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The Impact of Leverage on Firm Performance

An Empirical Study of Non-Financial Listed Companies in Norway

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NORWEGIAN SCHOOL OF ECONOMICS

Abstract

We study the impact of leverage on firm performance in the post-financial crisis period using a sample of non-financial listed companies in Norway. Based on various capital structure literature we expect a positive effect of increased leverage on performance at lower debt-ratios and negative effects on higher debt-ratios. We use Tobin's Q as a measure of firm performance and a dynamic panel data model to control for the reverse effect from performance on leverage and unobserved firm heterogeneity. We show that the positive relationship between leverage and performance occurs only when leverage is sufficiently high. We find a negative coefficient for the linear term and a positive coefficient on the square term which contradicts our predictions. However, the relationship between leverage and firm performance is not robust to other measures of performance. Testing for differences in the relationship between leverage and performance for low-growth and high-growth firms separated based on P/E-ratio and Tobin's Q yield inconclusive results. The results partly indicate that firms with high-growth potential are more affected by an increase in leverage than low-growth firms. Furthermore, the findings based on our sample do not support the predictions that the impact of leverage is different across industries.

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1 Introduction

The basic premise of financial theory can be broken down to which investments to pursue and how to finance them. Since investments are financed by equity, debt, or a composition of both, it is crucial to understand if investments can be positively or negatively affected by changing the debt to equity ratio. Literature on capital structure provide ample theoretical evidence on the potential consequences of increased leverage. It is argued that debt financing can result in benefits or costs to the firm, relative to equity financing. However, the predictions regarding the effects of increased leverage has proven difficult to substantiate through empirical research.

This paper aims to investigate the predictions based on theory on how leverage impacts firm performance. Most of the previous research is based on public, non-financial firms in the U.S. We focus on non-financial firms at Oslo Stock Exchange which is the central marketplace for listing and trading in the Norwegian market. To the best of our knowledge, no similar studies have yet been conducted for this market. In our sample, companies within the energy, shipping and seafood industries dominate, but IT and other sectors are also present. As of May 2019, total 196 companies are listed including financial firms (Oslo Stock Exchange, 2019). Since many companies operate in the petroleum sector, fluctuations in oil price are an important factor. In 2014, drop in oil prices led to uncertainty and decrease in investments in Norway (Norges Bank, 2015). Norwegian interest rates have also been all-time low as in other countries in the 8-year period (2010-2017) due to expansionary monetary policies[1]. Apart from that, Norway is a developed country known for its well-functioning legal environment and financial infrastructure. We hope this paper contributes to more updated knowledge about the relationship between leverage and firm performance in Norway and comparable countries.

Majority of the literature can be divided into two branches with different views on financing decisions. The first branch (Trade-off theory, Agency theory) posit that an optimal debt to equity ratio is where the marginal benefit of increased debt equals its marginal cost. The second branch (Pecking-Order theory, Signalling Theory) view leverage choice as conditional on asymmetric information. The effects of increased leverage as predicted by the two branches often contradict each other. The empirical research has yielded inconclusive interpretations on observed leverage decisions and the consequent impact on firms. Previous research papers argue for different relationships and use various measures for firm performance. We use

[1] For more information about the characteristics of the Norwegian economy and financial markets, we recommend the annual Financial Stability report from the Central Bank of Norway (Norges Bank).

Tobin's Q as a measure of firm performance and regress on leverage defined as total debt-to-assets ratio, and a set of other control variables. Tobin's Q, which is the market value of assets divided by the replacement costs, has been used interchangeably as a measure of a firm's value, growth and performance. We regard it as appropriate for our purpose as we want to assess the overall effect on the firm and account for both market performance and assets in place. Since firm-specific attributes are likely to affect the results, we use the fixed-effects estimator to focus on within-firm variation and eliminate the unobservable firm characteristics that remain constant over time. We also present other ways to handle the endogeneity which is likely to occur due the dualistic nature of the relationship between leverage and performance and omitted variables.

The rest of our thesis is structured as follow. In Chapter 2 we provide a brief review of relevant literature. In Chapter 3 we detail the methodology and variables used in our study. In Chapter 4 we detail the organization of our data along with sample statistics. In Chapter 5 we present the results of our estimations. We finally conclude this study with a summary and discussion detailing caveats and suggestions for further research in Chapter 6.

2 Theoretical framework

In this chapter we will give a brief overview of the main theories regarding capital structure. The aim of this chapter is to give a background for why we could expect a relationship between leverage and performance based on literature. We then discuss some relevant empirical studies that have set out to test the predictions of the theories. Lastly, we develop our hypotheses.

2.1 Literature review

Harris and Raviv (1991) have compiled a comprehensive survey of many influential research papers pertaining to capital structure. They have identified four broad categories of underlying factors affecting firm’s financing decisions through the desire to:

- ameliorate conflicts of interest among various groups with claims to the firm's resources, including managers (the agency approach),
- convey private information to capital markets or mitigate adverse selection effects (the asymmetric information approach),
- influence the nature of products or competition in the product/input market, or
- affect the outcome of corporate control contests

We acknowledge the vast literature and theories that influence leverage choices but will limit this paper to the trade-off, agency and asymmetric approaches. Broadly speaking, all the theories focus on trading off the costs and benefits of increased leverage. Agency theory is an extension of Trade-off theory that is often lumped under the same umbrella. However, to distinguish the different effects leverage can have on firm performance, we will separate the two as what constitutes the costs and benefits of leverage can be the result of different factors. Trade-off theory focuses on balancing the benefits of tax advantage of borrowed money against the cost of financial distress. In the agency approach, the primary source of costs and benefits is how debt relates to the conflict of interests between different stakeholders. In contrast, theories based on asymmetric information state that managers have a systematic preference for their leverage choice. Due to varying degree of asymmetric information between insiders and outsiders of a firm, managers either prefer to use retained earnings and debt to finance projects, or to use debt as a proxy to signal information.

2.1.1 Theoretical studies

In this section, we begin with Modigliani and Millers (1958) seminal paper that acts as the foundation for capital structure and how it set the stage for Trade-off theory. Then we discuss the models based on agency costs and asymmetric information and what they predict with regards to leverage and firm performance.

2.1.1.1 Capital Structure and Trade-off theory

The theory of capital structure stems from the seminal paper by Modigliani and Miller in 1958. It is one of the most cited papers within the field of finance. This theory serves mostly as a theoretical framework for further research as the assumptions made in this paper are not realistic or practically observed. In what they term the Irrelevance Proposition, Modigliani and Miller argue that if one assumes a perfect and complete market, where personal and corporate taxes do not exist, capital structure is irrelevant to the value of the firm. The proposition states that the value of a firm is equal to the value of the firm's assets; which is equal to the value of the equity and debt financing. No matter the combination of debt and equity used to finance assets, the value derived from the assets are independent of the composition. This implies that there is no optimal level of debt to equity ratio and that there is no need for an optimal leverage policy. Modigliani and Miller (1958) explicitly assume that ceteris paribus, the performance of levered and unlevered firms is equal, and that firm value would not be affected by leverage. In other words, leverage should not have any impact on the performance of a firm, as there is no benefit or cost of debt.

In Modigliani and Millers paper in 1963, they added taxes into their theoretical model. Due to tax shields, the value of a firm would increase with the present value of the additional tax benefit. Thus, levered firms, ceteris paribus, would achieve higher firm value and imply better performance as "cheaper" debt financing yields higher net returns. However, this implies that a firm should opt for 100% debt financing, which of course is not observed practically. In Norway and most countries, debt covenants, regulatory factors and other legal restrictions will limit the amount of debt financing a firm can practically attain. Acknowledging this inconsistency, Modigliani and Miller (1963, p. 442) comment: *«It may be useful to remind readers once again that the existence of a tax advantage for debt financing . . . does not necessarily mean that corporations should at all times seek to use the maximum amount of debt in their capital structures . . . there are as we pointed out, limitations imposed by lenders . . . as well as many other dimensions (and kinds of costs) in real-world problems of financial strategy...».*

The consideration that there are other costs, was also commented on by Robichek and Myers (1966) and Stiglitz (1969) in their review of the Modigliani and Miller propositions. They added the consideration of bankruptcy costs and postulated that the existence of bankruptcy costs could partially or fully offset the effect of any tax advantage stemming from leverage (Robichek and Myers, 1966). Hence, step by step departure from the Modigliani and Miller assumptions of a perfect and complete market by the introduction of more frictions paved the way for further research on "trading off" the costs and benefits of leverage, particularly with emphasis on finding an optimal debt to equity ratio.

Trade-off theory was first formalized into a model by Kraus and Litzenberger (1973). They stated that optimal debt to equity ratio reflects a trade-off between tax advantages of debt and the deadweight costs of bankruptcy. It is emphasized that debt is not merely a bundle of contingent claims but is a legal obligation to pay a fixed amount. If the firm cannot meet its debt obligation, it is forced into bankruptcy and incurs the associated penalties in the form of direct and indirect costs. Direct costs could include legal and administrative costs, whereas indirect costs can result from losing trust form customers, suppliers and other stakeholders (Bradley et.al., 1984).

As seen below in the diagram from Myers (1984), leverage has a non-linear impact on the market value of a firm. The marginal benefit of the interest tax shield is positively associated with the market value as debt levels increase towards the optimal level of debt to equity ratio. The benefits of tax shields are greater in magnitude than the costs of financial distress. Increasing leverage beyond the optimal level of debt would incur disproportionately greater financial distress costs resulting in a decrease in the market value of a firm. The graph shows that the marginal benefit of tax shield is negative when leverage is increased beyond the optimum debt.

Figure 1: Market value as a function of debt. Source: Myers (1984)

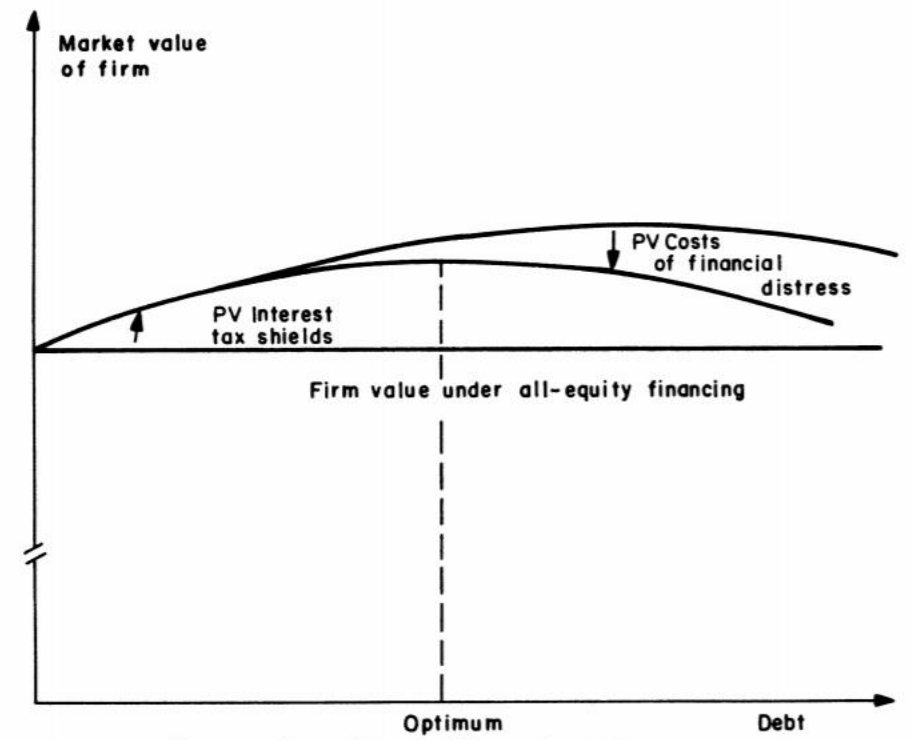


Figure 1. The static-tradeoff theory of capital structure.

