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Financial constraints and operating leasing

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Abstract

In this thesis, the effect of financial constraints on the usage of operating leasing by firms will be examined. For determining financial constraints, three of the most common used indices for financial constraints will be applied: The KZ-, WW-, and HP-index. For financially constrained firms, operating leasing (prior IFRS 16) presumable is an interesting form of external funding due to tax-incentives and collateral characteristics. The sample used consists of the firms listed at the Amsterdam stock exchange for the entire period 2012-2017, amounting to a sample composed of 52 firms and 312 firm years. On average I have found that financially constrained firms make more use of operating leasing than their financially unconstrained peers. Furthermore, the debt capacity preservation, which states that debt increases with operating leases, appears to be prevalent when considering the entire sample. However, when panel data regressions were run on the unconstrained firms and constrained firms separately, the results were inconclusive.

Table of contents:

1. Introduction

An extensive stream of literature in corporate finance focuses on financial constraints. Financial constraints are frictions, which prevent firms form funding all desired positive NPV-projects. These constraints may be caused by a firm's inability to issue equity, firm's dependency on bank loans or illiquidity of assets. (Lamont, Polk, & Saá-Requejo, 2001).

A great deal of studies has attempted to identify financial constraints through indirect measures and indices. Three indices have been developed in the literature, based on different notions of financial constraints. Based on the study of Kaplan & Zingales (1997), Lamont et al. (2001) have developed an index named after the former two: The KZ-index. The KZ-index is primarily established on a firm's reliance on external capital. Whited & Wu (2006) constructed their own index, the WW-index, based on the perception that financially constrained firms face a higher elastic supply of external capital and consequently a higher shadow cost of external capital. The final index used in this thesis, is the index proposed by Hadlock & Pierce (2010). They found mixed evidence on the validity of the other two indices and argue that firm size and age in particular are useful characteristics to determine financial constraint levels.

Since financially constraint firms seem to run into difficulties when attempting to obtain external funding, an interesting alternative for these firms may be operating leasing. Operating leasing and debt have been seen as substitutes, due to the similarities in collateral and expense structures (Myers et al., 1976; Miller & Upton, 1976; Liu, 2021). However, some studies showed different results. Ang & Peterson (1984) were the first to conclude that debt and operating leasing seem to behave as if they are complements, rather than substitutes. Since assets obtained under operating leasing are generally easier to repossess than assets obtained by debt, Sharpe & Nguyen (1995) and Eisfeld & Rampini (2009) show that operating leases perseveres debt capacity.

Lin, Wang, Chou & Choeh (2013) and more recently Liu (2021), are at the intercept of these two streams of literature concerning financial constraints and operating leasing. Lin et al. (2013) provide evidence that the leasing versus debt decisions depends on the level that a firm is financially constrained. Firms with relatively low internal funds, higher variability of internal funds and younger firms tend to make more use of

operating leases, according to Lin et al. (2013). Liu (2021) shows that the substitutability theory and debt capacity preservation are not mutually exclusive in the economy, but rather are universal features of leasing, utilized by a specific subset of firms. The substitution effect of leasing appears to be stronger for more financially constrained firms in the article of Liu (2021). Furthermore, financially constrained firms lease on average more, which is consistent with the debt capacity preservation theory of leasing.

This thesis will also be following these two streams of literature. The indices mentioned above will be used on a sample of firms listed at the Amsterdam stock exchange. The aim of this thesis is to test whether the usage of operating leases is influenced by the level of financial constraints experienced by a firm. This aim is encapsulated into the following research question:

To what extent do financial constraints influence the usage of operating leasing?

with the implementation of IFRS 16 in 2019, some significant changes have been made to the manner leases have to be reported. With these new regulations, firms are required to report almost all their leased assets, including operating leases, on their balance sheet. This new standard will provide way more transparency on firms' leased assets and liabilities, according to former IASB Chairman Hans Hoogervorst in 2016. These new accounting rules make it interesting to study the usage of operating leasing and what kind of firms specifically made use of operating leasing due to the advantages mentioned above. This thesis extends on the streams of literature on this topic, by using a sample of listed firms at the Amsterdam stock exchange.

The remainder of this thesis is organized as follows. First, an overview is given on the existing literature on financial constraints and operating leasing, after which the hypotheses based on these streams of literature are formulated. Then, the sample selection procedure and final sample are presented. After this, an explanation of the variables used, and methodologies applied is presented in the methodology section. Next, the regression results are elaborated on in the results section. Lastly, conclusions regarding the results, limitations of this study and recommendations for future research are given.

2. Literature Review

2.1 Financial constraints

A firm traditionally finances its activities either internally or externally. If a firm chooses to internally fund a project, profits or assets are used to finance the project. External fundings refer to the issuance of either equity, debt, or hybrid securities. The choice among these forms of external funding, will ultimately determine the capital structure of the firm (Berk & DeMarzo, 2020).

In the fifties of the last century, Modigliani & Miller (1953) published their ground-breaking paper on this subject, which is still influential to this day. In a world with perfect capital markets (i.e., no frictions), internal and external forms of funding should be perfect substitutes of one other. This boils down to the idea that the capital structure of a firm should not affect the investment choice of a firm; firms should always be able to raise capital to fund their positive net present value (NPV) projects.

However, capital markets are not free of frictions. Some obvious frictions are taxes, transaction costs and issuance costs (Berk & DeMarzo, 2020). Information asymmetry (Myers & Majluf, 1984) and Agency costs (Jensen & Meckling, 1976) are also causes of frictions in financial markets.

Due to the frictions in financial markets, external and internal forms of funding are not perfect substitutes of one another. Fazzari, Hubard & Peterson (1988) focus in their influential paper on financial market imperfections and argue that the financial situation of a firm influences the cost of external funds; The cost of external financing will exceed that of internal funds. They show that firms with a higher cost of external capital, are more reliant on internal capital when positive NPV-projects arise. These kinds of firms may have to forgo positive NPV investment opportunities and hence are deemed financially constrained. They define the opportunity costs between internal and external funds as the wedge.

Fazzari, Hubard & Peterson (1988) conclude in their article that firms which heavily rely on internal funds for investment, experience a high sensitivity of investment spending to cash flow. When the cash inflows are higher for these firms, so will be the cash used for investments. Consequently, the firms seen as financially constrained will only be able to increase investments when cash flows also increase. They concluded

that in their set of firms, the firms with the highest sensitivity of cash inflows to investment, paid the lowest dividends (these firms had the highest retention rate). The authors argued not paying out dividends may be a characteristic of financially constrained firms.

The article of Fazzari, Hubard & Peterson (1988) signified the starting shot of academic debate over financial constraints. Kaplan & Zingales (1997) responded in their article directly to the article of Fazzari, Hubard & Peterson.

Kaplan and Zingales investigated the source of correlation between cash inflows and investments by doing an in-depth analysis of the set of firms defined by Fazzari, Hubard & Peterson as experiencing this high level of sensitivity. They gathered qualitative information from statements by managers in SEC filings on financial constraints and combined this with Fazzari et al.'s used quantitative sources. For example, the quantitative information includes management's explanation regarding the need of external funding and the accessibility to it. Their result was the opposite. They found that the firms which appeared less financially constrained, experienced a higher level of cash flow to investment sensitivity than firms that appear more financially constrained. Kaplan and Zingales found evidence that the high sensitivity in their sample is explained by cash flow acting as a proxy for investment opportunities. This however, doesn't explain the high sensitivity they found for the least constrained firms. They argue that managers of the least constrained firms may in fact follow the pecking order theory[1], which explains the high sensitivity of cash flow to investment for these firms.

Kadapakkam et al. (1998) examine whether cash inflows influence investment. Since there is a consensus that smaller firms have less access to external capital and consequently, these firms should be more affected by the availability of internal funds. Kadapakkam et al. study to what degree reliance on internal funds is affected by firm size. In line with Kaplan & Zingales (1997), they also conclude that larger firms generally experienced a higher cash inflow to investment sensitivity. They explained their findings, by stating that larger firms experience a higher flexibility in the timing of investments. Furthermore, they also dismiss cash inflows to investment sensitivity as

[1] The pecking order theory states that, due to asymmetric information, managers prefer to first use internal funds, secondly the issuance debt and lastly issuance of equity (Myers and Majluf, 1984)

a measure of financial constraints, because of the general agreement on smaller firms having less access to external financing.

