Finance SET*, 135–202. https://doi.org/10.1016/B978-0-444-53265-7.50004-4

Frank, M. Z., & Goyal, V. K. (2009). Capital Structure Decisions: Which Factors Are Reliably Important? *Financial Management*, *38*(1), 1–37. https://doi.org/10.1111/j.1755053x.2009.01026.x

Frydenberg, S. (2004). Determinants of Corporate Capital Structure of Norwegian Manufacturing Firms. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.556634

Harris, M., & Raviv, A. (1991). The Theory of Capital Structure. *The Journal of Finance*, *46*(1), 297–355. https://doi.org/10.1111/j.1540-6261.1991.tb03753.x

Hanssens, J., Deloof, M., & Vanacker, T. (2016). The evolution of debt policies: New evidence from business startups. *Journal of Banking & Finance*, *65*(65), 120–133. https://doi.org/10.1016/j.jbankfin.2016.01.008

Innovasjon Norge. (2023, May 15). *Bli kjent med våre finansieringsordninger for oppstartbedrifter*. Www.innovasjonnorge.no. https://www.innovasjonnorge.no/no/verktoy/verktoy-for-oppstart-av-bedrift/kan-du-fa-stotte-fra-innovasjon-norge/

Jensen, M. C. (1986). Agency Costs of Free Cash Flow, Corporate Finance, and Takeovers. *The American Economic Review, 76*(2), 323–329. http://www.jstor.org/stable/1818789

Kollmann, T., Stöckmann, C., Niemand, T., Hensellek, S., & de Cruppe, K. (2021). A configurational approach to entrepreneurial orientation and cooperation explaining product/service innovation in digital vs. non-digital startups. *Journal of Business Research*, *125*, 508–519. https://doi.org/10.1016/j.jbusres.2019.09.041

Kunst, R. (2009). *Methods of Panel Data - Part II*. https://homepage.univie.ac.at/robert.kunst/panels2e.pdf

Laurens, R., & Tampang, Y. (2018). *Long-Term Liabilities*. https://doi.org/10.2139/ssrn.3210082

Leary, M. T., & Roberts, M. R. (2010). The pecking order, debt capacity, and information asymmetry. *Journal of Financial Economics, 95*(3), 332–355. https://doi.org/10.1016/j.jfineco.2009.10.009

Martinez Jr, A. (2020, March 19). *Long-Term vs. Short-Term Loans*. Plains Capital Bank. https://www.plainscapital.com/blog/long-term-vs-short-term-loans/

Mjøs, A. (2007). *Corporate Finance: capital structure and hybrid capital.* Norwegian School of Economics and Business Administration.

Mjøs, A., & Flatebø, S. (2022). *Regnskapsdatabasen -Norwegian Corporate Accounts*. https://snf.no/media/durjpedn/r04_22.pdf

Montani, D., Gervasio, D., & Pulcini, A. (2020). Startup company valuation: The state of art and future trends. *International Business Research, 13*(9), 31-45. https://doi.org/10.5539/ibr.v13n9p31

Modigliani, F., & Miller, M. H. (1958). The Cost of Capital, Corporation Finance and the Theory of Investment. *The American Economic Review, 48*(3), 261–297. http://www.jstor.org/stable/1809766

Myers, S. C. (1984). The Capital Structure Puzzle. *The Journal of Finance*, *39*(3), 575–592. https://doi.org/10.2307/2327916

Myers, S. C., & Majluf, N. S. (1984). Corporate financing and investment decisions when firms have information that investors do not have. *Journal of Financial Economics*, *13*(2), 187–221. https://doi.org/10.1016/0304-405x(84)90023-0

NHO. (n.d.). *Fakta om små og mellomstore bedrifter (SMB)*. Www.nho.no; Næringslivets Hovedorganisasjon. https://www.nho.no/tema/sma-og-mellomstore-bedrifter/artikler/sma-og-mellomstore-bedrifter-smb/

Robb, A., & Robinson, D. T. (2008). The Capital Structure Decisions of New Firms: Second in a Series of Reports Using Data from the Kauffman Firm Survey. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.1292552

Saunders, M. N. K., Lewis, P. & Thornhill, A. (2019). *Research Methods for Business Students* (8. edition). Pearson Education Limited

Statistics Norway. (n.d.). *Standard Industrial Classification 2007 (SIC 2007).* SSB. https://www.ssb.no/en/klass/klassifikasjoner/6

Statistics Norway. (2022, September 12). *Nyetablerte foretaks overlevelse og vekst*. SSB. https://www.ssb.no/virksomheter-foretak-og-regnskap/virksomheter-og-foretak/statistikk/nyetablerte-foretaks-overlevelse-og-vekst

Stock, J. &Watson, M. (2011). *Introduction to Econometrics* (3rd edition). Addison Wesley Longman.

