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The impact of debt maturity on stock returns

A quantitative study of the Japanese stock market

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Abstract

This thesis presents how debt maturity affects equity returns in the Japanese stock market. Some studies have been done on the topic in the US, but the research in Japan is limited. When applying a cross-sectional approach to our dataset, we find that a shorter maturity structure is associated with a positive premium.

Further, we make portfolios based on different leverage metrics. The portfolios with a high amount of short-term leverage have a higher average return than the portfolios with a low amount of short-term leverage. We also regress the portfolios against the CAPM, FF3 and FF5 to study the exposure to systematic risk. We do not find a significant alpha, but there is a positive significant loading on several of the systematic risk factors.

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1. Introduction

In this thesis, we will empirically test if there is a relation between debt maturity and excess returns. Our analysis is motivated by the relative cost and benefits of short-term debt compared to long term-debt. Short-term debt exposes equity holders to debt rollover risk, while long-term debt does not (He and Xiong, 2012). However, short-term debt may increase a firm's financial flexibility compared to long-term debt (Dangl and Zechner, 2021). Therefore, we have two economic forces which impact the equity risk in opposite directions. Research studying these effects has given contradictive results. Chaderina, Weiss and Zechner (2022) argue for a long-term maturity premium, while Friewald, Nagler and Wagner (2022) argue that shorter maturity is compensated with higher returns.

In this thesis, we apply the research-methodology used by Friewald et al. (2022). We will research the Japanese stock market to inspect if the findings done by Friewals et al. (2022) is consistent in a different market. We want to test the notion that shareholders care about the firm's maturity structure, and therefore price short-term and long-term leverage differently. Our hypotheses are as follows:

H1: *There is a positive risk premium associated with shorter debt maturity*

H2: *The debt maturity risk premium can be explained by systematic risk factors*

To test our hypothesis, we create a ratio for debt that is due in one year or less compared to total debt. We then sort firms into portfolios based on this ratio as well as size and leverage ratio. The average returns for these portfolios show that firms with shorter maturity give higher returns. Further, we regress short-term- and long-term leverage against CAPM, Fama and French 3 factor and 5 factor model. The exposure to systematic risk factors is not able to explain the higher returns for short-term leverage.

In the first section we present the development of the most relevant theory done on the topic to establish a theoretic magnitude for our research. This is followed by a data section rationalising the data selection done in the thesis. The next section explains the methodology used in the thesis inspired by previous research. Thereafter, the results of our studies are presented and discussed, before finishing off with our conclusion.

2. Literature review

A full understanding of the chosen capital structure of a firm and how its leverage is likely to evolve over time has yet to be identified. Still, there has been done a lot of research that contributes to give a better understanding of the capital structure puzzle. In this part, we will present theory that we think has had a big impact on the topic, and look at the development of these theories evolving into newer research.

2.1 Leverage ratio

Deciding the leverage ratio of a firm is a crucial financial decision. In our thesis, leverage ratio is an important factor, and we have therefore gathered some studies on how leverage affects firm value and returns.

Modigliani and Miller (henceforth referred to as MM) have had a huge influence on leverage theory. Their first proposition claims that the company's capital structure does not impact its value in a perfectly efficient market (Modigliani and Miller, 1958). The second proposition states that the company's cost of equity is directly proportional to the company's leverage level. An increase in leverage level induces a higher default probability for the company. Therefore, investors demand a higher cost of equity to be compensated for the additional risk.

MM (1958) elaborates that with a corporate income tax, under which interest is a deductible expense, gains can accrue to stockholders from having debt in the capital structure, even when capital markets are perfect. This is backed by Bhandari (1988), who states that the expected common stock returns are positively related to the ratio of debt to equity, controlling for the beta and firm size.

This might substantiate what is later to be called the trade-off theory, where Kraus and Litzenberger (1973) argue that the firms have a trade-off between tax-shield advantages and the cost of bankruptcy that increases with the leverage ratio. Criticism of this theory however is that the tax shield can't be the only incentive for debt, as debt financing was common before corporate income taxes (Braudel, 1982). Fischer et al (1989) later introduced transaction costs to a dynamic model based on the trade-off theorem. Hennessy and Whited (2005) also implement corporate and personal taxes, financial distress costs, and equity flotation costs in their model.

Another well-known theory that might be seen as the competing theory to the trade-off theory is what Myers (1984) calls the pecking order theory. This theory argues that firms follow a specific order in the chase of financing: first retained earnings, then to issue debt and at last financing through equity. Criticism to this theory is that it empirically seems to be other drivers for debt issuing than the financing deficit (Frank and Goyal, 2003).