In 2000, Fazzari, Hubard & Peterson wrote an article in which they criticized the study of Kaplan & Zingales (1997). They based their critique on their own lack of a theoretical approach of their study in 1988. Therefore, from the point of view of Fazzari, Hubard & Peterson, the results of Kaplan and Zingales wouldn't be solid enough. In the same year, Kaplan & Zingales (2000) responded. They agreed on the point regarding the lack of a theoretical approach. Nonetheless, they would not reject their own empirical result. In the eyes of Kaplan and Zingales, the sensitivity of cash flow to investment is a rather dubious measure of financial constraints, due to the contradicting results.

Based on the study of Kaplan & Zingales (1997), Lamont, Polk & Saá-Requejo (2001) introduced an index in their article based on the ideas of Kaplan and Zingales: The KZ index. Rather than examining cash flows and real activity, Lamont et al. used asset price data and sorted portfolios of traded securities to examine whether a firm's ability to invest is hampered by financial constraints. With the help of the KZ index to identify financially constrained firms, they put together financially constrained firms in a portfolio and sought to test whether these firms share a common source of covariation in their stock returns. If financial constraints are an important factor of stock returns, differing levels of a firm being constrained should be reflected in stock returns. They did in fact find common covariation, not captured by other sources of co-movements in stock returns. This result suggests that financial constraints do influence firm value. The KZ-index is formulated in the following way:

(1) KZ = -1.001909 *cashflow kz* + 0.2826389 *Tobin's Q* + 3.139193 *leverage kz* - 39.3678 *dividends* – 1.314759 *cash holding kz*

Whited & Wu (2006) also examined whether financial constraints affect asset returns. They argue that elasticity of supply of external capital can be used to define financial constraints. The shadow price of raising an additional unit of external capital determines the slope of the supply-of-external-capital curve. Eventually, the curve becomes vertical, and the supply frictions inhibit firms from obtaining external capital.

Thus, firms which face a high elastic supply of external capital are deemed financially constrained. Whited and Wu constructed an index of financial constraints based on a

standard intertemporal investment model. The model predicted that external finance constraints indeed affect the substitution of investment today for investment tomorrow via the shadow price of obtaining scarce external funds. The index proposed by Whited & Wu (2006) is based on the notion that certain firm characteristics determine the firm's shadow cost of external financing. Within the index' formula, they have accounted for cash flow, a dividend dummy, leverage, total assets, industry sales growth and firm specific sales growth. The WW index is computed in the following way:

(2) WW = -0.091 *Cash flow ww* – 0.062 *Dividend dummy* + 0.21 *Leverage ww* -0.044 *Log total assets* + 0.102 *Industry sales growth* - 0.035 *Sales growth*

Hadlock & Pierce (2010) studied the different measures of financial constraints. they used the same approach as Kaplan & Zingales (1997) to evaluate the KZ Index proposed by Lamont et al. (2001). They gathered qualitative information on financial constraints from statements of managers in SEC-fillings to classify firms as financially constrained. For evaluating the index, they have estimated numerous ordered logit models, predicting financial constraints as a function of numerous quantitative factors. Additionally, they studied the relation between different firm characteristics and financial constraints, to allow for general inferences to be made for larger datasets, without having to intensively collect data by hand. The firm characteristics which were the most meaningful explanatory variables of financial constraints, were firm age and firm size (Hadlock & Pierce, 2010). They used these two variables to construct a new index: The SA-index or size-age index. This is in line with the studies earlier mentioned: smaller firms are expected to be more financially constrained than their larger peers (Fazzari et al., 1988) (Kadapakkam et al.,1998) (Kaplan & Zingales 1997). The SA index implies that, once small and young firms start to grow and mature, financial constraints decline sharply. The SA index is formulated as follows:

(3) SA = -0.737 *size* + 0.043 $size^2$ – 0.040 *age*

Farre-mensa & Ljungqvist (2016) have attempted to clarify whether the measures proposed in the literature do in fact capture financial constraints. They test this by examining how supposed constraints firms are hampered in their ability to receive external financing. They discuss the two main notions previously discussed in the literature on financial constraints. The first notion builds on the ideas of Whited & Wu

(2006). They characterized constraints as the slope of the supply-of-external-capital curve: the steeper the curve, the more inelastic the supply of external capital. The second definition is based on the paper of Fazzari et al. (1988), in which they define financial constraints by the wedge between internal and external cost of capital. The authors use a natural experiment to analyze the effect of a state-tax increase. Apparently, financially constrained firms face no higher difficulty in obtaining debt after the tax increase event. Additionally, financially constrained firms engage in equity recycling: simultaneously raising equity and increasing payout to shareholders. Farre-Mensa & Ljungqvist (2016) concluded that the notions of being financially constrained, as described by Fazzari et al. (1988) and Whited & Wu (2006), do not correctly characterize the behavior of firms classified as being financially constrained

2.2 Leasing

A different form of external financing, which probably is interesting for financially constrained firms, is leasing. Leasing is a form of financial contracting which separates the use and ownership of an asset. Rather than straight out buying, for example, machinery, a firm (lessee) pays a monthly lease rate to another firm (lessor) which rents out the machinery.

The lessee is obligated to periodic payments and in return receives the right to use the asset. The lessor is owner of the asset and receives the payments in exchange for lending the asset. At the end of the leasing period, the contract determines which party will retain ownership of the asset and at what terms. The lease contract also specifies any renewal, purchase and cancelation options and obligations concerning maintenance and related services costs (Berk & Demarzo, 2020).

In frictionless markets, firms would be indifferent between leasing and buying an asset. Hence the literature on this subject has suggested that leasing is motivated by the frictions present in capital markets. Numerous studies have focused on the tax incentive to lease an asset instead of buying an asset. Myers et al. (1976) state that the only rational explanation for leasing, is that both parties benefit from it. They show that a high taxed lessor can make use of accelerated depreciation and the interest tax shield, which is of no use to a low-taxed lessee. The tax savings are the gains in leasing. Miller & Upton (1976) share the same views as Myers. et al. (1976). In both

studies, leasing and secured debt are considered to be substitutes. Thus, an increase in leasing will lead to a decrease in secured debt.

However, Ang & Peterson (1984) demonstrated different results. Their results show that an increase in leasing is associated with an increase in debt; debt and leasing are complements. They proposed several possible explanations. However, they regarded their findings at the time as an unsolved puzzle: 'The leasing puzzle'. Lewis & Schallheim (1992) apply the tax incentive used earlier on by advocators of the substitutability of debt and leasing, to show the opposite. Based on the reasoning that leasing is a tool for selling excess tax deductions, the lessee may be motived to increase the portion of debt in its capital structure. Therefore, the lessee will use more debt than it would if it didn't lease.

Sharpe & Nguyen (1995) as well as Eisfeldt & Rampini (2009) show that there is a different incentive for leasing. Leasing results into agency costs, due to the separation of ownership and control. The leased asset is under the control of the lessee. However, the lessor remains the owner. This will lead to agency problems and additional costs. However, there is also a benefit to leasing. In case of a bankruptcy, leased assets and collaterals of secured loans are treated quite differently. When a lessee files for bankruptcy, it must either keep control of the leased asset and continue to make the lease payments or return the asset to the lessor. In contrast to this, the collateral of a secured loan must automatically stay with the bankrupted firm. Thus, repossession of a leased asset is much easier and less costly than taking control of a collateral for a secured debtholder. This implies that leasing has a higher debt capacity than secured lending. The authors show, based on empirical evidence, that firms which are more financially constrained, lease more of their capital than less financially constrained. The reasoning behind this is based on the idea that more financially constrained firms value the additional debt capacity and therefore would lease more than their less financially constrained peers.

Rampini & Viswanathan (2013) have developed a dynamic model of firm financing and include leasing as an alternative form of financing. Because loans need to be collateralized with tangible assets, the authors perceive tangible assets as an important determinant of a firm's debt capacity. A low level of tangible assets is seen as a low debt capacity. Hence firms with low tangible assets are more constrained. Since leased assets can be repossessed with ease, leasing is a strong form of

collateralization. Consequently, the cost of leasing will be lower than the cost of debt for financially constrained firms.