Talberg, M., Winge, C., Frydenberg, S., & Westgaard, S. (2008). Capital Structure Across Industries. *International Journal of the Economics of Business*, *15*(2), 181–200. https://doi.org/10.1080/13571510802134304

Teixeira, G., & Coutinho dos Santos, M. J. (2005). Do Firms Have Financing Preferences along their Life Cycle? *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.676869

Vernimmen, P., Quiry, P., Dallocchio, M., Le, F. Y., & Salvi, A. (2014). *Corporate finance: Theory and practice*. John Wiley & Sons, Incorporated.

Villamil, A.P. (2008). Modigliani–Miller Theorem. In: *The New Palgrave Dictionary of Economics. Palgrave Macmillan*, London. https://doi.org/10.1057/978-1-349-95121-5_2455-1

Wifstad, K., Grünfeld, L., Forsberg Johnsen, P. F., & Motrøen Foseid, H. (2022). *EVALUERING AV INNOVASJON NORGES OPPSTARTSFINANSERING*. https://www.menon.no/wp-content/uploads/2022-81-Evaluering-av-INs-Oppstartfinansiering.pdf

Wooldridge, Jeffrey M., 1960-. (2012). *Introductory econometrics: a modern approach*. Mason, Ohio: South-Western Cengage Learning

Öhman, P., & Yazdanfar, D. (2017). Short- and long-term debt determinants in Swedish SMEs. *Review of Accounting and Finance*, *16*(1), 106–124. https://doi.org/10.1108/raf-08-2015-0118

Appendix A

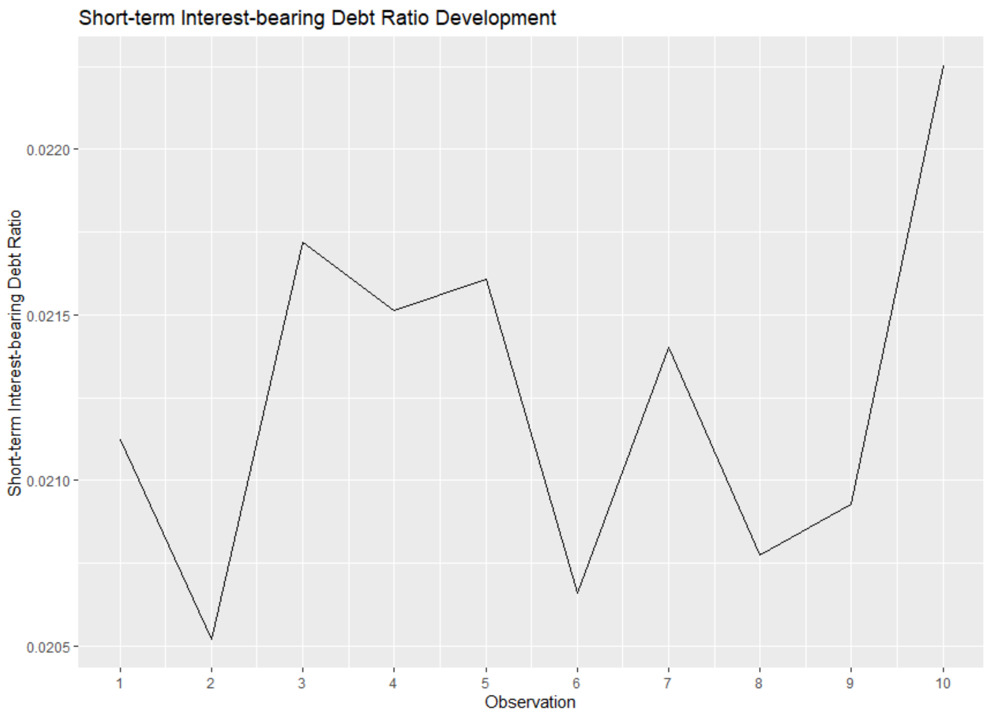

Figure A-1 Short-term Interest-bearing Debt Ratio Development

Figure A-1 illustrates the development of the Short-term Interest-bearing debt ratio. The figure illustrates that STDR does not seem to follow any kind of trend during the time period.