The reason for the positive association between leverage and returns is not only because of tax write-offs. Gomes and Schmid (2010) find that the link between leverage and stock returns depends on the investment opportunities available to the firm. In the presence of financial market imperfections, leverage and investment are generally correlated so that highly levered firms are also mature firms with relatively more safe book assets and fewer risky growth opportunities.

Admati et al. (2018) argue that shareholders resist reduction in leverage no matter how big positive effect it might have on firm value. They also argue that shareholders would choose to increase leverage, even if this would mean a reduction in firm value. Admati et al. (2018) call this unrationed behavior the leverage ratchet effect. The effect is making the shareholders biased if forced to a leverage reduction by making them favor selling assets instead of a recapitalization that is more efficient.

2.2 Long-term debt vs. Short-term debt

Leverage ratio is an area that has undergone a good amount of research. However, we want to keep our main focus on the impact of debt-maturity for stock returns. In this section we present theories on the positive and negative sides of short-term and long-term financing.

First, we look at flexibility vs. rollover risk. He and Xiong (2012) show that short-term debt exposes equity holders to debt rollover risk, while long-term debt does not. Debt rollover risk is a risk associated with the refinancing of debt. Rollover risk is faced by companies when a loan or other debt obligation is about to mature and needs to be converted into new debt. If interest rates have risen in the meantime, they would have to refinance their debt at a higher rate than before (Segal, 2022).

On the other hand, short-term debt may increase a firm's financial flexibility (Dangl and Zechner, 2021). A firm with a higher fraction of short maturity debt has greater flexibility by reducing its leverage in relatively bad states. This flexibility increases the value of the firm since it can operate with higher debt ratios, thereby shielding its taxable income more effectively.

There are also other reasons for why tax is an important factor in determining debt maturity. While short-term debt does not exploit tax benefits as completely as long-term debt, it is more likely to provide incentive compatibility between debt holders and equity holders. Short-term debt reduces or eliminates "asset substitution" agency cost. This agency cost can be explained with risk-shifting. Risk shifting comes with information asymmetry between the lender and the borrower, where the lender has limited control over which project that is undertaken after the loan is given. The borrower then might undertake a riskier project than promised to the lender, giving the borrower a higher expected return on behalf of the lender. The tax advantage of debt must therefore be balanced against bankruptcy and agency costs in determining the optimal maturity of the capital structure (Leland and Toft, 1996).

From the previous theories, it may seem like leverage maturity is a result of strategy. However, Barclay and Smith Jr. (1995) argue that debt maturity is rather a consequence of size and beta. They find that firms that either have few growth options, are large, or are regulated have more long-term debt in their capital structure. In terms of beta, Chen, Xu and Yang (2021) find that higher-beta firms tend to have a longer maturity.

Size and beta are not the only factors in determining the debt maturity of a firm. An explanation for firms having shorter maturity can be the maturity rat race. Brunnermeier and Oehmke (2012) show that extreme reliance on short-term financing may be the outcome of a maturity rat race. This is a scenario where a borrower may have an incentive to shorten the maturity of an individual creditor's debt contract because this dilutes other creditors. In response, other creditors opt for shorter maturity contracts as well.

More recent research in the US shows that there is a risk premium with longer debt maturities that is not explained by unconditional factors. Chaderina, Weiss and Zechner (2022) use an asset pricing framework where the market price of risk evolves with the business cycle. Embedding dynamic capital structure choices into this model shows that firms with more long-term debt have more countercyclical leverage. They argue for a long-term maturity premium above zero controlled on both firms with long and short maturity.

Friewald, Nagler and Wagner (2022) also found empirical evidence that the maturity structure of financial leverage affects the cross-section of equity returns in the US. However, they found that short-term leverage is associated with a positive premium, but not long-term leverage like Chaderina et al. presented. The biggest difference is that Friewald et al. argue that leverage and debt maturity effects need to be studied jointly, resulting in a premium for higher maturity that is not significant different from zero. It is the consistency of these results we want to verify for another market in our thesis.

2.3 Fama French

We want to understand if there is a premium associated with debt maturity and if the premium can be explained by systematic or unsystematic risk. For the latter question we will use theory from the Fama-French Model, which is an asset pricing model developed in 1992. Fama-French is much used to interpret leverage-related return patterns in research. We will use it as standard benchmarks in our empirical asset pricing.

The Fama-French model expands on the capital asset pricing model by adding size-risk and value-risk factors to the market risk factor in CAPM. This model considers the fact that value- and small-cap stocks outperform market on a regular basis in the US. In 2014, Fama and French adapted their model to include five factors (FF5). Along with the original three factors (FF3), the new model adds the concept that companies reporting higher future earnings have higher returns in the stock market, a factor referred to as profitability. The fifth factor, referred to as investment, suggests that companies directing profit towards major growth projects are likely to experience losses in the stock market (Hayes, 2022). Fama and French (1992) also provide evidence that leverage effects are captured by firms' book-to-market. In other words, leverage affects the expected stock price.