Lasfer & Levis (1988) demonstrate, based on a sample of 3000 firms situated in the UK, that the determinants of leasing are not the same for firms of different size. Larger companies tend to lease, due to the tax savings associated with leasing. On the other hand, the leasing decision for smaller firms is driven by the inability to access debt. The inability to access debt for start-ups is caused by adverse selection and risk shifting incentives (Huyghebaert & Van de Gucht, 2007). Specifically, these authors show that leasing is used more extensively, when the adverse selection and risk shifting problems are more severe. They give a potential explanation, by stating that lessors use other mechanisms to reduce these problems. Operating lease contracts also reduce the risk of default, as is shown by Sharpe & Nguyen (1995),

In the past, the Financial Accounting Standards Board (FASB) and the International Accounting Standards Board (IASB) distinguished two types of leasing: operating leasing and capital leasing. Operating leasing was viewed as 'renting' an asset. Consequently, the lease payments were seen as an operating expense. The lessee did not have to report the asset or the lease payment liability on its balance sheet. This could help firms manage cash flows or take advantage of alternative routes to raise funds. Firms would even use off-balance sheet items to artificially boost earnings per share or return on assets (Koller, Goedhart & Wessel, 2020). A capital lease on the other hand, is seen as an acquisition for accounting purposes. The asset is reported on the lessee's balance sheet and incurs depreciation expenses for the asset. Additionally, the present value of the future lease payments is listed as a liability and the interest portion deductible as an interest expense (Berk & Demarzo, 2020). The repossession advantage of leasing described earlier in this section, is usually only enjoyed by operating leasing, and are therefore considered to be a 'true' lease. Capital leasing on the other is more similar to buying with secured debt (Sharpe & Nguyen, 1995) (Eisfeldt & Rampini, 2009) (Graham et al., 1998). Therefore, this thesis will be covering operating leases rather than capital leases.

2.3. Hypotheses development

2.3.1 Financial constraint measures

Financial constraints hamper a firm's ability to obtain external financing. These constraints may prevent firms from funding all the positive NPV-project which they desire to fund (Lamont et al., 2001). The three indices described earlier in this section, are based on different notions of financial constraints. Based on this, the first hypothesis has been developed:

> *Hypothesis 1: the KZ index, WW index and HP index do not define the same firms as being financially constrained.*

2.3.2 Leasing and financially constrained firms

In earlier finance theories, leasing and debt have been seen as substitutes of one other. This is based on the similarities between both forms of funding.

When an asset is leased, the lessor is compensated for interest expense and depreciation expense through lease expense payments paid by the lessee to the lessor. Furthermore, the leased asset serves as collateral and can be repossessed by the lessor upon default of the lessee.

On the other hand, when a firm finances an asset with secured debt, it incurs both interest and depreciation expense and commits the asset as a collateral. Moreover, when the principal comes due, the debt issuer may decide to sell the asset to pay the principal.

Due to these similarities between leasing and secured debt in both their expense structure and collateral commitment, these two forms of financing have been seen as essentially the same and substitutable. Consequently, in line with the substitutability theory, an increase in leasing should be offset by a decrease in secured debt (Liu, 2021).

Based on the substitutability theory of leasing and the articles of both Lin et al. (2013) and Liu (2021), the following hypotheses will be tested:

> *Hypothesis 2: An increase in leasing, leads to a decrease in secured debt.*

Hypothesis 3: The substitution effect between leasing and secured debt is greater for financially constrained firms than for less financially constrained firms.

In frictionless markets, firms would be indifferent between leasing an asset and using debt to purchase an asset. However, financial markets aren't frictionless, and the literature has suggested leasing is motivated by these frictions.

When an asset is leased, Myers et al. (1976) and Miller & Upton (1976) show that a lessor with a higher tax rate than a lessee, has the opportunity to more rapidly depreciate assets and take advantage of the lessee's interest tax shield that are useless to the low taxed lessee. Thus, creating an incentive for leasing.

Although Myers et al. (1976) and Miller & Upton (1976) assumed leases and debt to be substitutes, Ang & Peterson (1984) have shown that an increase in leasing is associated with an increase in debt. In line with these results, Lewis & Schallheim (1992) also apply the tax incentive and come to the same conclusion as Ang & Peterson (1984). By selling the excess tax deductions, the lessee may have the incentive to take on more debt while leasing.

Sharpe & Nguyen (1995) and Eisfeldt & Rampini (2009) both elaborate on the difference between secured debt and leasing when the debt issuer or lessee files for bankruptcy. They reason that repossession of a leased asset is significantly easier for a lessor than it is for a debt holder to take control of a collateral. Due to this, lessors are willing to grant more capital per unit of collateral.

In accordance with these authors, Rampini & Viswanathan (2013) show that since leasing is a strong form of collateralization, the cost of leasing will be lower than the cost of debt for financially constrained firms. Considering this leaves a firm's current assets unsecured, these assets can later on be committed as collateral to obtain secured debt. Therefore, leasing preserves secured debt capacity and can plausibly even increase it (Liu, 2021). This boils down to the idea that financially constrained firms may prefer leasing over secured debt, due to leasing being self-collateralized (Eisfeldt & Rampini, 2009) (Rampini & Viswanathan, 2013) (Liu, 2021). Based on these findings and the article by Liu (2012), the fourth and final hypothesis is the following:

Hypothesis 4: Financially constrained firms lease more compared to their less constrained peers.

3. Data

The sample that will be used to test the hypotheses stated in the previous section, will consist of all listed firms at the Amsterdam stock exchange. The Amsterdam stock exchange is part of Euronext. Euronext is the pan-European stock exchange, which also includes the exchanges in Paris, Milan and Brussels among others. At any time, there are in total 75 firms listed at the Amsterdam stock exchange

The firms listed at the Amsterdam stock exchange are divided among three equity indices based on market capitalization. The 25 firms with the highest market capitalization, also known as 'high caps', are compiled in the Amsterdam Stock Exchange-Index (AEX). The next 25 firms with the highest market capitalization are compiled in the Amsterdam Midcap-index (AMX). Lastly, the 25 firms with the lowest market capitalization are compiled in the Amsterdam Small cap Index (AScX).

The firms listed in the period between 2012-2017 have been selected. No earlier than 2012 has been chosen, due to the economic recession prior. No later than 2017 has been chosen, due to the implementation of IFRS 16 in January 2019 (which also could be implemented earlier by firms, under certain criteria). IFRS 16 coming into force, means assets leased under operating leasing will also have to be capitalized on the balance sheet, removing the former advantages of not having to capitalize leased assets under operating leasing (Hoogervorst, 2016).

In the period from 2012 until 2017, a total of 118 firms have been listed at the Amsterdam stock exchange. 33 of these firms have not been listed for the entire period and have been removed from the sample. For the KZ index, it is required that these firms have a non-zero positive value for property, plant and equipment, since PPE is in the denominator in the ratio's used for this index. 10 firms had a zero value in at least a single year in the period 2012-2017, leading to their removal from the sample. Furthermore, data on the year end market capitalization is required for the WW index. For 19 firms, in at least a single year the market capitalization wasn't reported on DataStream. These 19 firms have also been removed from the sample. Four firms

didn't report anything on operating leasing in their annual reports, leading to their removal as well. AFC Ajax, the only listed Football Club in Amsterdam, has been removed. Finally, Heineken Holding, has also been removed, due to being a holding company for Heineken N.V., which is also listed at Amsterdam stock exchange. The remaining sample exists out of 52 firms, amounting to 312 firm years over the period 2012-2017. A description of the sample selection procedure can be found in Table 2 in Appendix A

Financial data required for the indices has primarily been obtained from CompStat. Data on the annual market capitalization of the 52 firms has been retrieved from DataStream (Worldscope). DataStream tends to have data on annual rental/operating lease expense and the operating lease commitments for the next five years. However, for the sample specified above, the data was very limited[2]. This has led to the necessity of handpicking the data on yearly rental/operating lease expense and the operating lease commitments for following five years from the notes of annual reports, which has been quite time consuming.

Data on annual firm/industry group sales growth is obtained from Eikon. The firms have been grouped based on the GICS (Global Industry Classification System) Industry groups. A list with the firms included in the final sample can be viewed in Table 1 of Appendix A.

4. Methodology

In this section, the methodology for testing the hypotheses will be described. First, the analysis of the financial constraint indices and how the first hypothesis will be tested is described. Secondly, the method for testing the hypotheses concerning operating leasing (hypothesis 2-4) will be set out and the model specifications for testing these hypotheses will be described.

[2] Apparently for European firms in general, the data on these data items on CompStat and DataStream is very limited.