2.1.1.2 Agency models

Building upon the notion of trading-off the costs and benefits of debt, Jensen and Meckling (1976) pioneered the Agency Model. Agency models postulate that capital structure and optimal debt to equity ratio are governed by agency costs, i.e. costs due to conflicts of interest. Jensen and Meckling (1976) identify two types of conflicts that encompass different arguments on how leverage can impact firm value and performance.

First type of conflict is between managers and shareholders. These conflicts result in agency cost of outside equity. Managers hold less than 100% of the residual claim of any gain from profit enhancing activities resulting in a misalignment between the incentives of managers and shareholders. Instead of pursuing investments that maximize firm value and shareholder value, managers can take on investments that maximize their own utility. This conflict is increased the smaller is the fraction of the firm's equity owned by the manager (Jensen and Meckling 1976). Managers can end up using firm resources for personal perquisites (Jensen, 1986). These could include spending on corporate jets, lavish offices and empire building through non-value adding mergers and acquisitions. In his free cash flow theory, Jensen (1986) calls this the overinvestment problem. The more free cash flow a firm has, the more it allows for managerial discretionary behavior and overinvestment. Jensen (1986) argues that increasing leverage will limit deviations from firm maximizing behavior. When a firm takes on more debt, it will commit to make debt payments which consequently limits the amount of free cash flow available to managers for wasteful spending. Another benefit of increasing leverage is the potential for debt to act as a disciplinary tool. Debt covenants could include monitoring by debtholders to make sure managers perform well. Grossman and Hart (1982) adds upon the argument of debt having disciplinary capabilities. If bankruptcy bears personal costs to managers through loss of reputation and control, the disciplinary effect is further enhanced and incentivizes less consumption of perquisites (Grossman and Hart, 1982). Pressure to generate cash-flow in order to meet interest expenses can lead managers to improve performance and make better investment decisions since this behavior reduces the probability of bankruptcy (Jensen, 1986). An important implication of the conflict between managers and shareholders is that in order to prevent overinvestment and reduce agency costs of outside equity, mature firms with little growth opportunity coupled with a steady cash flow stream should be highly leveraged compared to smaller firms with high growth potential (Stulz 1990; Jensen 1986). Thus, for low growth firms, performance should positively be correlated with leverage.

Second type of conflict is between debtholders and shareholders when there is risk of default due to increase in leverage. These conflicts result in agency cost of debt. Debtholders are assumed to be more risk averse and prefer safer investments in order to safeguard the face value of their debt (Smith and Warner, 1979). If riskier investment strategies are pursued, the gain is allocated to shareholders whereas the burden and costs of failed investment falls heavier on debtholders. Thus, increased risk of default can incentivize managers acting on behalf of shareholders to invest in riskier assets or shift to riskier operating strategies (Myers, 2001). This effect is generally called the “asset substitution effect” (Jensen and Meckling 1976). Another consequence due to conflict of interests between debtholders and shareholders can result in managers reducing equity-financed investments. If a firm suffers from financial distress, gains from positive net present value investments are used to service debt. Consequently, shareholders can be reluctant to provide additional capital. This can result in positive net present value projects to not be pursued as a result of increased leverage. Myers (1977) calls this the underinvestment problem, or debt overhang. As a result, increased leverage can increase agency costs of debt and lead to poorer firm performance (Myers, 1977). The magnitude and scale of these conflicts determine the influence of leverage on firm performance. Unlike low-growth firms that can benefit from increased leverage, high-growth firms are likely to suffer more from increased leverage. Thus, theory predicts for high-growth firms that leverage has a negative relationship with firm performance.

2.1.1.3 Asymmetric Information models

Asymmetric information describes an imbalance between the information that outsiders and insiders of a firm possess. Models based on asymmetric information do not focus on an optimal capital structure, but rather focus on the cost of adverse selection that stems from information asymmetry. The main focus of this strand of theory is that firms have a preference when it comes to their financing decisions as firm managers are assumed to have beneficial insider knowledge about firm characteristics. The two main type of models based on asymmetric information are Signalling[2], and Pecking-order theory[3].

The seminal paper by Ross (1977) on incentive signalling postulates that the choice of a firm's capital structure sends signals to outsiders about the information the insiders might possess. Debt can be used as a proxy to signal positive inside information whereas equity issue can be regarded as a negative signal. If a company takes on more debt, it could signal that the company is financially stable as it binds itself to make debt payments. Thus, debt levels are a sign of expected high performance. This implies that lower quality firms with higher marginal expected bankruptcy costs at any level of debt would not take on additional debt (Harris and Raviv, 1991). Therefore, any firm taking on additional debt knowing that they can incur higher bankruptcy cost would only do so if they were confident on their ability to cover their debt obligations. An important implication from this theory is that leverage increases with an increase in profitability (Harris and Raviv, 1990).

In their pioneering work, Myers and Majluf (1984) showed that due to information asymmetry, a firm's equity might be mispriced in the market. If investors are less informed than inside managers/owners, then the mispricing can be so severe that new shareholders will gain more than old shareholders. Therefore, positive net present value projects can be rejected by existing shareholders (or managers acting on their behalf), resulting in underinvestment and consequently poorer performance. Consequently, Myers and Majluf (1984) suggest that the problem of underinvestment can be mitigated if financing can be done from less mispriced financing sources, such as retained earnings or riskless debt. They posit that this holds true for (not too) risky debt. Considering the three types of financing, equity financing has more adverse

[2] Ross (1977) and Leland and Pyle (1977).
[3] Myers and Majluf (1984) and Myers (1984)

selection problems than debt financing while retained earnings avoids adverse selection. This leads to a sequential preference of financing, i.e. a Pecking-order. Contrary to Jensen (1986) and Stulz (1990), Myers and Majluf (1984) argue that leverage increases with a decrease in free cash flow. Thus, performance will dictate leverage. Low performance and less cash flow would mean less retained earnings available for funding for new projects. Since debt carries less information asymmetry, it will be preferred over equity. Firms that have less cash flows are expected to have more leverage. We would therefore expect a negative relationship between performance and leverage.

2.1.2 Empirical evidence

Even though there exists an extensive amount of research within this field, there is no unifying theory or model to explain the leverage choice of firms. Harris and Raviv (1991) detail a comprehensive review of empirical studies regarding Trade-off theory, Pecking-order theory, agency models and asymmetric information models. The empirical studies cover research that test the association of leverage with endogenous and exogenous variables. The results have been in support, against, or inconclusive regarding the explanatory powers of the two main branches of competing models of financing decisions.

Shyam-Sunder and Myers (1999) in their study test the Trade-off model predictions against the Pecking-order theory. Their sample of firms are from 1971 to 1989, consisting of 157 non-financial and non-utility firms, taken from the Compustat database. They find an overall stronger support for the Pecking-order theory than for the Trade-off model. Fama and French (2002) in their study also test the Trade-off model and the Pecking order predictions about dividends and debt. Their sample exists of non-financial and non-utility firms from 1965 to 1999 taken from the Compustat database. Their research shows that the Trade-off model and the Pecking order predictions conflict on the nature of relationship between leverage and performance. Trade-off theories state that more profitable firms will increase leverage while Pecking order theory predicts a decrease in leverage. Fama and French (2002) find a negative relationship between leverage and performance which is consistent with the Pecking order model and contradicting with the Trade-off model.

Berger and Bonaccorsi di Patti (2006) test the relationship between leverage and firm performance with regards to agency costs. They additionally account for the reverse causation of performance on leverage in order to control for simultaneous bias. Their result show that for the U.S banking industry from 1990 to 1995, higher leverage results in lower agency cost, subsequently leading to improved firm performance. Margaritis and Psillaki (2010) test similar hypothesis as Berger and Bonaccorsi di Patti (2006) regarding the relationship between leverage and firm performance. They use a sample of French manufacturing firms during the period of 2002-2005. They also control for the reverse causation of firm performance on leverage and find a positive relationship between leverage and firm performance in support of agency cost theory.

McConnel and Servaes (1995) test the relationship between leverage and performance. They use a large sample of firms from the Compustat database, from 1976 to 1988. Tobin's Q is used as a measure of firm value. They find a positive relationship between leverage and firm value for low-growth firms and a negative relation between leverage and firm value for high-growth firms. These results are consistent with the hypothesis that debt can have either a positive or negative effect on the value of the firm. Their overall interpretation of their result is that leverage impacts firms differently based on the number of available positive net present value investments. As mentioned in section 2.1.1.2, different agency costs will impact low growth and high growth firms differently. Thus, their results show support for Agency theory. However, they do not reject that the result could be interpreted to support elements of Pecking-order theory. Their result for high-growth firms are consistent with Pecking-Order theory, but contradictory for low-growth firms where they find a positive relation between performance.

Lang et al. (1996) study the relationship between leverage, investment and growth opportunities. Their sample includes all firms from the Compustat database over the period 1970 to 1989. They find a negative relation between leverage and future growth at firm level. Their study highlights the fact that leverage does not seem to reduce growth opportunities for firms known to have good investment opportunities but is negatively related to firms whose growth opportunities are limited. They point to the fact that such companies either have growth opportunities not recognized by the capital markets or are not sufficiently valuable to overcome the effects of their debt overhang. Consistent with Agency theory, these results suggest that leverage prevents low-growth firms with poor investment opportunities from overinvesting. However, they do not find support for high-growth firms being negatively impacted by leverage as theory would suggest debt overhang and other costs of debt to be greater than the benefits of leverage.

Baker and Wurgler (2002) are one of the studies which focus more on the reverse effect from market valuation to capital structure. Using a sample of non-financial firms between year 1968 and 1999 in the Compustat database, they argue that current leverage is a cumulative result of past market timing attempts. That is because firms issue equity when market value is high and repurchase shares when market value is low (relative to book and past market values). Thus, the capital structure is dependent on historical market values. They add that firms with lower debt are those that have raised funds when the market values were high, while firms with higher debt-ratios raised funds when market values were lower.