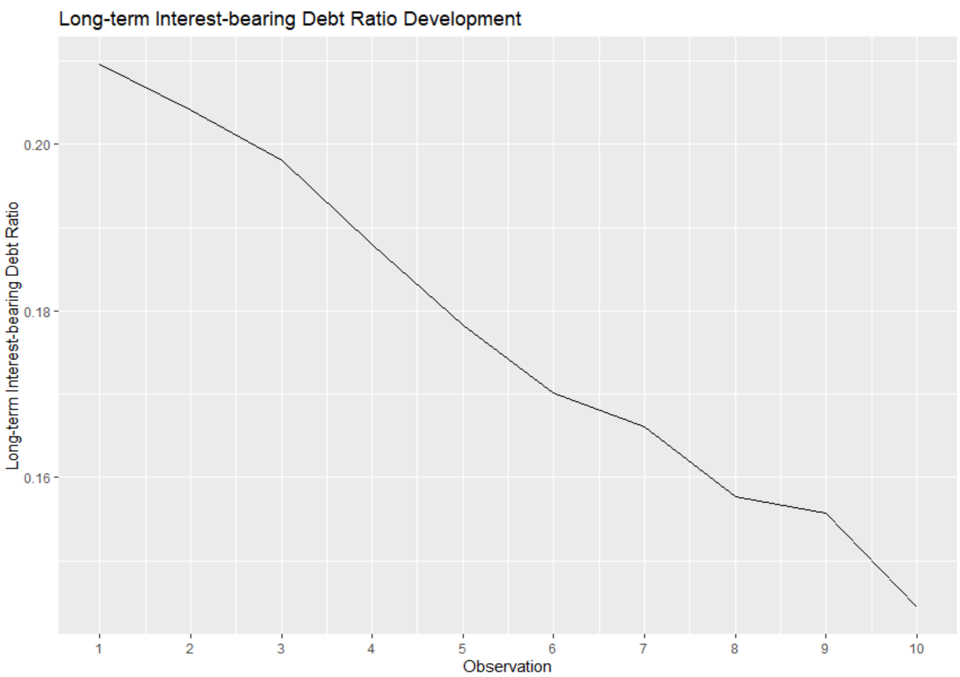

Figure A-2 Long-term Interest-bearing Debt Ratio development

Figure A-2 illustrates the Long-term Interest-bearing debt ratio. The Figure demonstrates how LTDR steadily decreases going from about 0.21 down to about 0.145 similar to the development of IBDR.

Appendix B

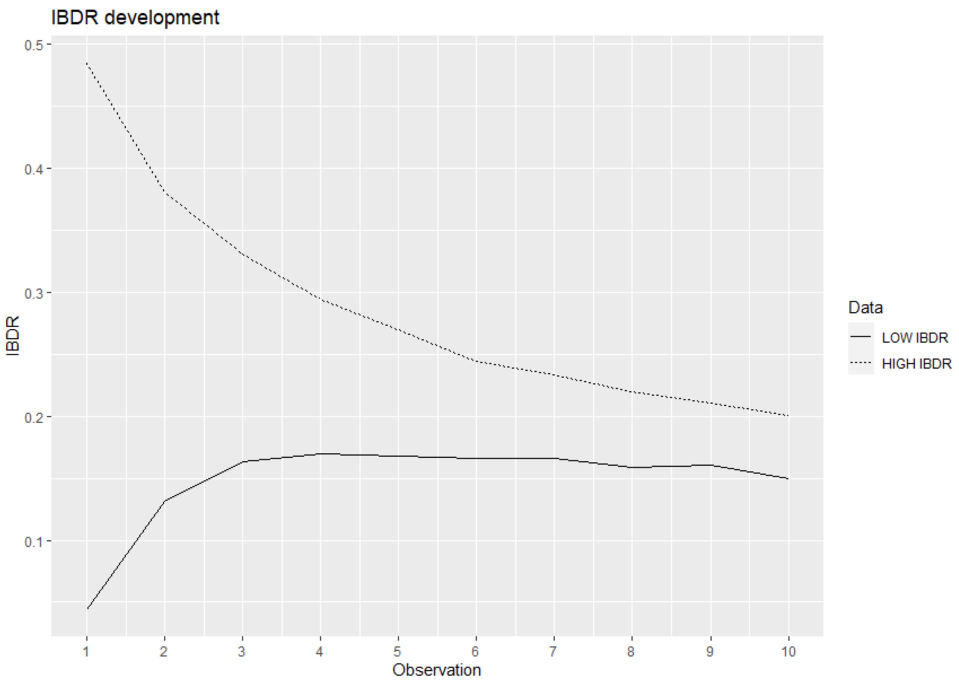

Figure B-1 IBDR development High- vs Low Initial IBDR

Figure B-1 illustrates and compares IBDR development between High- and Low Initial IBDR start-ups. The figure demonstrates how the High initial IBDR start-ups have a downward curve while the Low initial IBDR has an upward curve both curves turning toward the mean over time.