4.1 Financial constraint indices

Like mentioned in the literature review section, no consensus has been reached on how to measure financial constraints. Equivalently, there is no general agreement in the literature on which index or measure of financial constraints is the right one to use. In this thesis, a combination of the KZ index, WW index and HP index will be used to determine financially constrained firms in the selected sample. Each of these indices are based on different characteristics and behaviour associated with firms that are financially constrained. Therefore, none of these indices may be a perfect measure of financially constrained firms when used individually (Khatami, Marchica & Mura, 2015). For an overview of the different characteristics and behaviours associated with each index, see the literature review. The KZ-, WW-, and HP-index are computed according to equations (1)-(3):

(1) KZ = -1.001909 *cashflow kz* + 0.2826389 *Tobin's Q* + 3.139193 *leverage kz*
- 39.3678 *dividends* – 1.314759 *cash holding kz*

(2) WW = -0.091 *Cash flow ww* – 0.062 *Dividend dummy* + 0.21 *Leverage ww*
- 0.044 *Log total assets* + 0.102 *Industry sales growth*
- 0.035 *Sales growth*

(3) SA = -0.737 *size* + 0.043 $size^2$ – 0.040 *age*

All the indices mentioned above have been winsorized at the 5% level. The winsorization is based on Hadlock & Pierce (2010) and has also been applied by Liu (2021).

For each index, the firms are divided into terciles and are assigned a score from 1 to 3. A firm assigned a score of 1, is in the first tercile for the specific index and is labelled as financially unconstrained by that specific index. A score of 2, assigned to a firm in the second tercile of an index, is labelled 'undefined': not constrained nor unconstrained. A score of 3 means the firm is in the third tercile and is deemed financially constrained by the specific index. Dividing firms among such groups is along

the work of, among others, Whited & Wu (2006), Denis & Sibilkov (2010) and Lin et al. (2013). The formulas and relevant variables are described in Table 4 of Appendix A.

To test whether the three indices label the same firms as being financially constrained, cross tabulation analysis will be performed between each index. To test the relationship between the indices, a correlation test will also be performed. Lastly, ordered probit regressions will be used to test whether a firm's tercile allocation by a specific index can be predicted by the other two indices.

4.2 Operating leasing

For testing the second to fourth hypotheses, a composite measure of financial constraints will be created, based on the KZ-, WW-, and HP-index. The methodology of composing these indices is based on the studies of Campello & Chen (2010), Whited & Wu (2006) and Khatami et al. (2015).

The overall score for each firm is determined by summing the scores it received from each index. Finally, based on the composite score, financially constrained and unconstrained firms will be determined. Firms in the first tercile of the overall score, will be regarded as financially unconstrained. Firms in the third tercile of the overall score, will be regarded as financially constrained.

4.2.1 Dependent variable

The dependent variable used in the analysis, will be the lease ratio. In defining the lease ratio, the ideas of Graham et al. (1998) and Lin et al. (2013) have been followed.

The lease ratio is defined as the present value of operating leases to the market value of the firm. The market value of the firm is calculated as book value of total assets, minus book value of equity, plus the market value of equity and the present value of operating leases. The present value of operating is included in the market value of the firm, since it represents the off-balance-sheet financing for the firm, hence it should be included. The present value (PV) of operating leases is defined as the current year's rental/operating lease expense plus the present value of the operating lease commitments in the following five years. Since different firms have different costs of lease capital, the lease ratio variable could be biased. Therefore, Graham et al. (1998) and Lin et al. (2013) have used the average short-term borrowing rate over the period

from which their sample was extracted. However, over the period 2012-2018, the average short-term borrowing rate in the EU has been approximately zero (OECD). Because of this, I have decided to not discount the operating lease commitments in the following five years, as a borrowing rate which is approximately zero won't make much of a difference. Therefore, the 'present' value of operating leases is just the current year's rental/operating lease expense plus the operating lease commitments over the next five years. The independent variable lease-ratio can be summarized in the following way:

(4) Lease ratio = PV of operating leases / market value firm

(5) PV operating leases = Current year's lease expense + PV of next five years' operating lease commitments

(6) Market value firm = Book value assets – Book value equity + Market value equity + PV operating leases

4.2.2 Independent variable

For testing the second and third hypotheses, the indices for measuring financial constraints will be used as independent variables. Besides those indices, the debt-ratio will also be used as an independent variable to test the substitutability theory by testing the second and third hypotheses. The debt ratio is defined as the total debt to the market value of the firm, which can be described in the following way:

(7) Debt-ratio = Total debt / Market value firm

(8) Total debt = Long-term debt + short-term debt

(9) Market value firm = Book value assets – Book value equity + Market value equity + PV operating leases

4.2.3 Control variables

Literature suggests that the 'uniqueness' of the assets required by a firm, affects the leasing versus debt decision. Since unique or more specialized assets are more valued by a specific firm than by another, specialized assets are unlikely to be leased (Smith

& Wakeman, 1985). Titman & Wessels (1988) suggest that a firm's proportion of specialized assets over total assets can be proxied by its expenditure on R&D over sales turnover. Lin et al. (2013) included a control variable for R&D expenditure, based on this theory. However, within the Sample Lin et al. use, less than half of the firms has expenditures on R&D and the distribution is highly skewed. Therefore, they have used a dummy variable, which equals one if a firm has R&D expense. Since that is not the case for the sample used in this thesis, I have decided to use research & development expense over sales turnover to proxy for uniqueness of a firm's assets. This proxy for uniqueness has been put to use before by Titman & Wessels (1988). An alternative reasoning for why R&D expenditure and leasing are negatively correlated is that upon default, intangible assets like R&D cannot be repossessed. Therefore, the agency costs would be more severe and are the reason why these intangible assets will not be leased.

In the literature review, the tax-incentive for leasing put forward by Lewis & Schallheim (1982) was discussed. Leasing could be a tool for selling excess tax deductions. Therefore, the lease payments would be reduced if the lessor obtains the tax shields from the lessee. Lin et al. (2013) proxy for non-debt tax shields by using the control variable tax-loss-carry forwards. This control variable in their model is a dummy, which equals one if a firm has tax-loss-carry forwards. They have shown that firms which do have tax-loss-carry forwards make more use of operating leasing.

However, data on tax-loss-carry forwards is hard to obtain for European firms. Therefore, I have decided to proxy for non-debt tax shields by using the pre-tax income item from CompuStat Global. The control variable used in the model, will also be a dummy which takes the value one if a firm's pre-tax income is non-positive. I expect firms that have a non-positive value for pre-tax income, make more use of operating leasing.

Besides these control variables controlling for tax-incentives and specialized assets, Lin et al. (2013) also control in their model for financial distress. Following Graham et al. (1998), they have included a dummy equal to one if a firm's common equity is negative, to proxy for firms in financial distress. However, only in 11 firm years do certain firms have a negative value for common equity, making this proxy useless for my sample. Therefore, I have decided to omit this control variable from the model. Summary statistics of all variables can be viewed in Table 5 to 10 in Appendix A.

4.2.4 Model specification

A robust Hausman test will be performed to determine whether a fixed- or random effect should be used. The null and alternative hypotheses for the Hausman test are the following:

H_o: The random effect model is preferred

H_a: The fixed effect model is preferred

Table 1: Robust Hausman test.

Hausman specification test		
Test	**Statistic**	**P-value**
Chi	166,88	0,0000

The null hypothesis is rejected at the 1% level, which means a fixed effect should be used.

The model specifications of the regressions for testing hypothesis two and three can be found in in Table 11 in Appendix A. Separate regressions will be run with the debt-ratio and each index as the sole independent variables. Then, another regression will be run with all three indices as the independent variables.[3]

To test the fourth hypothesis, a different model is used of which the specification can be found in Table 12 in Appendix A. This model includes the dummy variables FC and NFC. FC is equal to one if the firm is considered to be financially constrained by the composite score. NFC is equal to one if a firm is considered to be financially unconstrained by the composite score. The middle tercile of the composite score is not included in the model, to account for perfect multicollinearity.

5. Results

5.1 Financial constraint indices

The crosstabulation between the KZ terciles and WW terciles for 2012 is shown below in Table 2. The other crosstabulation tables for each year can be found Appendix B. The Pearson's chi-square statistic is also reported below each table, which tests for a relationship between the two variables.

[3] Each regression will include the control variables mentioned earlier in the methodology section.

12 out of the 16 firms considered to be financially unconstrained by the KZ index (first KZ tercile) in 2012, are being classified as financially unconstrained by the WW index (first HP tercile) as well. Furthermore, only 12 out of the 29 firms considered to be financially unconstrained by the WW index, are being classified as being financially unconstrained by the KZ index.