2.2 Hypotheses development

Based on the literature review and empirical evidence, we want to test three hypotheses. As evident from the above sections, there is great ambiguity regarding what drives leverage choices and its consequent impact on performance and firm value. We try to include a broad set of elements and predictions from theory and empirical studies on what assumptions can be made regarding the nature of relationship between leverage and firm performance. As our main emphasis is on the impact of leverage on firm performance, most of the hypothesis development is based upon Trade-off theory and Agency theory.

First, we test for a relationship between leverage and firm performance based on the fundamental premise of Trade-off theory. As discussed above, literature review and empirical studies provide ample reasons for why we should expect a relationship. Essentially, all theories trade-off costs and benefits of changing their capital structure. We would expect leverage to have a positive effect on performance through tax advantages of borrowed money. However, as leverage increases, there should be a reduction in the benefits where the cost of financial distress are greater than the benefits of debt resulting in a negative relationship between debt and performance. We therefore assume a non-linearity in the relationship between leverage and firm performance. As seen in figure 1, the marginal effects show a concave association with the market value of a firm. This leads us to the first hypothesis:

H1: Overall, leverage has a non-linear effect on performance. At smaller level of debt-to-asset ratio, firm performance improves with more leverage. Contrary, at high debt-to-asset ratio, there is a negative effect of more leverage.

Secondly, we test for different relationship of leverage and firm performance for high-growth and low-growth firms. Myers (1977), Jensen (1986), and Stulz (1990) each focus on a connection between the firm's investment opportunities and the effect of debt on the value of the firm. Debt influences performance through corporate investment decisions based on the degree of available positive net present value investments (McConnel and Servaes, 1995; Lang et al., 1996). Agency theory states that both the positive and negative effects of debt can be present for all firms (McConnel and Servaes, 1995). High-growth firms are regarded as firms with many available positive net present value investments. Agency theory states that increasing leverage in high-growth companies can result in underinvestment and other agency cost of debt to have a stronger impact than potential benefits of debt. Low-growth firms are regarded as firms with few available positive net present value investments. Agency theory states that increasing leverage in low-growth firms would result in advantages from reduced overinvestment problems and the reduction of other agency costs of outside equity to have a greater impact than potential costs of debt. Berger and Bonaccorsi di Patti (2006) highlight the difficulty to distinguish empirically between the agency costs of outside equity and agency cost of debt. As argued by literature and empirical research, we also allow the relationship between total agency effects of increased leverage to be non-linear. This leads us to our second hypothesis:

H2: Overall, leverage has a non-linear effect on performance for both high growth and low growth firms. However, the negative effects are comparatively stronger for high growth firms than for low growth firms

Lastly, we test if the impact of leverage on firm performance is different across industries. Bradley et al. (1984) find strong industry influences across firm leverage ratios. The degree of asset tangibility relative to intangibility tends to vary across sectors, as does the extent of available positive net present value (NPV) investments. In some industries, firms may rely more on human capital and have less fixed capital. For such firms, the negative effects of leverage can be expected to be greater than benefits of debt due to inferior ability of securing debt at advantageous rates or debt overhang problems (Jensen and Meckling, 1976). In other more matured industries, higher asset tangibility and lower extent of growth opportunities could make the positive effects of leverage to be greater than the cost of debt due to easier access to debt and reduced agency cost of outside equity.

As representative industries with regards to growth potential and tangible assets, we specifically test for differences between technology and communications industry and offshore industry. We find it natural to assume firms in technology and communications have more valuable growth opportunities and less fixed capital relative to firms in offshore; which we assume to have higher asset tangibility combined with limited growth opportunities. This leads us to our third hypotheses:

H3: In industries with higher asset tangibility and less available positive NPV investments, positive effects of leverage will dominate. In contrast, the negative effects from leverage will dominate in industries with lower asset tangibility and stronger growth opportunities.

3 Methodology

In this chapter, we first introduce the main variables. Then, we argue for fixed effects as the most appropriate estimation method. Finally, alternative specifications are derived to reduce potential endogeneity bias.

3.1 Variables

Several variables are used in this paper. In this section, we discuss the selected definitions and discuss how they are expected to correlate with performance and leverage by revisiting empirical studies. Control variables are introduced in order to mitigate omitted variables bias as certain variables are expected to jointly affect firm performance and leverage (see Margaritis and Psillaki, 2010; Berger and di Patti, 2006). We mainly focus on firm-specific variables and assign dummy variables to factors that may have categorical effects on the results.

3.1.1 Performance

Firm performance is measured in many ways and it is often subjective to the firm. A start-up may evaluate its performance through sales growth, while an incumbent may focus on gross margins. Despite differences in firm characteristics, certain measures allow for a standardized assessment of performance. Many studies have focused on accounting and market-based measures[4]. Market-based measures, typically stock returns, price-to-book etc., are forward-looking as they reflect changes in anticipated future profitability. In contrast, accounting-based measures, such as return on assets and EBIT-margin, demonstrate past performance. Some studies also focus on managerial efficiency[5], allowing one to control for factors that are exogenous to the firm's management such as input and output prices as well as fluctuations in currency and demand.

In this study we are primarily interested in how overall firm performance is affected by leverage. That includes changes in future growth expectations caused by changes in debt. Tobin's Q[6] should include market expectations about debt benefits such as the tax shield or downsides as distress costs and underinvestment. High Q indicates higher growth potential

[4] Studies focusing on accounting measures include Demsetz and Lehn (1985) and Ang et al. (2000), while Shyam-Sunder (1991) and Cole and Mehran (1998) focus on market-based measures

[5] See Berger and di Patti (2006) and Margaritis and Psillaki (2010)

[6] Tobin's Q is also a frequently used measure for growth opportunities (see: Lang et al., 1996). However, we introduce other variables to control for growth opportunities.

(Tobin and Brainard, 1976) and a management performing well with the assets under control. Despite being a noisy indicator, it includes the predictable effects from explanatory variables on firm value and is frequently used to test agency costs hypotheses[7]. Tobin's Q is calculated as market value of assets divided by its replacement cost. However, due to data limitations on debt market values, we use the modified definition by Chung and Pruitt (1994) which closely approximates the original version:

$$Tobin's\ Q_t = \frac{Market\ Value\ [E]_t + Book\ Value[Liabilities]_t}{Book\ Value\ [Assets]_t} \tag{1}$$

As alternative definitions of performance, sales-to-assets ratio and ratio of operating expenses to sales are reported. The first measures how efficiently the management deploys the assets, while the latter reflects how well the management controls operating costs (Ang el al., 2000). These are expected to highlight the effect of leverage as disciplinary mechanism. As in Berger and di Patti (2006) results with return on equity (ROE) as dependent variable are also reported.

3.1.2 Leverage

Based on the literature overview, leverage is expected to have non-linear effect on performance. First, the effect of leverage on performance should be positive as suggested by the agency cost hypothesis, the debt tax shield argument (Miller and Modigliani, 1963), the signalling argument (Ross, 1977) and the cash flow argument (Jensen, 1986). At some point, leverage is expected to affect the performance negatively, which is in accordance with financial distress costs and debt overhang hypotheses (Myers, 1977). Therefore, a quadratic specification of leverage is included to capture potential non-linearity in the relationship between leverage and performance.

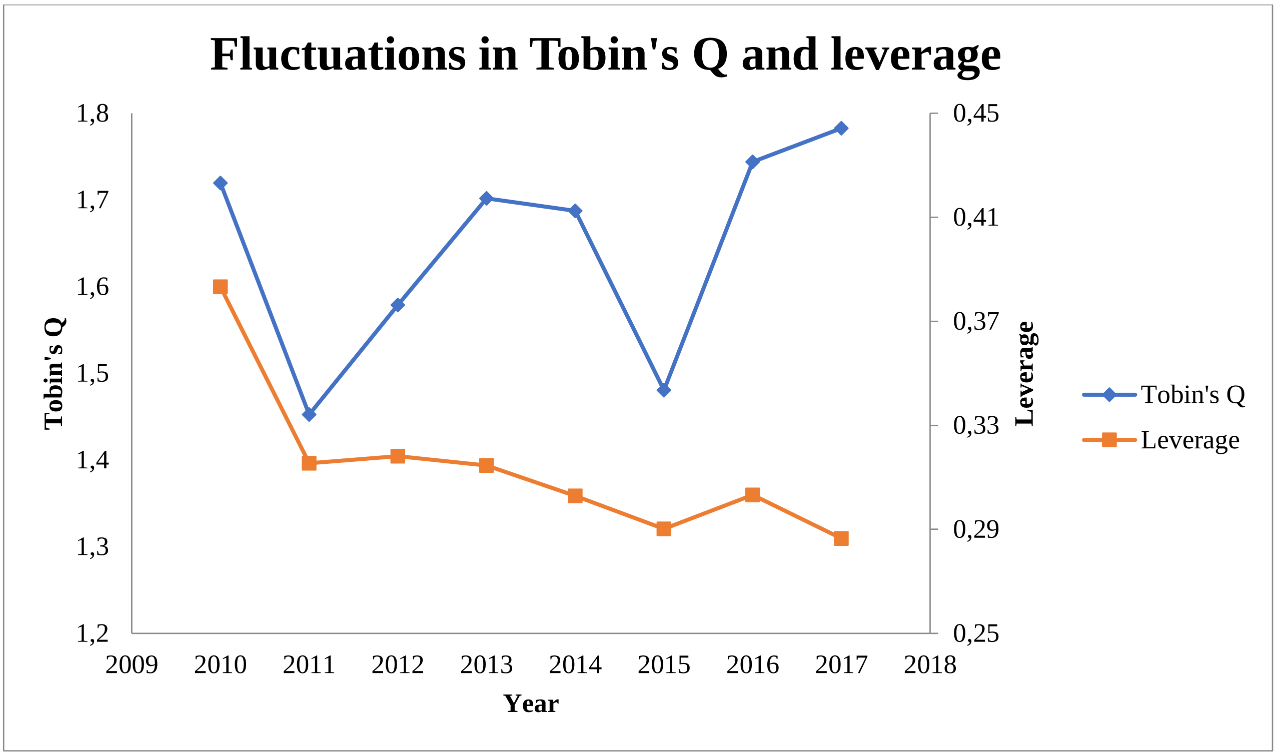
Leverage is calculated as the ratio of total debt to total assets (Lang et al., 1996; Margaritis and Psillaki, 2010), where total debt represents all interest bearing short-term and long-term debt and capitalized lease obligations. Only book values are used and not market values. By using market values, changes in equity would be given too much importance since it correlates with Tobin's Q. An increase in the market value of equity would, all else equal, reduce debt-to-asset ratio and increase Q (Lang et al., 1996). Furthermore, Myers (1977) states that managers focus

[7] E.g., Morck et al. (1988), McConnell and Servaes (1995), Mehran (1995) and Himmelberg et al. (1999).

on book leverage since it is supported by assets in place rather than growth opportunities. Data limitations on debt market values also force us to use book values. Any misspecification by using book values is expected to be minor due to large correlation between book value and market value of debt (Bowman, 1980). Thus, we use the formula below:

$$Leverage_t = \frac{Book\ Value\ [Debt]_t}{Book\ Value\ [Assets]_t} \tag{2}$$

Figure 2: Development in mean values of Tobin's Q and leverage over the sample period.