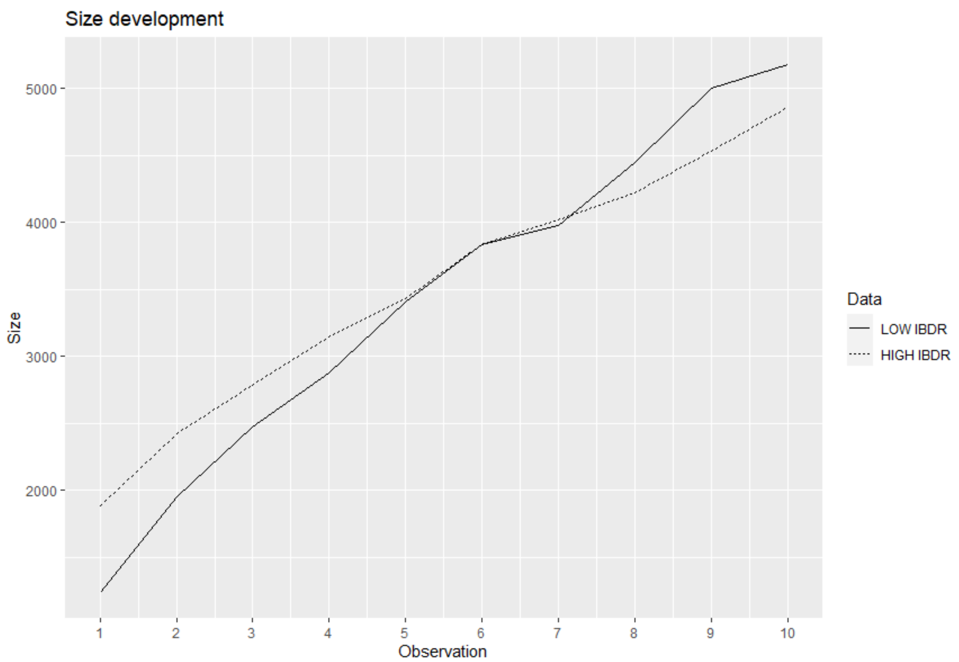

Figure B-2 Size development High- vs Low Initial IBDR

Figure B-2 illustrates Size development for high- and low-initial IBDR firms. The variable Size is measured as an absolute number. The Size for low initial IBDR has a steeper slope, growing from about 1,250 to about 5,100. While the Size for high initial IBDR goes from about 2,000 to about 4,900.

Appendix C

OLS Assumptions

In addition to the tests shown in ***Chapter 6.3 Test Results Deciding Preferred Regression Model***, we also conducted tests for both linearity and normality. As described in ***Chapter 5.3 OLS Assumptions*** these assumptions are also necessary to ensure the validity of our results. Based on the tests conducted in ***Chapter 6.3 Test Results Deciding Preferred Regression Model***, and the results shown here, we conclude that all assumptions are satisfied, and the Fixed Effects model provides valid and reliable results.

Linearity

As described in ***Chapter 5.3 OLS Assumptions***, the OLS assumes a linear relationship between the dependent and independent variables, otherwise, the models would provide biased results. In ***Figure C-1*** we have made a residual plot, showing the residuals from a chosen independent variable. Thus, we can examine if there is a linear relationship between the predicted values and observed values. Given the plot in ***Figure C-1,*** we can see that there is not a perfect linear relationship. However, we conclude with the linearity being at a satisfactory level. All variables not shown here have all been investigated manually in R studio and concluded with being satisfactory as well.