The same appears to be the case when the firms classified as financially constrained by the KZ index are considered. Only 4 out of the 20 firms labelled as financially constrained by the KZ index (third KZ tercile), are also considered to be financially constrained by the WW index (third WW tercile). While 4 out of the 9 firms labelled as financially constrained by the WW index, are also considered to be financially constrained by the KZ index.

Table 2: Crosstabulation between KZ terciles and WW terciles for 2012

KZ/WW	1st WW tercile	2nd WW tercile	3rd WWtercile	total
1st KZ tercile	12	2	2	16
	75%	12,50%	12,50%	
2nd KZ tercile	9	4	3	16
	56,25%	25%	18,75	
3rd KZ tercile	8	8	4	20
	40%	40%	20%	
Total:	29	14	9	52

Pearson chi2(4) = 4,7987 P = 0,309

The Pearson's chi-square test below Table 2 indicates that the null hypothesis, under which there is no significant relationship between the two variables[4], cannot be rejected. This is not surprising, since these three indices are based on different notions, as mentioned previously. To grasp to what extend these indices access the same phenomenon, a correlation test is run. The results are shown below in Table 3.

[4] The crosstabulation between the WW and HP terciles for the years 2013 and 2015 return a significant p-value at the 1% and 10% level respectively. Although labelling a slightly higher proportion of the firms in the same category (see Appendix B), their correlation is insignificant, meaning there is no significant relationship between these two indices.

Table 3: Correlation between indices

	KZ index	WW index	HP index
KZ index	1,0000		
WW index	0,1232*	1,0000	
HP index	-0,0578	0,0424	1,0000
* Significant at 5% level			

Although the KZ index and the WW index appear to be significantly correlated at the 5% level, the correlation between these indices is rather low. The significant, although low, correlation between these two indices, is most likely due to overlapping components within the two formulas of these two indices. Furthermore, it seems the HP is completely unrelated to the other two indices, based on the correlation matrix and crosstabulations. Lastly, the results of the ordered probit regressions can be found in Table 4 down below. Only the KZ-index seems to significantly predict the tercile allocated to a firm by the WW-index. All the other coefficients are insignificant. This is in line with the results from the crosstabulations and correlation test. Based on these results, one can conclude that these indices do not label the same firms in this sample as financially constrained or unconstrained.

Table 4: Ordered probit regressions, with the independent variables being the terciles of each index.

	KZ terciles	WW terciles	HP terciles
KZ		0,00636**	0,00144
		(0,00272)	(0,00276)
WW	0,05019		0,0826
	(0,10939)		(0,10844)
HP	0,09927	0,17073	
	(0,10626)	(0,10733)	
First cut	-0,8256	-1,16053	-0,44344
	(0,41003)	(0,41721)	(0,08735)
Second cut	0,03775	-0,28503	0,41932
	(0,40847)	(0,41416)	(0,08707)
pseudo-R^2	0,0016	0,0113	0,0011

Significance levels: 10% *, 5% **, 1% ***

5.2 Operating leasing

The results of the panel data regressions for all firm years can be viewed down below in Table 5. Because the average standard error appeared to differ between firms, it is very likely the residuals are correlated within firms. Therefore, the standard errors have been adjusted for the 52 different firms present in the sample.

For the regressions in which each index is included separately, the debt-ratio variable is significant in the first two regressions. However, only the KZ-index appears to be significant. Furthermore, within the HP regression, none of the variables seem to be significant.

Within the regression in which all indices are included, the variables debt-ratio, KZ, HP, RDsales and the constant term are all significant. The Tax incentive control variable appears to be not significant, along with the WW-index. As expected, the lease-ratio seems to decrease with an increase of R&D expense over sales. This indicates that firms having more unique or specialized assets, make less use of operating leasing. The lease-ratio appears to increase with an increase of the KZ- and HP-index. This means that firms which become more financially constrained, according to these indices, make more use of operating leasing.

The main variable of interest is the Debt-ratio. As can been seen in Table 5, the lease-ratio appears to increase with an increase of the debt-ratio, when testing on the entire sample. For the sample used in this thesis, the substitutability theory of operating leasing and debt doesn't seem to apply. Rather, the debt capacity preservation theory seems to be prevalent, which is in line with the studies of Ang & Peterson (1984) and Lewis & Schallheim (1992). The debt capacity preservation theory implies that debt and operating leases act as complements.

Table 5: Results of regressions with lease ratio being the independent variable

	KZ	WW	HP	All indices
Constant	0,05363***	0,04860***	0,26033	0,25044***
	(0,00489)	(0,00395)	(0,06024)	(0,05865)
Debt-ratio	0,08230***	0,08993***	0,06707	0,07563**
	(0,02747)	(0,02594)	(0,03196)	(0,02917)
KZ	0,00041*			0,00029*
	(0,00022)			(0,00016)
WW		0,00241		0,00286
		(0,00270)		(0,0025)
HP			0,05555	0,05185***
			(0,01554)	(0,01531)
RDSales	-0,01346	-0,01542	-0,01940	-0,02108**
	(0,01640)	(0,01823)	(0,00802)	(0,00846)
Tax incentive	0,00302	0,00475	0,00515	0,00220
	(0,00409)	(0,00404)	(0,00433)	(0,00379)
Adjusted R^2	0,09754	0,05566	0,14205	0,16789

Significance levels: 10% *, 5% **, 1% ***
Standard errors underneath coefficients between parentheses
adjusted for clusters within firms.

On the next page in Table 6, the panel data regression results for the regressions on financially constrained (FC) and financially unconstrained (NFC) firms are displayed. Again, the standard errors have been clustered by firms. Unfortunately, for both the panel data regression over the firms labelled as financially constrained and unconstrained, all the independent variables are insignificant. Only the HP-index appears to be significant at the 5% level for the unconstrained firms. As expected, an increase of the HP-index (which would mean a firm becomes relatively more financially constraint, according to the HP index), leads to an increase in the lease-ratio. In general, nothing can be said about the substitutability effect of leasing and debt when dividing the sample into financially constrained firms and financially unconstrained firms.

Table 6: Results of regressions with lease ratio as the independent variable for firms labelled financially constrained (FC) and unconstrained (NFC) separately. Standard error between Parentheses underneath coefficients

	FC	NFC
constant	-0,07722	0,26981**
	(0,05865)	(0,10433)
Debt-ratio	0,02522	-0,01713
	(0,09961)	(0,05792)
KZ	0,01550	-0,00001
	(0,00927)	(0,00006)
WW	0,00078	0,00039
	(0,00769)	(0,00223)
HP	-0,05312	0,05609**
	(0,07871)	(0,02503)
RDSales	-0,08072	-0,01411
	(0,35236)	(0,04281)
Tax incentive	-0,00992	0,00002
	(0,01051)	(0,00338)
Adjusted R^2	0,2618	0,212

Significance levels: 10% *, 5% **, 1% ***

Standard errors adjusted for clusters within firms

To test whether financially constrained firms lease more in comparison to their less constrained peers, the model specified in Table 12 in Appendix A was run. The results of the panel data regression can be viewed down below in Table 7.

All variables, besides the control variables RDSales and Tax incentive, appear to be significant. Since the NFC coefficient is negative and significant at the 1% level, one can conclude that the firms labelled as being financially unconstrained make on

Table 7: Panel data regression with Lease-ratio being the independent variable, including the financially constrained and financially unconstrained dummies.

Significance at 1%***, 5%** and 10* respectively.

	Coefficient	Clustered SE
Constant	0,05191***	0,00373
Debt-ratio	0,08769***	0,02640
FC	0,00712*	0,00422
NFC	-0,01099***	0,00365
RDSales	-0,01702	0,01677
Taxincentive	0,00178	0,00394

Adj. R^2: 0,0988 SE adjusted for 52 clusters in Firm

average less use of operating leases. On the other hand, although the FC dummy variable is only significant at the 10% level, the financially constrained firms appear to make more use of operating leases on average. The Debt-ratio variable's coefficient is again positive and significant (at the 1% level), indicating an increase in the debt-ratio implies an increase of the lease-ratio. This signals again that debt and operating leases appear to act as complements, rather than substitutes, for this sample.

6. Discussion & conclusion

6.1 Summary results

The aim of this thesis was to test whether financially constrained firms make more use of operating leasing. In the literature on financial constraints, three indices have been determined and frequently used to label firms either constrained or unconstrained. These indices are the KZ-, WW- and HP-index. All three are based on different assumptions and characteristics which presumably distinguish financial constraints.