For listed companies in Norway, we observe an overall increase in Tobin's Q, while leverage seems to have decreased over the same time period. The fluctuations in Tobin's Q seem to be stronger, while the average leverage ratio appears more persistent over time. Furthermore, we see a sharp decrease from year 2010 to 2011, and a substantial increase from 2015 to 2016 for both variables.

3.1.3 Control variables

Since many factors may jointly affect performance and leverage and thus cause a spurious relationship, we include control variables. Here, we establish the definitions, and discuss how they are expected to correlate with performance and leverage.

3.1.3.1 Firm size

Firm size has frequently been linked to both debt and firm performance. It is plausible to hypothesize that larger firms are more likely to exploit economies of scale and attract better management. On the other hand, bigger size may be associated with weaker performance due to increase in inefficient hierarchical structures within the organization (Williamson, 1967). Thus, we allow for a quadratic term as in Margaritis and Psillaki (2010) and Himmelberg et al. (1999).

Larger firms also tend to be more diversified and less risky, allowing them to withstand a higher debt-to-asset ratio compared to smaller firms (Frank and Goyal, 2009). Therefore, bigger firm size is associated with higher leverage.

Logarithm of assets and logarithm of sales are two frequently used measures for size in the literature[8]. We expect that the logarithm of assets directly affects Tobin's Q due to the high correlation with Q's denominator, book value of assets. Therefore, we measure size as the natural logarithm of total sales:

$$Size_t = ln(Sales)_t \tag{3}$$

3.1.3.2 Tangibility

Tangible assets are easy to monitor and can reduce agency costs (Himmelberg et al., 1999), consequently improving firm performance. A firm with high level of tangible assets may also be less subject to information asymmetries. Therefore, the underinvestment problem is expected to occur less often (Harris and Raviv, 1991). Magaritis and Psillaki (2010) found that tangibility had negative effect on performance at lower tangibles to assets ratio and a positive effect at higher ratios. They argue that a high proportion of tangible assets reduces the extent of the growth opportunities and hence the agency costs of managerial discretion.

[8] Ln (assets) is used in Yermack, 1996; Berger and Di Patti, 2006. Ln (sales) is also used in Himmelberg et al. (1999), Margaritis and Psillaki (2010), Titman and Wessels (1988)

Firms with high level of tangible assets could use them as collateral when issuing debt (Titman and Wessels, 1988). This may lead to lower debt costs and a willingness to increase leverage. Baker and Wurgler (2002), Frank and Goyal (2009) and Rajan and Zingales (1995) find a positive relationship between tangibility and leverage.

We calculate tangibility as fixed assets divided by total assets. As in Margaritis and Psillaki (2010) and Himmelberg et al. (1999), we also allow for non-linearities by including a square term of tangibility.

$$Tangibility_t = \frac{Tangible\ Assets_t}{Total\ Assets_t} \tag{4}$$

3.1.3.3 Growth opportunities

In accordance with Margaritis and Psillaki (2010), two proxies are used to measure growth opportunities; *sales growth* and *intangibility* of assets. Valuable growth opportunities, all else equal, are expected to increase the market value of the firm and thus Tobin's Q. Generally, the relationship between intangibles and performance is ambiguous, but according to Himmelberg et al. (1999), a firm with higher portion of intangible asset will have larger Tobin's Q because the market will value these intangibles in the numerator, while the denominator will understate the value of the intangible assets.

Regarding the effect on leverage, growth opportunities are related to an increase in agency costs of debt. Therefore, a negative effect on leverage is expected[9]. Jung et al. (1996) also found that firms with growth opportunities were more likely to issue equity when raising external finance. Furthermore, high growth firms could face serious debt overhang problems as they are engaged in high risk and return investments that are associated with high agency costs of debt.

In contrast to the arguments above, equity owners in smaller firms with valuable growth opportunities might be reluctant to issue equity in fear of losing control, thus making leverage more attractive (Giannetti, 2003). Furthermore, Titman and Wessels (1988) state that since growth opportunities add value to the firm, they may also increase a firm's debt capacity.

[9] See Myers (1977), Titman and Wessels (1988) and Lang et al. (1996).

We calculate sales growth as the percentage increase in sales from last year (Lang et al.,1996), and intangibility is calculated as the ratio of intangible assets to book value of equity as in Margaritis and Psillaki (2010).

$$Sales\ growth_t = \frac{Sales_t - Sales_{t-1}}{Sales_{t-1}} \quad (5)$$

$$Intangiblity_t = \frac{Intangible\ Assets_t}{Equity_t} \quad (6)$$

We also include year and industry indicators (see Lang et al., 1996; Yermack, 1996) to control for business cycle- and industry effects[10]. For example, if performance has positive correlation with business cycle and the firm is less levered at the same time, we may obtain a negative relationship between firm performance and leverage although the change in performance is not caused by changes in leverage. However, industry dummy variables are not allowed in the fixed-effects estimator since it eliminates all time-invariant variables (see section 3.2.2).

[10] See appendix 4 for an OLS-estimation with industry- and year dummy variables.

Table 1: Summary of variables and their impact on performance and leverage. All variables except Tobin's Q are included in Margaritis and Psillaki (2010). The studies in this table either empirically prove or theoretically argue for a relationship between the variables. "Ambiguous" indicates non-linear relationships or contradictory findings in previous research papers.

<table>
<tr><th>Variable</th><th>Definition</th><th>Effect on leverage</th><th>Effect on Tobin's Q and/or performance</th></tr>
<tr><td>Tobin's Q
(TQ)</td><td>(market value [equity] + book value [liabilities]) / book value [assets]</td><td colspan="2" rowspan="2"><u>Ambiguous</u>

McConnell & Servaes, 1995;
Danis et al., 2014; Margaritis & Psillaki, 2010; Berger & di Patti, 2006; Morck et al., 1988;
Fama & French, 2002; Frank & Goyal, 2009; Baker & Wurgler, 2002</td></tr>
<tr><td>Leverage
(LEV)</td><td>book value [debt] / book value [assets]</td></tr>
<tr><td>Size
(SIZE)</td><td>natural logarithm of sales</td><td><u>Positive</u>

Frank & Goyal, 2009; Titman & Wessels, 1988; Hovakimain et al., 2004</td><td><u>Ambiguous</u>

Himmelberg et al., 1999; Williamson, 1967; Berger & di Patti, 2006; Yermack, 1996;</td></tr>
<tr><td>Tangibility
(TANG)</td><td>tangible assets / total assets</td><td><u>Positive</u>

Frank & Goyal (2009); Faulkender & Petersen, 2005; Chatterjee & Scott, 1989</td><td><u>Ambiguous</u>

Himmelberg et al., 1999; Margaritis & Psillaki, 2010</td></tr>
<tr><td>Growth Opportunities:
(SGROWTH)
(INTANG)</td><td>$(sales_t/sales_{t-1})$ -1

intangible assets / book value [equity]</td><td><u>Negative</u>

Myers, 1977; Lang et al., 1996; Stulz, 1990; Jung et al., 1996; Kim & Sorensen, 1986</td><td><u>Positive</u>

Myers, 1977; Himmelberg et al., 1999</td></tr>
</table>

Based on the discussion above we seek to estimate the following model:

$$TQ_{it} = \beta_0 + \beta_1 LEV_{it} + \beta_2 LEV_{it}^2 + \beta_3 SIZE_{it} + \beta_4 SIZE_{it}^2 + \beta_5 TANG_{it} + \beta_6 TANG_{it}^2 + \beta_7 SGROWTH_{it} + \beta_8 INTANG_{it} + v_{it},$$

$$t = 2010, 2011, \ldots, 2017 \quad (7)$$

>β_0 is the intercept and β_1, $\beta_2 \ldots \beta_8$ are the coefficients associated with the independent variables.
>v_{it} is the error term.

From now, we label model with contemporaneous variables as the *static model*. The *dynamic model*, which is expected to account for endogeneity issues, is presented in section 3.3.

3.2 Selecting estimation method

Firms' unobservable time-constant characteristics such as brand, reputation and managerial skills are likely to influence the relationship between performance and leverage. A firm known for its skilled management may, in addition to improved performance, obtain better access to credit. To control for unobserved characteristics, we argue for fixed effects (FE) as the most appropriate estimation method. FE is used in many capital structure related studies (e.g. Berger and di Patti, 2006; Himmelberg et al., 1999).

In cases where fixed effects are used, it is often informative to use the pooled OLS model. By comparing the different methods, we could obtain better insights into the nature and scale of the biases that occur by not considering the unobserved effect in the error term (Wooldridge, 2013). Furthermore, OLS does not ignore the variation between firms which could be useful when determining the effect of leverage on firm performance. We therefore report the results from pooled OLS in addition to FE. Below we briefly introduce the two estimators by following Wooldridge (2013).

3.2.1 Pooled Ordinary Least Squares (OLS)

OLS regressions aim to minimize the residual sum of squares, i.e. the distance between the residuals and fitted values. Pooled OLS may help us to achieve unbiased and consistent estimates even though unobservable firm-specific attributes (a_i) are present in the dataset. If the unobservable effect correlates with the explanatory variables, then pooled OLS is biased and inconsistent. Furthermore, panel data often suffer from heteroscedasticity and autocorrelation because entities are observed over several time periods while a_i remains constant. Pooled OLS ignores that the error term is composed of two elements: the unobservable effect and the idiosyncratic error term ($v_{it} = a_i + u_{it}$). Thus, the error term is expected to be serially correlated which makes the standard errors and test statistics invalid. Therefore, advanced panel data methods such as fixed effects (FE) might be more appropriate.

3.2.2 Fixed-effects estimator

The fixed-effects estimator uses a transformation process to get rid of time-constant unobserved effects (a_i) prior to the estimation. The data is transformed into deviations from individual means so that the standard equation:

$$y_{it} = a_i + \beta_1 x_{it1} + \beta_2 x_{it2} + u_{it}, \tag{8}$$

$$t = 1, 2, \ldots, T$$

… now becomes:

$$\ddot{y}_{it} = \beta_1 \ddot{x}_{it1} + \beta_2 \ddot{x}_{it2} + \ddot{u}_{it}, \tag{9}$$

$$t = 1, 2, \ldots, T$$

In equation (9), $\ddot{y}_{it}$, $\ddot{x}_{it}$ and $\ddot{u}_{it}$ are the time-demeaned data on y_i, x_i and u_i respectively. Most importantly, the unobservable effect and the intercept are eliminated. The FE-method omits explanatory variables that are constant over time for all firms, *i*. Consequently, it is not possible to include variables such as industry category as it remains constant over time. A second disadvantage is that the FE estimator will not be fully efficient under certain circumstances as it ignores variation across the entities. An advantage is that we can allow a_i to be correlated with the independent variables. If it was present and correlated with the explanatory variables at the same time, then the estimators would be biased. Thus, the FE framework represents a way to control for omitted variables bias (Hausman and Taylor, 1981).