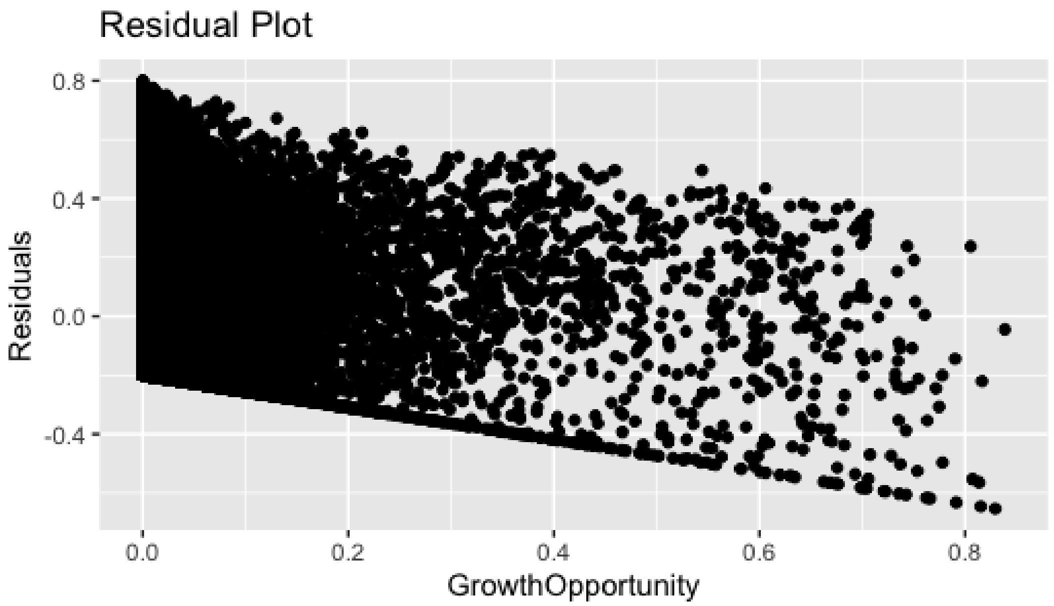

Figure C-1 Residual plot - Growth Opportunity

Normality

OLS also builds on the assumption that the observations are drawn from the normal distribution. Meaning that the error terms are normally distributed thus giving a non-biased estimation. In large sample sizes such as ours, we can assume that the error terms are normally distributed through the law of large numbers, and the central limit theorem.

The law of large numbers, states that the larger the sample size, the more likely the sample mean will be closer to the distribution mean. The central limit theorem indicates that when taking sufficient large random samples from the population, then the distribution of the sample means will be approximately normally distributed. Given that our data has over 100 000 observations from roughly 18 000 different start-ups, we conclude with the data being normally distributed.

Appendix D

Hausman

Table D-1 LTDR model

	Coefficients			
	Fixed Effects	Random Effects	Difference	Std. Error
	(b)	(B)	(b-B)	sqrt(diag($V_b - V_B$))
Size	0.540	0.037	0.504	0.001
Tangibility	0.425	0.542	-0.117	0.006
Growth Opportunity	-0.016	0.434	-0.450	0.022
Payout Ratio	1.021	-0.022	1.043	0.001
NIBOR 3m	-0.022	0.726	-0.748	0.054
Tax Shield	-0.070	-0.179	0.109	0.023
ROAA	0.005	-0.078	0.084	0.003
Growth Sales	0.059	0.004	0.055	0.0004

(b) = Consistent under H_0 and H_1
(B) = Inconsistent under H_1, efficient under H_0
H_0: Difference in coefficients not systematic

chi2(8) = 2378.6
P-Value = 0.000

Table D-1 illustrates the coefficients from a Fixed Effects model and Random Effects Model conducted with LTDR as the dependent variable, the difference in the coefficients (b-B), and the standard error of the difference in coefficient (b-B).

Table D-2 STDR model

	Coefficients			
	Fixed Effects	Random Effects	Difference	Std. Error
	(b)	(B)	(b-B)	sqrt(diag($V_b - V_B$))
Size	-0.010	0.007	-0.017	0.001
Tangibility	0.044	-0.020	0.064	0.002
Growth Opportunity	-0.004	0.019	-0.023	0.008
Payout Ratio	0.043	-0.006	0.049	0.001
NIBOR 3m	-0.026	0.112	-0.138	0.024
Tax Shield	-0.028	-0.057	0.029	0.007
ROAA	-0.0004	-0.033	0.033	0.001
Growth Sales	0.007	-0.0001	0.008	0.0002

(b) = Consistent under H_0 and H_1
(B) = Inconsistent under H_1, efficient under H_0
H_0: Difference in coefficients not systematic

chi2(8) = 489.88
P-Value = 0.000

Table D-2 shows the coefficients from a Fixed Effects model and Random Effects Model conducted with STDR as the dependent variable, the difference in the coefficients (b-B), and the standard error of the difference in coefficient (b-B).