The first objective was to test whether these indices classify the same firms as being financially constrained. This has been done through a crosstabulation analysis of each index' terciles, by means of a correlation test and through ordered probit regressions.

At best, 12 out of 16 firms were labelled the same by two indices in a specific year[5]. The correlation test was run to see whether the financial constraint indices perceive the same phenomenon. In general, the correlations between the indices are insignificant, apart for the correlation between the KZ and WW index. Although significant, the correlation between these two indices is rather low: 0,1232. Furthermore, the ordered probit regressions show that only the WW-index appears to significantly predict in what KZ-tercile a firm will end up in. Consequently, these indices do not label all the same firms as constrained. These indices focus on different aspects, features and characteristics, supposedly distinguishing constraints. Therefore, it is unsurprising that these indices label different firms as being constrained or unconstrained. Although there is some overlap, the goal of these indices is to label a firm's financial constraints. Therefore, double labeling can be seen as attaching more value to overlapping elements of the indices. It appears both cash-flow and dividends are considered to be of importance in labelling a firm constrained [6] (Fazzari et al., 1988; Lamont et al., 2001; Whited & Wu, 2006).

The next hypotheses concern operating leasing. The first objective was to test whether leasing and debt act as substitutes in this sample. The opposite seems to be the case when taking the entire sample into account. In Table 5 in the results section, the lease-ratio appears to increase with the debt-ratio. This indicates debt and leasing are complements, which is in line with the studies of Ang & Peterson (1984) and Lewis & Schallheim (1992). Furthermore, leasing may even preserve debt capacity (Eisfeldt & Rampini, 2009; Rampini & Viswanathan, 2013; Liu, 2021).

Although insignificant, the panel data regression on the financially constrained firms has a negative coefficient for the variable debt-ratio, meaning leasing and debt act as substitutes for these firms[7]. However, due to the insignificance, no conclusions can be drawn for the third hypothesis. The result is most likely insignificant, due to the relatively small sample size and the variables not being normally distributed.

[5] Appendix B, crosstabulation between the KZ- and WW-index in 2012. Out of the 16 firms labelled as financially unconstrained by the KZ-index, 12 of those firms were also labelled as financially unconstrained by the WW-index.
[6] For instance, both cash flow and dividends are part of the KZ and WW index
[7] See Table 6 in the results section. For the financially unconstrained firms, the coefficient is positive. Meaning leasing and debt would act as complements for these firms. However, the coefficient is insignificant as well, meaning no conclusions can be drawn.

In contrast, the regression run for testing the last hypothesis did return significant coefficients. As can viewed in Table 7 in the results section, the financially constrained firms lease more on average than the financially unconstrained firms. These results are in accordance with the results of Lin et al. (2013) and Liu (2021).

In general, it appears financially constrained firms lease more than their unconstrained peers.

6.2 Limitations

This thesis has several limitations. First, the small sample size arguably has led to insignificant results, especially for the regressions on the subsamples. Furthermore, it appears the HP-index, based on size and age, doesn't seem to be entirely applicable on the sample. Following Hadlock & Pierce (2010), age and size have been minorized by setting the maximum age (years listed) at 37 and size (total assets) at 4.5 billion. The average size and age over the entire sample was 13,35 billion and 28 years respectively, leading to exclusively negative values[8] and quite some outliers for the HP-index. In general, for all three indices: whether these measures do in fact measure financial constraints is doubted in the literature (Farre-mensa & Ljungqvist, 2016). Besides that, the coefficients of the indices are not calibrated for the sample used for this thesis, which causes parameter instability (Farre-mensa & Ljungqvist, 2016). Although I have realized this is a concern, re-estimating the models of the indices falls outside the scope of this thesis

Moreover, the estimation of operating lease liabilities is based on current year's operating lease expense and the operating lease commitments over the next five years, found in the footnotes of annual reports. This only reflects current contracts. However, operating lease contracts are often renewed. Consequently, this method of estimating operating lease liabilities does not take into account that operating leases often are a permanent component of a firm's capital structure. This may lead to an underestimation of operating lease liabilities (Liu, 2021).

6.3 Future research

For future research, when studying firms' decisions regarding operating leasing prior IFRS 16, using a larger and more diverse sample presumably leads to more significant

[8] Descriptive statistics of the HP-index can be viewed in Table 8-10 in the Appendix.

results. Including private firms will shed more light on the phenomenon of financial constraints, as these firms arguably are more likely to be financially constrained. Furthermore, with the implementation of IFRS 16 in 2019, some significant changes regarding the way leases are reported went into effect. IFRS 16 now requires capitalization of operating leases on balance sheets. How this influences relative heavy users of operating leases, especially those labelled as financially constrained in some manner, may be an interesting topic for future research.

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Appendix A

Table 1: Overview of the final sample

ISIN	Company name	GIC	GIC INDUSTRY GROUP
NL0000334118	ASM INTERNATIONAL NV	4530	SEMICONDUCTORS & SEMICONDUCTOR EQUIPMENT
NL0000009538	KONINKLIJKE PHILIPS NV	3510	HEALTH CARE EQUPMENT & SERVICES
GB00BP6MXD84	SHELL PLC	1010	ENERGY
NL0013267909	AKZO NOBEL NV	1510	MATERIALS
NL0011794037	KONINKLIJKE AHOLD DELHAIZE	3010	FOOD & STAPLES RETAILING
NL0006237562	ARCADIS NV	2010	CAPITAL GOODS
NL0010273215	ASML HOLDING NV	4530	SEMICONDUCTORS & SEMICONDUCTOR EQUIPMENT
NL0000009082	KONINKLIJKE KPN NV	5010	TELECOMMUNICATION SERVICES
NL0000200384	CORE LABORATORIES NV	1010	ENERGY
NL0012866412	BESI-BE SEMICONDUCTOR INDS	4530	SEMICONDUCTORS & SEMICONDUCTOR EQUIPMENT
LU1598757687	ARCELORMITTAL	1510	MATERIALS
NL0006144495	RELX NV	1510	MATERIALS
NL0000386605	TELEGRAAF MEDIA GROEP NV	5020	MEDIA & ENTERTAINMENT
NL0010583399	CORBION NV	1510	MATERIALS
NL0009432491	VOPAK (KONINKLIJKE) NV	1010	ENERGY
NL0000395903	WOLTERS KLUWER NV	2020	COMMERCIAL & PROFESSIONAL SERVICES
ANN4327C1220	HUNTER DOUGLAS NV	2520	CONSUMER DURABLES & APPAREL
NL0000009827	KONINKLIJKE DSM NV	1510	MATERIALS
NL0000337319	KONINKLIJKE BAM GROEP NV	2010	CAPITAL GOODS
NL0000370419	ORANJEWOUD NV	2010	CAPITAL GOODS
NL0000852580	BOSKALIS WESTMINSTER NV	2010	CAPITAL GOODS
NL0000852564	AALBERTS NV	2010	CAPITAL GOODS
NL0000852523	TKH GROUP NV	2010	CAPITAL GOODS
NL0000371243	NEDAP NV	4520	TECHNOLOGY HARDWARE & EQUIPMENT
NL0000313286	AMSTERDAM COMMODITIES NV	3010	FOOD & STAPLES RETAILING
NL0000379121	RANDSTAD NV	2020	COMMERCIAL & PROFESSIONAL SERVICES
NL0000009165	HEINEKEN NV	3020	FOOD, BEVERAGE & TOBACCO
NL0009739416	POSTNL NV	2030	TRANSPORTATION
NL0006292906	BATENBURG TECHNIEK NV	2020	COMMERCIAL & PROFESSIONAL SERVICES
NL00150003E1	FUGRO NV	2010	CAPITAL GOODS
NL0000430106	GEOJUNXION NV	4510	SOFTWARE & SERVICES
NL0009269109	HEIJMANS NV	2010	CAPITAL GOODS
NL0000440311	HOLLAND COLOURS NV	1510	MATERIALS
NL0000440618	NEWAYS ELECTRONICS INTERNTL	4520	TECHNOLOGY HARDWARE & EQUIPMENT
NL0000440477	ROODMICROTEC NV	4530	SEMICONDUCTORS & SEMICONDUCTOR EQUIPMENT
NL0000852531	KENDRION NV	2510	AUTOMOBILES & COMPONENTS
NL0000378669	PORCELEYNE FLES (NV KONINK)	2520	CONSUMER DURABLES & APPAREL
NL0000440584	ORDINA NV	4510	SOFTWARE & SERVICES
NL0000339703	BETER BED HOLDING NV	2550	RETAILING
NL0010776944	BRUNEL INTERNATIONAL NV	2020	COMMERCIAL & PROFESSIONAL SERVICES
NL0009391242	HYDRATEC INDUSTRIES NV	1510	MATERIALS
NL0000442523	KONINKLIJKE BRILL NV	5020	MEDIA & ENTERTAINMENT