The dataset is an unbalanced panel since a substantial part of the firms miss data for certain years in the sample period. The FE-method can both handle balanced and unbalanced panels, but we may get biased estimators if the reason a company leaves the sample is correlated with the idiosyncratic error term u_{it}. Nevertheless, it is not problematic if the exit correlates with a_i.

When analysing panel data, one may also consider using random effects (RE) in addition to FE. For RE, the critical assumption of no correlation between the explanatory variables and the unobservable effect is not expected to hold. RE is therefore considered inappropriate. Also results from formal tests (see section 3.2.3) favour fixed effects over random effects.

3.2.3 Testing assumptions

Assumptions for running FE and OLS, as presented by Wooldridge (2013), are investigated.[11] Our findings suggest that assumptions of homoskedasticity, no serial correlation and zero conditional mean are violated. While graphic visualizations and formal tests as modified Wald-statistics for groupwise heteroskedasticity and Wooldridge-test (2002) indicates violation of the first two, the strict exogeneity assumption is *assumed* not to hold. We expect leverage and performance to correlate with unmodeled factors such as competitive landscape and takeover threats.

Wooldridge (2013) claims that there are solutions, known as *clustering*, for inference that is fully robust to violations of homoskedasticity and serial correlation in panel data. Computing cluster robust statistics after FE-estimation is also justified in cases where the number of observations *N* is substantially larger than the sample time period. Thus, all reported estimations are run with clustered standard errors.

To further assess appropriateness of the fixed effects method, several tests are performed to check the validity of fundamental assumptions. The F-test confirms the existence of firm heterogeneity, indicating the inappropriateness of pooled OLS. We also find evidence on existence of random effects by performing the Breusch-Pagan Lagrange Multiplier (1980) test, indicating that errors are not independent within firms ($\sigma_a^2 \neq 0$).[12]

Furthermore, the Hausman's test (1978) is used to compare fixed-effects and random-effects (RE). The results show that the coefficients are systematically different for FE and RE, possibly because $\hat{\beta}^{RE}$ is biased due to a correlation between the independent variables and the unobserved effect. As an alternative to Hausman's test, we perform a test for overidentifying restrictions and calculate Sargan-Hansen statistic (see Arellano, 1993 and Wooldridge, 2002, p. 291) to account for serial correlation and heteroskedasticity. Here, the results again favour fixed effects.

3.3 Handling endogeneity

Endogeneity is a major concern. Although several approaches are commonly used to limit endogeneity bias, we specify a model which accounts for dynamics as in Margaritis and Psillaki

[11] See appendix 1 for homoskedasticity and serial correlation tests.
[12] Results from F-test, Breusch-Pagan Lagrange Multiplier-test, Hausman's test and test for overidentifying restrictions are all presented in appendix 2.

(2010). They argue that the effect of leverage on performance and the reverse effect of performance on leverage[13] are not expected to be instantaneous by referring to the Pecking-order theory suggesting that it is past (and not present) profitability which is likely to affect leverage. By accounting for dynamics in this relationship, the simultaneity bias issues could be circumvented. Thus, the fixed effects equation (9) is transformed into a dynamic model:

$$\ddot{Q}_{it} = \beta_1 L\ddot{E}V_{it-1} + \beta_2 L\ddot{E}V^2{}_{it-1} + \beta_4 SI\ddot{Z}E_{it-1} + \beta_5 SI\ddot{Z}E^2{}_{it-1} + \beta_6 T\ddot{A}NG_{it-1} + \beta_7 T\ddot{A}NG^2{}_{it-1} + \beta_8 INT\ddot{A}NG_{it-1} + \beta_9 SGR\ddot{O}WTH_{it-1} + u_{it},$$

$$\mathrm{t} = 2010, 2011, \ldots, 2017 \qquad (10)$$

>Time period dummies will be tested and reported, while industry dummies are not tested in the FE-estimation as it eliminates all time-invariant firm-specific variables.

>All results are based on the dynamic model unless otherwise stated.

Wooldridge (2013) also claims that including a lagged dependent variable could help us to mitigate omitted variable problems because it accounts for the historical factors that may have caused current differences in the dependent variable. Furthermore, current levels of Tobin's Q are likely to be heavily dependent on its past values. However, Nickell (1981) warn of the possibilities of bias in dynamic panel data models. The magnitude of the bias could be substantial when the dataset covers many observations across relatively few years. We also check whether the inclusion of one-year lag of Tobin's Q affects our results (appendix 3).

Other ways to address the endogeneity issues include constructing a Two Stage Least Squares (2SLS) model and use an instrumental variable that creates exogenous variation in leverage. Finding an exogenous predictor for leverage is challenging. *Tangibility* is tested but its exogeneity remains questionable. According to Wooldridge (2013), 2SLS is a leading method for estimating simultaneous equations models (SEM) and the approach is tested in Berger and di Patti (2006) and Lang et al. (1996). Since 2SLS did not yield any important findings, we do not proceed with SEM (appendix 7).

[13] Besides pecking order theory, the reverse effect is justified by two competing hypotheses: efficiency-risk and franchise-value (see Berger and di Patti, 2006; Margaritis Psillaki, 2010)

4 Data

In this chapter we present the dataset and introduce steps to organize the data in order to obtain more reliable results. The summary statistics are also presented, and we show how firms are divided into subgroups with respect to the second and third hypotheses (H2 and H3).

4.1 Sample selection and data cleaning

The dataset has a cross-sectional and time series dimension. It covers the post financial crisis period from 2010 until 2017 and contains 1439 observations in total. Below we demonstrate how the number of observations gradually decreases due to certain requirements. The data is extracted from *Thomson Reuters Datastream,* and it contains yearly observations of financial statement data for companies listed on Oslo Stock Exchange during the whole or part of the period. In total, 231 companies have been observed whereas 83 (36 %) are inactive today.

Financial companies are omitted as their balance sheet characteristics make them incomparable to firms in other sectors.[14] The normally high leverage for these firms usually does not have the same meaning as for non-financial firms (Fama and French, 1992). Furthermore, financial firms' capital structure is often regulated by the government[15]. Omitting financial companies has been a common practice in various capital structure related studies.[16]

To avoid misleading conclusions, we handle outliers that do not appear as representative for the total sample. Outliers are treated carefully as they may impact the results. Some values may arise from errors, typing mistakes or missing accounting values. In addition to robust regression options, extreme values are identified and handled through winsorization and financial rules. Following financial rules, we require EBITDA-margin, tangible- and leverage ratios ≤ 1 for all observations[17]. Remaining continuous variables are winsorized at 1 % level in both tails of the distribution (Danis et al., 2014), which implies that the values considered extreme are replaced by the next value when counting inwards from extreme values.

In accordance with Yermack (1996) we establish a four-year rule[18] which requires minimum four observations per firm in order to balance two sampling issues: First, collect enough observations for each company so that panel data techniques can be used. Second, limit

[14] Although most financial firms were excluded from the initial data, we delete additional 27 observations for companies that falls into this category.
[15] There are special capital requirements for banks in Norway (Norwegian Ministry of Finance, 2018)
[16] see Yermack, 1996; McConnell and Servaes, 1990; Fama and French, 2002; Shyam-Sunder and Myers, 1999
[17] Following financial rules, 7 observations are deleted
[18] The four-year requirement eliminates 108 observations.

survivorship bias by allowing companies to enter and exit during those eight years. As robustness check we also run the estimation on a sample including firms with two and three observations. This is to further reduce potential survivorship bias in case the firms' exits correlate with leverage.

4.2 Summary statistics

After organizing the dataset and handling extreme outliers, our sample contains 181 firms and 1297 observations in total. Summary statistics for some key variables are presented below:

Table 2: Summary statistics

	Obs.	overall st.dev	WG st.dev	mean	median	max	min
Tobin's Q	1170	1.82	1.15	1.64	1.10	15.08	0.48
Return on equity	1282	0.76	0.67	-0.05	0.04	4.30	-3.65
Leverage	1279	0.25	0.12	0.31	0.28	0.88	0.00
Tangibility	1281	0.32	0.08	0.35	0.24	0.95	0.00
Intangibility	1280	0.66	0.40	0.44	0.19	3.97	-0.36
Sales growth	1113	2.08	1.81	0.41	0.06	16.49	-0.96

> Note that Intangibility is defined as the ratio of intangible assets to total equity (book values). Negative values of intangibility have occurred because of negative equity values.
> "WG st.dev" represents within-firm standard deviation.

We note that sales growth has less observations compared to remaining variables. Since its definition relies on sales in the previous year (t-1), a missing value occurs in the first year a company is observed. Other variables also have less than 1297 observations, but this is due to missing balance sheet data.

Although, the mean value of return on equity suggests negative firm performance over the sample period, the median value is still positive. We also note the differences in the variations of certain variables. As expected, sales growth and Tobin's Q are the most volatile variables, while leverage and tangibility ratios vary much less. Additionally, the within-firm variation of leverage is low which indicates that firms hold their leverage ratios relatively constant over time. This could make it more difficult to obtain a significant relationship between leverage and firm performance, especially using the fixed-effects estimator which focuses on the within-group variations. We address this issue in chapter 6.

Table 3: Matrix of correlations

Variables	Tobin's Q	Leverage	Tangibility	Intangibility	Sales growth	Size
Tobin's Q	1.00					
Leverage	-0.31	1.00				
Tangibility	-0.34	0.69	1.00			
Intangibility	-0.02	-0.15	-0,39	1.00		
Sales growth	0.16	-0.05	-0.09	0.03	1.00	
Size	-0.38	0.13	0.26	0.11	-0.14	1.00

The correlation between leverage and remaining independent variables, are in accordance with the anticipated correlations presented in table 1. For Tobin's Q, negative correlations with tangibility and size are observed. Furthermore, according to the predictions in table 1, Q should be positively correlated with the growth opportunity measures. This is true for *sales growth*, while it shows a weak negative correlation with *intangibility*. Finally, the negative correlation between Q and leverage is a possible indication of negative effects from debt on firms with growth opportunities. Alternatively, it might support the Pecking-order theory given that performance affects leverage.

4.3 Formation of subgroups

The data is divided into subgroups to provide a comprehensive response to the hypotheses derived in section 2.2. First, each firm is classified as either high-growth or low-growth firm. This is to assess H2 and investigate whether the two groups are differently affected by leverage. As in McConnell and Servaes (1995), the price-to-operating-earnings ratio (P/E) is used to distinguish between the two types. Since interest payments are deducted after operating earnings, our P/E-ratio is unaffected by changes in leverage. We separate the firms by first discarding observations with negative P/E-ratios to avoid that the low-growth sample mostly covers firms with negative earnings. Then, the mean P/E is calculated for all companies across the sample period. One-third of the firms with highest mean P/E-ratio are classified as high-growth (HG) and one-third with lowest ratio are classified as low-growth (LG). Firms that are not placed in any of the two samples are labelled as medium-growth firms (MG).