ISIN	Company name	GIC	GIC INDUSTRY GROUP
NL0000345577	CTAC NV	4510	SOFTWARE & SERVICES
NL0009767532	ACCELL GROUP NV	2520	CONSUMER DURABLES & APPAREL
NL0010391025	PHARMING GROUP NV	3520	PHARMACEUTICALS, BIOTECHNOLOGY & LIFE SCIENCES
NL0010389508	TIE KINETIX NV	4510	SOFTWARE & SERVICES
NL0000400653	GEMALTO	4510	SOFTWARE & SERVICES
BE0003818359	GALAPAGOS NV	3520	PHARMACEUTICALS, BIOTECHNOLOGY & LIFE SCIENCES
NL0013332471	TOMTOM NV	4510	SOFTWARE & SERVICES
NL0000888691	AMG ADVANCED METALLURGICAL	1510	MATERIALS
LU0569974404	APERAM SA	1510	MATERIALS

Table 2: Description of the sample selection procedure

Sample selection criteria	# firms
All fims listed in period 2012-2017	118
Not listed for the entire period	33
PPE equals zero for atleast one year	10
No complete data on market cap	19
AFC Ajax and Heinken holding	2
Final sample	52
Firm years	312

Table 3: Average lease ratio for each GIC industry group

GIC Industry Group	Firm count	Average lease-ratio
SEMICONDUCTORS & SEMICONDUCTOR EQUIPMENT	4	0,0222
HEALTH CARE EQUPMENT & SERVICES	1	0,0233
ENERGY	3	0,0355
MATERIALS	9	0,0219
FOOD & STAPLES RETAILING	2	0,0699
CAPITAL GOODS	8	0,0719
TELECOMMUNICATION SERVICES	1	0,0373
MEDIA & ENTERTAINMENT	2	0,0687
COMMERCIAL & PROFESSIONAL SERVICES	4	0,0663
CONSUMER DURABLES & APPAREL	3	0,0343
TECHNOLOGY HARDWARE & EQUIPMENT	2	0,0208
FOOD, BEVERAGE & TOBACCO	2	0,0269
TRANSPORTATION	2	0,0605
SOFTWARE & SERVICES	1	0,1393
AUTOMOBILES & COMPONENTS	6	0,0183
RETAILING	1	0,2785
PHARMACEUTICALS, BIOTECHNOLOGY & LIFE SCIENCES	1	0,0380

Table 4: Financial constraints indices

Financial constraint Index	Formulas & definitions
Kaplas and Zingales index	(1)KZ = -1.001909 Cash flow kz + 0.2826389 Tobin's Q + 3.139193 Leverage kz -39.3678 Dividends - 1.314759 Cash holding
Cash Flow kz	(Income before extraordinary items + depreciation and amortization)/property, plant and equipment (PPE)
Tobin's Q	(Market capitalization + total assets - common equity - deferred taxes)/total assets
Leverage kz	(total debt)/(total debt + stockholder's equity)
Dividends	(common dividends + preferred dividends) / PPE
Cash holding	(Cash + short-term investments) / PPE
Whited and Wu index	(2)WW = -0.091 Cash flow ww - 0.062 Dividend dummy + 0.021 Leverage WW -0.044 Log total assets + 1.02 Industry sales growth - 0.035 Sales growth
Cash flow ww	(Income before extraordinary items + depreciation and amortization)/Total assets
Dividend dummy	equal to one if the firm pays dividends, 0 otherwise
Leverage ww	Long-term debt/total assets
Log total assets	Natural logarithm of total assets
Industry sales growth	Firm's industry sales growth, based on firm's first three GIC digits
Sales growth	(Net $sales_t$ – net $sales_{t-1}$ / net $sales_{t-1}$)
Hadlock and Pierce (SA) index	(3) SA = -0.737 Size + 0.043 $Size^2$ -0.040 Age
Size	Natural logarithm of total assets (max value is 4.5 billion)
Age	Number of years firm is listed with a non-missing stock price in DataStream (max value 37 years)

Table 5: Descriptive statistics of all variables for all firms.

Observations: 312	Mean	SD	Min	Max
Lease-ratio	0,0584	0,0691	0,0021	0,3380
Debt-ratio	0,1121	0,0957	0	0,5076
Market capitalization*	8514,19	26210,96	4,51	230970,10
Total assets*	13355,89	52494,72	9,02	411275,00
Market value firm*	16510,34	55536,56	9,37	411275,00
Age	28,008	6,985	7,00	37,00
R&D over sales	0,0743	0,2900	0	3,2787

*in millions

Table 6: Descriptive statistics of all variables for the FC firms.

Observations: 51	Mean	SD	Min	Max
Lease-ratio	0,0951	0,0994	0,0044	0,3371
Debt-ratio	0,1455	0,1043	0	0,4329
Market capitalization*	1289,34	3435,19	5,51	21458,35
Total assets*	3044,30	10994,26	11,95	75142,00
Market value firm*	3280,93	10110,00	12,67	75142,00
Age	18,49	6,995	1,00	32,00
R&D over sales	0,0658	0,2759	0	1,4950

*in millions

Table 7: Descriptive statistics of all variables for the NFC firms.

Observations: 125	Mean	SD	Min	Max
Lease-ratio	0,0951	0,0994	0,0044	0,3371
Debt-ratio	0,1455	0,1043	0	0,4329
Market capitalization*	1289,34	3435,19	5,51	21458,35
Total assets*	3044,30	10994,26	11,95	75142,00
Market value firm*	3280,93	10110,00	12,67	75142,00
Age	28,008	6,986	7,00	37,00
R&D over sales	0,0658	0,2759	0	1,4950

*in millions

Table 8: Descriptive statistics of financial constraint variables for the entire sample

FC indices	All firms			
observations: 312	Mean	SD	Min	Max
KZ*	-12,04602	23,70099	-86,55358	1,71943
WW*	-0,35732	0,59147	-1,69016	0,78557
HP*	-3,77287	0,60636	-4,63689	-1,89673

*All winsorized at 5% level

Table 9: Descriptive statistics of financial constraint variables for the FC firms

FC indices	FC firms			
observations: 312	Mean	SD	Min	Max
KZ*	0,26053	1,63009	-4,71253	1,71943
WW*	0,19319	0,38548	-0,48525	0,78557
HP*	-3,28320	0,49659	-4,08426	-2,26503

*all winsorized at 5% level

Table 10: Descriptive statistics of financial constraint variables for the NFC firms

FC indices	NFC firms			
observations: 312	Mean	SD	Min	Max
KZ*	-21,88317	30,65424	-86,55358	1,25442
WW*	-0,66315	0,46925	-1,69016	0,78557
HP*	-4,10238	0,54899	-4,63689	-1,89673

*All winsorized at 5% level

Table 11: Description of the first 4 models.

Model description	Formulas & definitions
Dependent variable:	
Lease-ratio	PV operating leases / market value of firm
determinants of Lease ratio:	
Lease-ratio	PV operating leases / market value of firm
Market value of firm	Book value of assets - book value of equity + market value of equity + PV operating leases
Independent variables:	
Debt-ratio	Total debt / market value firm
determinants of debt-ratio:	
Total debt	Long-term debt + short-term debt
Market value of firm	Book value of assets - book value of equity + market value of equity + PV operating leases
KZ index*	See Table 4
WW index*	See Table 4
HP index*	See Table 4
Control variables:	
R&D over sales	R&D expense / sales
Tax incentive	equal to one if a firm's pre-tax income is non-positive, else zero

*Separate regressions will be run with each index as the sole independent variable (including the controls). Thereafter, a regression is run with all three indices as the independent variables (including the controls).

Table 12: Description of the final model.