Table 4: Number of firms in high-growth, medium-growth and low-growth categories.

Type of firm	Firms	%	Mean P/E	Leverage	Tobin's Q
High-growth	51	28 %	32.7	0.27	1.73
Medium-growth	50	28 %	13.1	0.28	1.45
Low-growth	53	29 %	6.3	0.43	1.09
Not available	27	15 %	-	-	-
Total	**181**	**100 %**	-	-	-

As expected, the mean price-to-operating earnings ratio increases with the growth samples. The table confirms that firms in the high-growth sample have the highest P/E-ratio on average while low-growth firms have lower P/E-ratios. We also note that the correlation between P/E-ratios and leverage across the subsamples are consistent with the notion that firms with many positive net present value projects choose less debt. The high-growth sample has the lowest leverage while the low-growth sample has the highest leverage. Furthermore, P/E-ratio seem to correlate positively with Tobin's Q, which is another frequently used measure for growth opportunities. The sample labelled as *Not available* represents both firms with negative P/E-ratios and firms that lack data for equity market values. If we ignore these firms, we note that the remaining subsamples, i.e. high, - medium- and low-growth, are nearly equal in size.

To assess H3, the companies are also divided into industry subgroups. The industry categories originate from Thomson Reuters, but the industries are merged and renamed to avoid small sample issues. We divide our sample into three categories. *Offshore* mainly covers firms in the petroleum and shipping industries. *Technology & Communications* includes companies within information technology, hardware, media and telecom. Remaining companies from industries such as seafood, construction, retail and materials are placed in the *Others* category.

Table 5: Number of firms across different sectors.

Industry	Firms	%
Offshore	76	42 %
Technology & Communications	33	18 %
Others	72	40 %
Total	**181**	**100 %**

>*Some firms may fit into both categories. For example, a firm in the technology sector may exclusively develop hardware for the offshore sector.*

5 Results

In this chapter, we present the results from the models and estimation methods argued for earlier in the paper. We start by focusing on the first hypothesis (H1) by presenting and discussing the results from the fixed-effects and pooled OLS estimator. We also compare the two estimations and try models with alternative definitions and specifications to check the robustness of our results. Finally, we test if high-growth firms are differently affected by leverage than low-growth firms (H2), and whether the effects differ across industries (H3).

5.1 Fixed-effects- and pooled OLS estimation

We first run the dynamic and static model (see chapter 3) with both the fixed effects and pooled OLS estimator. This is to test the first hypothesis (H1) that leverage affects performance positively at smaller levels of debt-to-assets ratio because of advantages from tax-shield and reductions in agency costs, while the effects become negative when the company is highly levered due to the increase in financial distress costs and debt overhang problems. To confirm the validity of H1, we would expect the results to provide positive coefficients for the linear term of leverage and a negative coefficient for the square term. The results are presented below:

Table 6: Regression results with Tobin's Q s dependent variable. Industry and year dummies are included where indicated but not reported. The definitions of all variables are summarized in table 1. The dynamic model with fixed-effects estimator refers to eq. (10) where independent variables are run with one-year lag.

	Fixed Effects		Pooled OLS	
	Dynamic Model	Static Model	Dynamic Model	Static Model
Leverage	-1.81*	-0.86	-5.26***	-5.04***
	(0.98)	(1.51)	(1.19)	(1.27)
Square of leverage	2.41**	1.61	5.60***	4.86***
	(0.99)	(1.07)	(1.26)	(1.06)
Size	-1.28	-1.44*	-0.89	-0.78
	(0.92)	(0.74)	(0.57)	(0.51)
Square of size	0.04	0.05*	0.03	0.02
	(0.04)	(0.03)	(0.02)	(0.02)
Tangibility	-1.92	-0.14	0.37	0.53
	(2.06)	(1.87)	(1.06)	(1.09)
Square of tangibility	1.62	-0.26	-1.17	-1.25
	(1.70)	(1.75)	(1.03)	(1.00)
Sales growth	0.09**	0.07*	0.07	0.09
	(0.04)	(0.04)	(0.04)	(0.06)
Intangibility	0.03	-0.10	-0.09	-0.12
	(0.08)	(0.13)	(0.10)	(0.11)
Constant	11.11*	12.60**	9.38**	8.80**
	(5.68)	(4.90)	(3.89)	(3.60)
Obs.	903	1016	903	1016
R-squared	0.10	0.12	0.31	0.29
Year dummies	Yes	Yes	No	No
Industry dummies	No	No	No	No

Clustered standard errors are in parenthesis
*** p<0.01, ** p<0.05, * p<0.1

We observe that the estimations yield different coefficients. While both models estimated by pooled OLS provide a convex relationship, only the dynamic model using the fixed-effects estimator indicates the same relationship. The static model does not provide any statistically significant coefficients associated with leverage using the fixed-effects estimator. However, since the static model is likely to suffer from simultaneity bias, we focus on the coefficients in the dynamic model. Here, fixed effects and pooled OLS show a vertex (the function's turning point) around a debt-ratio of 0.38 and 0.47 respectively. The vertex represents the debt-to-assets ratio where we would expect the effect of leverage on performance to turn positive. Given the average debt-to-assets ratio of 0.31 in our sample, firms near this ratio are expected to be negatively affected by leverage. Furthermore, the results may indicate that the positive effects dominate the negative effects at higher debt-to-assets ratios.

As argued earlier, the OLS estimates might be biased due to an expected correlation between the unobservable effect and explanatory variables. We should also be aware of a caveat when using fixed-effects estimator. Since the variation between firms is ignored, the estimator can exacerbate the bias towards zero and show "too low" or insignificant coefficients in some cases despite the existence of a relationship (Griliches and Hausman, 1986).

We continue to check the robustness of the results by including a lagged dependent variable (TQ_{it-1}) based on the discussion in section 3.3. The requirement of minimum four observation for each company is also relaxed, and we control for industry effects[19]. The results seem robust to all these modifications. Other performance measures are also used to see if the results change. Tobin's Q is replaced with return on equity (ROE), sales-to-assets ratio and the operating expense-to-sales ratio, where the last variable requires an inversed interpretation. All three models are run with FE and OLS estimator and explanatory variables with one-year lag.

Table 7: Regression results with alternative performance measures. As earlier, all independent variables are run with one-year lag.

	Return on Equity		Sales-to-assets		Opex-to-sales	
	FE	OLS	FE	OLS	FE	OLS
Leverage	-0.48	-0.63	0.04	-0.79*	-4.86	-17.16
	(1.10)	(0.50)	(0.27)	(0.45)	(16.52)	(25.24)
Square of leverage	0.94	1.38**	-0.07	0.81**	13.98	13.85
	(1.20)	(0.60)	(0.27)	(0.40)	(20.20)	(29.91)
Obs.	942	942	944	944	945	945
R-squared	0.07	0.09	0.14	0.33	0.28	0.41
Industry dummies	No	No	No	No	No	No
Year dummies	Yes	No	Yes	No	Yes	No
Control variables	Yes	Yes	Yes	Yes	Yes	Yes

Standard errors are in parenthesis
*** p<0.01, ** p<0.05, * p<0.1
>Regression results with operating expenses-to-sales ratio as performance measure requires an inversed interpretation
>The higher model fit for the last two performance measures is possibly due to log(sales) as control variable and the presence of sales in numerator of sales-to-assets and denominator of operating expenses-to-sales.

Using operating expenses-to-sales ratio, no significant relationship between leverage and performance is found. For sales-to-assets ratio, only OLS suggest the convex relationship as in previous results. For ROE, the pooled OLS estimation shows a statistically significant positive coefficient related to the square term of leverage, but the results are interpreted with caution

[19] See appendix 3, 4 and 8.

since changes in book value of equity are expected to have a direct effect on both capital structure and thus book leverage, and indeed also ROE.

Based on the results from fixed effects estimations above, the relationship between leverage and performance seems to remain ambiguous. A possible explanation of the convex relationship with Tobin’s Q as a measure for performance or pooled OLS as estimator might be that in Norway, disciplinary effects and tax shield effects require higher debt-ratios in order to affect performance positively. The negative effect from leverage at lower debt ratios could also be interpreted in favour of Pecking-Order theory. As Myers and Majluf (1984) state, increase in cash flow can result in a decrease in leverage (see section 2.1.1.3). Thus, if more profitable firms accumulate retained earnings, sequential financing preferences of firms can result in a negative relationship between leverage and profitability. Another reason our findings are not compatible with the hypothesis could be that firms adjust leverage based on inside information so that leverage already proxies for the trade-offs between tax-shield advantages, agency costs and bankruptcy costs.

5.2 High-growth firms vs. low-growth firms

In section 2.2 we hypothesized that the impact of leverage on Tobin’s Q is expected to be different for high-growth and low-growth firms. This is because a firm with plentiful growth opportunities may have to pass up positive net present value investments when issuing debt. In contrast, leverage will prevent firms with poor growth opportunities from overinvestments (Jensen, 1986; Stulz, 1990). To test whether this hypothesis holds for Norwegian non-financial listed companies, we first present separate regressions results for high- and low-growth firms to see if the non-linearity exists for both samples. Then, we estimate a model with interaction variables to see if the coefficients associated with leverage are statistically different for the two samples.

Table 8: Separate regressions for high-and low-P/E firms with Tobin's Q as dependent variable. We continue to estimate the dynamic equation 10. Year dummies are excluded to obtain higher degree of freedom.

	High-growth		Low-growth	
	FE	OLS	FE	OLS
Leverage	-2.18	-6.51**	-1.96*	-2.03*
	(2.81)	(2.59)	(1.10)	(1.08)
Square of leverage	1.48	8.84**	1.63*	2.12**
	(3.23)	(3.58)	(0.90)	(0.89)
Control variables	Yes	Yes	Yes	Yes
Observations	190	190	246	246
R-squared	0.05	0.31	0.16	0.17
Industry dummies	No	No	No	No
Year dummies	No	No	No	No

Clustered standard errors are in parenthesis
*** p<0.01, ** p<0.05, * p<0.1

A convex relationship is shown for low-growth firms using both FE and OLS. For the high-growth sample, pooled OLS supports the same convex relationship while the fixed-effects estimator provides no statistically significant results for leverage coefficients. Although the results from fixed effects shows a statistically significant non-linearity for the low-growth sample and not for the high-growth sample, we analyse the results with interaction variables to see if the effects are systematically different for the two samples.

Table 9: Regression results from fixed effects and pooled OLS estimations with interaction variables. Tobin's Q is dependent variable. This estimation is based on the dynamic model. HG and MG indicate that the firms belong to high-growth and medium-growth samples respectively. The low-growth sample is excluded as the base case. The interaction terms and intercepts are in bold font. Observations with negative P/E-ratios are omitted. Year dummies are excluded to obtain higher degree of freedom.

	FE	OLS
MG		**0.45**
		(0.27)
HG		**1.49*** **
		(0.56)
Leverage	-1.97	-1.02
	(1.27)	(0.91)
MG x leverage	**0.24**	**-1.32**
	(1.55)	**(1.12)**
HG x leverage	**-1.04**	**-7.24** **
	(2.76)	**(2.96)**
Square of leverage	1.60*	1.39*
	(0.95)	(0.77)
MG x leverage square	**0.32**	**0.78**
	(1.29)	**(1.15)**
HG x leverage square	**0.97**	**8.31** **
	(3.34)	**(3.68)**
Constant	2.53	1.64
	(2.39)	(1.38)
Obs.	650	650
R-squared	0.03	0.33
Industry dummies	No	No
Year dummies	No	No
Control variables	Yes	Yes

Clustered standard errors are in parenthesis
*** p<0.01, ** p<0.05, * p<0.1

The variables that interact are *leverage* and an indicator variable which specifies the growth sample a firm belongs to (high-, medium-, or low-growth). The table above shows whether firms in the high-growth and medium-growth samples are differently affected than firms in the low-growth sample.

The coefficients associated with the interaction variables are not significantly different from zero in the fixed-effects estimation. According to pooled OLS, leverage has a stronger relationship with Tobin's Q in the high-growth sample as compared to the low-growth sample. Both the linear and the square term are statistically significant with p-value below 0.05 with negative and positive coefficients respectively. Thus, there are possible indications that high-growth firms in this sample are differently affected than low-growth firms, while results from the fixed-effects estimator show no support for this hypothesis.

The results differ when firms are divided into high-growth and low-growth samples based on their Q-values[20]. Using the interaction variables approach, the results for both fixed-effects and pooled OLS now show a stronger relationship between leverage and performance for the high-growth sample. When running separate regressions for the two samples, we obtain convex relationship for the high-growth sample with both FE and OLS. This relationship is not found for the low-growth sample. Here, pooled OLS show a negative effect from the linear term of leverage on performance, while no relationship is found using fixed effects. Thus, the results with Q as determinant for growth opportunities appear more different across the two groups of firms.

A reason why robust negative effects from leverage is not found on high-growth firms could be that managers choose leverage based on their private information about growth opportunities so that leverage already proxies for this. Lang et al. (1996) find negative relationship between growth and leverage only for low-Q firms. They argue that there are less difficulties in obtaining credit when growth opportunities are recognized by outside investors. Hence, if growth declines because of leverage, it is through the incapability of highly levered companies with unrecognized growth opportunities.

As discussed, our results using Q as a measure of growth opportunities showed a convex relationship between leverage and performance for the high-growth sample, while this relationship was not found for low-growth firms. Thus, high-growth firms seem to be positively affected by leverage at higher debt-to-assets ratio in our sample. A reason for this could be that for firms that have their growth opportunities recognized by outside investors (high Q), external funds are expected to be used profitably.

An advantage with Q as a measure for growth opportunities is that more observations are available. On the other hand, sampling on Q violates the OLS assumptions since it is also the dependent variable (McConnell and Servaes, 1995). A caveat using price-to-operating earnings is the ratio's within-firm volatility over the sample period. Since firms are categorized based on their mean P/E-ratios over the years, extreme values (due to huge variation in earnings) are likely to influence which category a firm is finally assigned to. Although exclusion of firms with negative earnings limits these effects, it also reduces the sample size significantly. In table

[20] As in McConnell and Servaes (1995) and Lang et al. (1996), companies are divided into subgroups based on their q-values as robustness-check. Firms with $Q > 1$ are classified as high-growth and firms with $Q < 1$ are placed in the low-growth sample. Tobin's Q is a frequently used measure for growth opportunities. The results using this approach are presented in appendix 5.

4, we demonstrated that high P/E samples also had higher Tobin's Q. Thus, whether we form groups based on P/E-ratios or Q-values should not affect the results dramatically.

5.3 Differences across industries

The last hypothesis presented in section 2.2 (H3) suggested that since the scale of asset tangibility and growth opportunities tend to vary across industries, the relationship between leverage and performance should differ across industries. Firms are divided into three broad industry categories to avoid small sample issues.[21] We assume firms in *Technology and Communications* have more valuable growth opportunities and less fixed capital. Consequently, negative effects from leverage is expected to dominate due to low collateral value and underinvestment problems.[22] For firms in *Offshore*, higher asset tangibility combined with limited growth opportunities will make the positive effects from leverage to dominate because of better access to credit and reduction in overinvestments. Before running the estimations, we present the summary statistics for some key variables across the industries to illustrate the differences discussed above.

Table 10: Summary statistics across sectors.

	Tobin's Q	ROE	Leverage	Tangibility	Intangibility
Offshore	1.08	-0.05	0.41	0.54	0.26
Technology & Communications	2.79	-0.02	0.17	0.10	0.75
Others	1.75	-0.05	0.26	0.27	0.47
Average	**1.64**	**-0.05**	**0.31**	**0.35**	**0.44**

>Intangibility is still defined as the ratio of total intangible assets to firms equity (book values).

As shown in table 10, we find support for our assumptions regarding the characteristics of our chosen representative industries. Technology and communications industry has the highest Tobin's Q. It is also the one with the lowest leverage and tangibility, and highest intangibility. In contrast, the offshore sector has the lowest Tobin's Q. It also has more leverage, higher degree of asset tangibility and lower intangibility. These results are in accordance with the notion that firms in industries with high degree of asset tangibility can bear more leverage, potentially due to lower information asymmetry and high collateral value of assets. Conversely, in industries with less tangible assets, firms potentially choose less debt due to higher information asymmetries. Despite differences in balance sheet characteristics, all sectors

[21] For more details about the subgrouping, see section 4.3.
[22] See Jensen and Meckling (1976) and Harris and Raviv (1991)

experienced a negative return on equity on average during the sample period. Below we estimate the dynamic model to see if we obtain different relationships between leverage and performance across industries.

Table 11: Regression results from fixed effects estimations across industries. Tobin's Q is dependent variable and control variables are lagged with one year. Year dummies are excluded to maintain higher degree of freedom.

	Offshore	Technology/ Communications	Others
Leverage	-0.64	-1.94	-2.95***
	(1.29)	(1.85)	(0.95)
Square of leverage	0.68	3.13	2.40***
	(1.01)	(2.18)	(0.86)
Obs.	396	171	336
R-squared	0.05	0.49	0.01
Control variables	Yes	Yes	Yes
Industry dummies	No	No	No
Year dummies	No	No	No

Standard errors are in parenthesis
*** p<0.01, ** p<0.05, * p<0.1

All three samples show the same directional relationship between leverage and Tobin's Q, but the leverage coefficients of offshore and technology industries are not statistically significant and does not allow for a comprehensive comparison between the industries. The convex relationship found earlier in the paper seems to have been driven by firms in other sectors than offshore, technology and communications. This indicates that the impact of leverage on performance cannot be generalized for all industries in our sample. As a supplementary method we perform the regression with interaction variables for the two sectors in appendix 6. Again, we cannot derive a conclusion based on our sample. The results should anyway be interpreted with caution due to the small sample size.

6 Conclusion

6.1 Summary

We studied the impact of leverage on firm performance in the post-financial crisis period using a sample of non-financial listed companies in Norway. We used Tobin's Q as a measure of firm performance and a dynamic panel data model to control for the dualistic nature of leverage and performance.

Based on Trade-off theory, we hypothesized a non-linear relationship between leverage and performance. That is, at smaller levels of debt, an increase in leverage would improve performance, while the relation would become negative at higher levels of debt. Fixed effects and pooled OLS estimations indicate a convex relationship between leverage and firm performance when we run the dynamic model. This indicates contradictions with the Trade-off theory predictions. However, the fixed-effects results are not robust to other performance measures as return on equity, sales-to-assets ratio and operating expenses-to-sales ratio. Pooled OLS results appear more consistent to other measures of performance, but the coefficients are likely to suffer from omitted variables bias.

After dividing firms into low-growth and high-growth samples based on P/E-ratio and Tobin's Q, we performed separate regression and tested for differences in leverage effects across samples. The results partly suggest that firms with valuable growth opportunities (high-growth firms) are more affected by leverage. For these firms, performance increases with more leverage at higher debt-ratios. This contradicts the second hypothesis where we expected the negative effect of leverage to dominate for the high-growth sample due to greater vulnerability to underinvestment problems.

To test for differences across industries with regards the scale of asset tangibility and growth opportunities, we divided our sample into three broad industry categories: Technology and Communications, Offshore and Others. The findings based on our sample do not support the predictions that the impact of leverage is different for industries with higher asset tangibility combined with fewer growth opportunities, compared to industries with lower asset tangibility and stronger growth opportunities. Due to the ambiguity of the results, we remain cautious in all our conclusions.

6.2 Caveats and suggestions for further research

We should be aware of potential caveats. First, this study was only conducted for Norwegian listed companies. Thus, we are careful on generalizing the results for other countries and types of firms. Listed firms tend to be larger, and differences in legal environment and culture may as well influence capital structure decisions and performance. Furthermore, a substantial part of the firms belongs to the petroleum industry which is both cyclical and highly levered.

This study also lacks control variables for market competition and regulatory factors. We expect the entries and exits of competitors to have an impact on firm performance. The same factors could also affect a firm's capital structure. For example, firms may adjust their leverage ratios according to threats from competitors and potential acquirers (Harris and Raviv, 1991).

Some capital structure related studies also control for the ownership structure of firms.[23] Typically, this includes managerial ownership, ownership concentration or type of owners (e.g. institutions and families). Furthermore, Berger and di Patti (2006) argue that the exclusion of ownership structure variables can bias tests of the agency costs hypothesis when assessing the impact of capital structure on performance. Agency costs are clearly conditional on ownership structure and should therefore be controlled for unless data availability is an issue.

In section 4.2 we briefly mentioned that the within-firm volatility of leverage was small. It is reasonable to increase the time span so that the fixed-effects estimations are based on sufficient levels of variation in the variables. Also, the results using subgroups are based on small samples which make the results less reliable. This is especially a concern when we assess the relationship across industries in the third hypothesis.

To conclude, future research on the impact of leverage on firm performance should aim to control for internal and external factors such as ownership structure and market factors. A larger sample size is recommended if the analysis involves subgrouping.

[23] McConnel and Servaes (1990), Morck et al. (1988) and Himmelberg et al. (1999) are some of the studies that investigate the impact of ownership structure variables on Tobin's Q.