Model description	Formulas & definitions
Dependent variable:	
Lease-ratio	PV operating leases / market value of firm
Determinants of Lease ratio:	
Lease-ratio	PV operating leases / market value of firm
Market value of firm	Book value of assets - book value of equity + market value of equity + PV operating leases
Independent variables:	
Debt-ratio	Total debt / market value firm
Determinants of debt-ratio:	
Total debt	Long-term debt + short-term debt
Market value of firm	Book value of assets - book value of equity + market value of equity + PV operating leases
FC (financially constrained)	dummy variable equal to one if the firm is in the third tercile of the summed-up score
NFC (not financially constrained)	dummy variable equal to zero if the firm is in the third tercile of the summed-up score
Control variables:	
R&D over sales	R&D expense / sales
Tax incentive	equal to one if a firm's pre-tax income is non-positive, else zero

Appendix B – Crosstabulations between indices

Crosstabulation between KZ- and WW terciles by year

2012

KZ/WW	1st WW tercile	2nd WW tercile	3rd WW tercile	total
1st KZ tercile	12	2	2	16
Row %	75%	12,50%	12,50%	
2nd KZ tercile	9	4	3	16
Row %	56,25%	25%	18,75	
3rd KZ tercile	8	8	4	20
Row %	40%	40%	20%	
total:	29	14	9	52

Pearson chi2(4) = 4,7987 P = 0,309

2013

KZ/WW	1st WW tercile	2nd WW tercile	3rd WW tercile	total
1st KZ tercile	2	6	6	14
Row %	14,29%	42,86%	42,86%	
2nd KZ tercile	9	5	3	17
Row %	52,94%	29,41%	17,65%	
3rd KZ tercile	6	5	10	21
Row %	28,57%	23,81%	47,62%	
total:	17	16	19	52

Pearson chi2(4) = 7,2167 P = 0,125

2014

KZ/WW	1st WW tercile	2nd WW tercile	3rd WW tercile	total
1st KZ tercile	5	7	5	17
Row %	29,41%	41,18%	29,41%	
2nd KZ tercile	3	9	3	15
Row %	20%	60%	20%	
3rd KZ tercile	6	7	7	20
Row %	30%	35%	35%	
total:	14	23	15	52

Pearson chi2(4) = 2,3123 P = 0,679

2015

KZ/WW	1st WW tercile	2nd WW tercile	3rd WW tercile	total
1st KZ tercile	9	2	5	16
Row %	56,25%	12,50%	31,25%	
2nd KZ tercile	9	7	4	20
Row %	45%	35%	20%	
3rd KZ tercile	6	4	6	16
Row %	37,50%	25%	37,50%	
total:	24	13	15	52

Pearson chi2(4) = 3,4088 P = 0,492

2016

KZ/WW	1st WW tercile	2nd WW tercile	3rd WW tercile	total
1st KZ tercile	3	10	7	20
Row %	15%	50%	35%	
2nd KZ tercile	2	10	8	20
Row %	10%	50%	40%	
3rd KZ tercile	3	3	6	12
Row %	25%	25%	50%	
total:	8	23	21	52

Pearson chi2(4) = 2,8234 P = 0,588

2017

KZ/WW	1st WW tercile	2nd WW tercile	3rd WW tercile	total
1st KZ tercile	4	8	9	21
Row %	19,05%	38,10%	42,86%	
2nd KZ tercile	3	4	9	16
Row %	18,75%	25%	56,25%	
3rd KZ tercile	5	3	7	15
Row %	33,33%	20%	46,67%	
total:	12	15	25	52

Pearson chi2(4) = 2,4206 P = 0,659

Crosstabulation of KZ- and HP-terciles by year

2012

KZ/HP	1st HP tercile	2nd HP tercile	3rd HP tercile	total
1st KZ tercile	4	4	8	16
Row %	25%	25%	50,00%	
2nd KZ tercile	7	5	4	16
Row %	43,75%	31,25%	25%	
3rd KZ tercile	3	7	10	20
Row %	15%	35%	50%	
total:	14	16	22	52

Pearson chi2(4) = 4,6877 P = 0,321

2013

KZ/HP	1st HP tercile	2nd HP tercile	3rd HP tercile	total
1st KZ tercile	4	3	7	14
Row %	28,57%	21,43%	50,00%	
2nd KZ tercile	8	5	4	17
Row %	47,06%	29,41%	23,53%	
3rd KZ tercile	4	7	10	21
Row %	19,05%	33,33%	47,62%	
total:	16	15	21	52

Pearson chi2(4) = 4,6299 P = 0,327

2014

KZ/HP	1st HP tercile	2nd HP tercile	3rd HP tercile	total
1st KZ tercile	5	5	7	17
Row %	29,41%	29,41%	41,18%	
2nd KZ tercile	6	4	5	15
Row %	40%	26,67%	33,33%	
3rd KZ tercile	6	9	5	20
Row %	30%	45%	25%	
total:	17	18	17	52

Pearson chi2(4) = 2,1134 P = 0,715

2015

KZ/HP	1st HP tercile	2nd HP tercile	3rd HP tercile	total
1st KZ tercile	5	6	5	16
Row %	31,25%	37,50%	31,25%	
2nd KZ tercile	8	5	7	20
Row %	40%	25%	35%	
3rd KZ tercile	5	7	4	16
Row %	31,25%	43,75%	25%	
total:	18	18	16	52

Pearson chi2(4) = 1,5212 P = 0,823

2016

KZ/HP	1st HP tercile	2nd HP tercile	3rd HP tercile	total
1st KZ tercile	6	8	6	20
Row %	30%	40%	30%	
2nd KZ tercile	8	7	5	20
Row %	40%	35%	25%	
3rd KZ tercile	4	5	3	12
Row %	33,33%	41,67%	25%	
total:	18	20	14	52

Pearson chi2(4) = 0,5172 P = 0,972

2017

KZ/HP	1st HP tercile	2nd HP tercile	3rd HP tercile	total
1st KZ tercile	8	9	4	21
Row %	38,10%	42,86%	19,05%	
2nd KZ tercile	7	4	5	16
Row %	43,75%	25%	31,25%	
3rd KZ tercile	6	4	5	15
Row %	40%	26,67%	33,33%	
total:	21	17	14	52

Pearson chi2(4) = 2,0165 P = 0,733

Crosstabulation of WW- and HP-terciles by year

2012

WW/HP	1st HP tercile	2nd HP tercile	3rd HP tercile	total
1st WW tercile	9	7	13	29
Row %	31,03%	24,14%	44,83%	
2nd WW tercile	4	6	4	14
Row %	28,57%	42,86%	28,57	
3rd WW tercile	1	3	5	9
Row %	11,11%	33,33%	55,56%	
total:	14	16	22	52

Pearson chi2(4) = 3,1718 P = 0,530

2013

WW/HP	1st HP tercile	2nd HP tercile	3rd HP tercile	total
1st WW tercile	7	4	6	17
Row %	41,18%	23,53%	35,29%	
2nd WW tercile	8	6	2	16
Row %	50,00%	37,50%	12,50%	
3rd WW tercile	1	5	13	19
Row %	5,26%	26,32%	68,42%	
total:	16	15	21	52

Pearson chi2(4) = 14,0507 P = 0,007

2014

WW/HP	1st HP tercile	2nd HP tercile	3rd HP tercile	total
1st WW tercile	4	6	4	14
Row %	28,57%	42,86%	28,57%	
2nd WW tercile	10	7	6	23
Row %	43,48%	30,43%	26,09%	
3rd WW tercile	3	5	7	15
Row %	20%	33,33%	46,67%	
total:	17	18	17	52

Pearson chi2(4) = 3,3040 P = 0,508

2015

WW/HP	1st HP tercile	2nd HP tercile	3rd HP tercile	total
1st WW tercile	12	5	7	24
Row %	50,00%	20,83%	29,17%	
2nd WW tercile	5	4	4	13
Row %	38,46%	30,77%	30,77%	
3rd WW tercile	1	9	5	15
Row %	6,67%	60%	33,33%	
total:	18	18	16	52

Pearson chi2(4) = 9,2984 P = 0,054

2016

WW/HP	1st HP tercile	2nd HP tercile	3rd HP tercile	total
1st WW tercile	2	2	4	8
Row %	25%	25%	50%	
2nd WW tercile	8	10	5	23
Row %	34,78%	43,48%	21,74%	
3rd WW tercile	8	8	5	21
Row %	38,10%	38,10%	23,81%	
total:	18	20	14	52

Pearson chi2(4) = 2,7031 P = 0,609

2017

WW/HP	1st HP tercile	2nd HP tercile	3rd HP tercile	total
1st WW tercile	6	3	3	12
Row %	50%	25%	25%	
2nd WW tercile	7	3	5	15
Row %	46,67%	20%	33,33%	
3rd WW tercile	8	11	6	25
Row %	32%	44%	24%	
total:	21	17	14	52

Pearson chi2(4) = 3,1154 P = 0,539