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Appendices

Appendix 1: Testing homoscedasticity and serial correlation

Wooldridge (2002) test for autocorrelation in panel data

H0: no first order autocorrelation
F(1, 155) = 3.197
Prob > F = 0.076

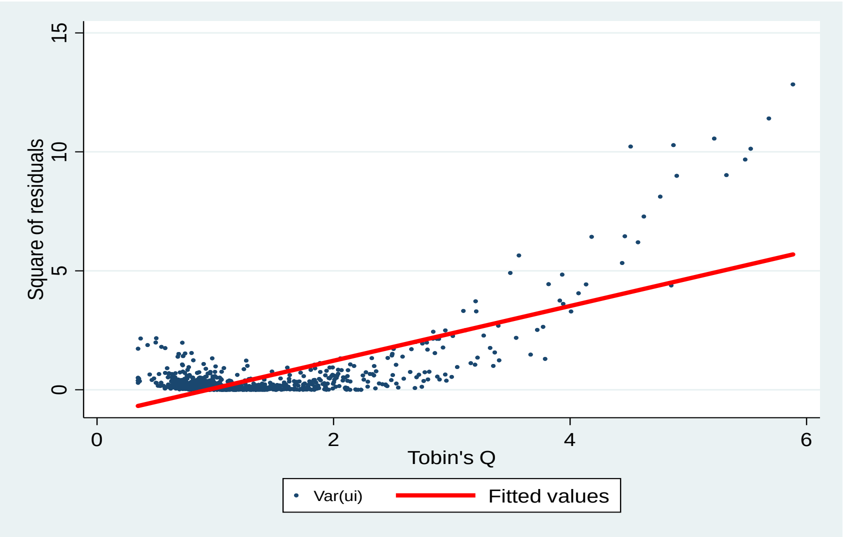
The null hypothesis is rejected at 10% level. Thus, there are indications of autocorrelation in our data.

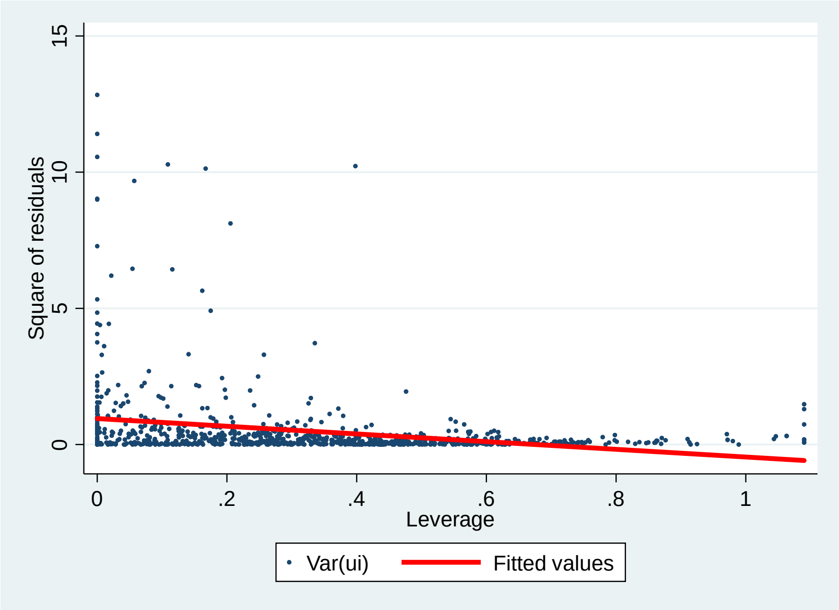
Wald-test

Modified Wald test for groupwise heteroskedasticity in fixed effect regression model
H0: sigma(i)^2 = sigma^2 for all i
chi2 (172) = 4.2e+07
Prob>chi2= 0.0000

The null hypothesis is rejected. Thus, there are indications of heteroskedasticity in our data.

Graphic visualizations





The idiosyncratic error term (u_i) seems to not be independent of different values of Tobin's Q and leverage. These results indicate violations of the homoscedasticity assumption.

Appendix 2: Panel data assumptions

F-test for firm heterogeneity

F-test that all a_i=0:
F(172, 713) = 5.1
Prob > F = 0.0000
The results indicate firm heterogeneity

Breusch-Pagan Langragian multiplier test

Breusch and Pagan Lagrangian multiplier test for random effects
Test: Var(a) = 0
chibar2(01) = 411.00
Prob > chibar2 = 0.0000

Hausman's test

	Coef.
Chi-square test value	27.25
P-value	0.0009

The null hypothesis that difference in coefficients (for FE and RE) are not systematic, is rejected.

Sargan-Hansen statistics

Test of overidentifying restrictions: fixed vs random effects
Cross-section time-series model: xtreg re robust cluster(Company_num)
Sargan-Hansen statistic 20.526 Chi-sq(8) P-value = 0.0085

Appendix 3: Lagged dependent variable

Table 12: Regression results including lagged dependent variable (an extension of the dynamic model). Tobin's Q is the dependent variable.

	FE	OLS
1-year lag of Tobin's Q	0.308***	0.625***
	(0.090)	(0.067)
Leverage	-1.931***	-1.988***
	(0.736)	(0.635)
Square of leverage	1.540**	1.796***
	(0.773)	(0.575)
Obs.	841	841
R-squared	0.176	0.593
Year dummies	Yes	No
Industry dummies	No	No
Control variables	Yes	Yes

Clustered standard errors are in parenthesis
*** p<0.01, ** p<0.05, * p<0.1

Appendix 4: Year and industry fixed effects

Table 13: OLS estimation. The dynamic model with industry and year fixed effects. Tobin's Q is dependent variable

	Tobin's Q
Leverage	-5.011***
	(1.110)
Square of leverage	5.374***
	(1.151)
Observations	903
R-squared	0.351
Control variables	Yes
Year dummies	Yes
Industry dummies	Yes

Clustered standard errors are in parenthesis
*** p<0.01, ** p<0.05, * p<0.1

Appendix 5: Tobin's Q as determinant for growth opportunities

Table 14: Results from separate regressions for high-growth and low-growth firms based in Tobin's Q values. Tobin's Q is also the dependent variable and this an estimation of the dynamic model.

	Tobin's Q > 1		Tobin's Q < 1	
	FE	OLS	FE	OLS
Leverage	-2.65**	-5.51***	0.18	0.32**
	(1.16)	(1.40)	(0.33)	(0.15)
Square of leverage	3.14**	5.68***	0.12	-0.01
	(1.28)	(1.62)	(0.27)	(0.13)
Obs.	578	578	323	323
R-squared	0.12	0.32	0.14	0.15
Industry dummies	No	No	No	No
Year dummies	No	No	No	No
Control variables	Yes	Yes	Yes	Yes

Clustered standard errors are in parenthesis
*** p<0.01, ** p<0.05, * p<0.1

Table 15: Regression results with interaction terms for high-growth firms based on Tobin's Q values. A firm is classified as high-growth firm if its mean value of Tobin's Q over the sample period is above 1. Otherwise, the firm is placed in the low-growth sample (Tobins's < 1). Here, HG is the high-growth indicator which interacts with variables associated with leverage. We estimate the dynamic model (10) with both fixed-effects and pooled OLS where Tobin's Q is also the dependent variable.

	FE	OLS
HG		**2.44*** **
		(0.32)
Leverage	0.93	1.84**
	(0.91)	(0.79)
HG x leverage	**-3.89*** *	**-8.10*** **
	(1.54)	**(1.54)**
Leverage square	-0.34	-0.74
	(0.69)	(0.68)
HG x leverage square	**3.76*** *	**7.03*** **
	(1.53)	**(1.67)**
Constant	7.16***	4.47***
	(2.10)	(1.39)
Obs.	901	901
R-squared	0.10	0.37
Industry dummies	No	No
Year dummies	No	No
Control variables	Yes	Yes

Clustered standard errors are in parenthesis
*** p<0.01, ** p<0.05, * p<0.1

Appendix 6: Testing differences across industries

Table 16: Regression results using fixed effects and pooled OLS with interaction variables and Tobin's Q as dependent variable. Control variables are run with one-year lag.

	FE	OLS
Leverage	-2.065*	-4.957***
	(1.219)	(1.204)
Leverage square	2.071*	4.685***
	(1.114)	(1.203)
Offshore x leverage	0.988	-0.663
	(2.087)	(0.672)
Offshore x leverage square	-0.924	0.585
	(1.646)	(0.975)
Tech x leverage	-1.439	-0.643
	(2.247)	(1.194)
Tech x leverage square	2.969	3.485
	(2.514)	(2.263)
Constant	10.473*	8.839**
	(5.327)	(3.536)
Obs.	903	903
R-squared	0.097	0.328
Control variables	Yes	Yes
Year dummies	No	No

Standard errors are in parenthesis
*** p<0.01, ** p<0.05, * p<0.1

Appendix 7: Two Stages Least Square (2SLS)

Table 17: Regression results with 2SLS-approach for panel data (STATA-command: xtivreg). Tobin's Q is the dependent variable and leverage is the explanatory variable suspected to be endogenous. This estimation is based on the dynamic model, thus all variables except Tobin's Q are run with one-year lag.

	FE
Leverage (=Tangibility)	-3.041
	(2.797)
Size	-0.452***
	(0.082)
Square of size	0.002
	(0.004)
Square of tangibility	1.346
	(1.484)
Intangibility	0.087
	(0.119)
Sales growth	0.074***
	(0.017)
Constant	8.221***
	(1.154)
Obs.	901
R-squared	.z
Year dummies	No
Industry dummies	No

Standard errors are in parenthesis
*** p<0.01, ** p<0.05, * p<0.1

Appendix 8: Results including firms with less observations

Table 18: Regression results from fixed effects and pooled OLS estimations. Tobin's Q is the dependent variable.

	Fixed-effects		Pooled OLS	
	Dynamic Model	Static Model	Dynamic Model	Static Model
Leverage	-1.81*	-0.74	-5.25***	-5.02***
	(0.98)	(1.46)	(1.15)	(1.21)
Square of leverage	2.41**	1.74	5.59***	4.95***
	(0.99)	(1.07)	(1.23)	(1.03)
Obs.	920	1062	920	1062
R-squared	0.10	0.12	0.32	0.29
Year dummies	Yes	Yes	No	No
Industry dummies	No	No	No	No
Control variables	Yes	Yes	Yes	Yes

Clustered standard errors are in parenthesis
*** p<0.01, ** p<0.05, * p<0.1

Table 19: Regression results with alternative performance measures. Only the dynamic model is run.

	Return on Equity		Sales-to-assets		Opex-to-sales	
	FE	OLS	FE	OLS	FE	OLS
Leverage	-0.48	-0.76	0.04	-0.82*	-4.86	-19.11
	(1.10)	(0.50)	(0.27)	(0.43)	(16.52)	(25.41)
Square of leverage	0.94	1.45**	-0.07	0.83**	13.98	15.88
	(1.20)	(0.61)	(0.27)	(0.39)	(20.19)	(30.32)
Obs.	960	960	962	962	963	963
R-squared	0.07	0.07	0.14	0.33	0.28	0.40
Industry dummies	No	No	No	No	No	No
Year dummies	Yes	No	Yes	No	Yes	No
Control variables	Yes	Yes	Yes	Yes	Yes	Yes

Standard errors are in parenthesis
*** p<0.01, ** p<0.05, * p<0.1