3. Methodology

In this section, we will first present our data selection and data collection. Moreover, we describe our variables used in the thesis. In the end, we will explain our methodology used to investigate our hypothesis.

3.1 Data selection

In our thesis, we want to replicate the studies done by Friewald, Nagler and Wagner (2022). We are depending on a large population to make good models. We have therefore chosen the Japanese stock market, as Japan has the second-largest stock market in the world by share of the total world equity market value (Statista, 2022). Japan exchange group (2022) reports that it is approximately 3 800 companies listed on Japan stock markets in October 2022.

Friewald et al. (2022) separate between long-term debt maturing in three years or less and debt with a longer maturity. This is also the method used by Chaderina, Weiss and Zechner (2022), Barclay and Smith (1995) and Custódio et al. (2013). Our thesis, however, does not follow previous research as we segregate between long-term debt maturing in one year or less and debt with longer maturity[1].

3.2 Data collection

Our data consist of Japanese-listed firms from 1990 to 2021. The financial- and accounting data is downloaded from Wharton Research Data Services (WRDS). For our spanning regressions, we use the Fama-French Japanese 5 factor monthly data downloaded from the Kenneth R. French website (French, n.d). We have used Compustat – Capital IQ Global for all financial and accounting data. The financial data was only available as daily observations,

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[1] *Friewald et al. (2022) uses the variables dd2, dd3, dd4 and dd5 for debt maturing in 2, 3, 4 and 5 years respectively. These factors have been removed by Compustat. Chaderina et al. (2022) find that "Incorporating information on the dispersion between different maturity buckets by calculating a weighted average maturity in years from Compustat" did not change their main results. Therefore, using a segregation between dd1 and total long-term debt should not have a big impact on our conclusion.*

therefore, we have calculated returns and the other variables on a monthly basis as described below. To make sure that the accounting data was publicly available before the comparable returns, we use a lag of three months. We choose three months as Japanese firms are required to report annual reports within 3 months of their financial calendar year end (Covrig and Low, 2005). We have then merged the financial dataset with the lagged accounting data downloaded from the Fundamentals Annual page on Compustat.

To make sure that our data only consist of one observation per firm at a given time, we only include the first issued stocks. Further, we remove firms that are missing the necessary accounting data to calculate the variables we have described below. Following Davis, Fama and French (2000) we exclude all firms with nonpositive book equity. As the equity variable downloaded had a lot of missing values, we generated our own as described below. Firms with nonpositive total assets are also removed. In addition, we set missing values of dd1 (long-term debt maturing in 1 year) and dltt (Long term debt total) to zero inspired by Cooper, Gulen and Schill (2008). We then require dd1 and dltt to be greater than zero. By following Almeida et al. (2011) we remove observations where total debt (dd1 + dltt) is greater than total assets (at).

The financial firms are removed by sorting the companies based on Standard Industrial Classification (SIC) following Fama and French (1992). All firms in the range of SIC-code 6000-6999 are classified as financial firms.

As we in our studies are interested in the effect of debt, we do not include firms with either no debt or a very low proportion of debt. Strebulaev and Yang (2013) define firms with less than 5% leverage ratio as almost zero leverage firms (AZL). Strebulaev and Yang (2013) argue that multiples for AZL firms and levered firms must be interpreted differently. We therefore follow them and Friewald et al. (2022) and control for AZL firms. Further, we also control for microcap firms, as we don’t want these firms to be overrepresented in the regression. We choose to control for the 10 percentile firms with the lowest market capitalization.

3.3 Description of variables

3.3.1 Book equity

We calculate the book value of equity by taking total assets (at) and subtract total liabilities (lt):

$$Book\ equity = at - lt \qquad (1)$$

3.3.2 Market capitalization

The market cap is calculated by multiplying the daily closing price (prccd) with the number of shares outstanding (cshoc). Because the short-term debt and the long-term debt variables are in millions, we convert the market cap to millions by dividing it by 1 000 000:

$$marketcap = \frac{prccd \cdot cshoc}{1\ 000\ 000} \qquad (2)$$

3.3.3 Monthly Returns

The dependent variable in our thesis is monthly returns, but it is not directly available from Capital IQ. To get returns we first downloaded the necessary factors from Compustat Global to calculate the daily returns ourselves in STATA. In addition to the daily closing price (PRCCD), we also used the adjustment factors AJEXDI and TRFD. By doing so we have adjusted for stock splits, cash equivalent distribution, reinvestment of dividends and the compounding effect of dividends paid on reinvested dividends (Wharton University, 2020). The formula for daily returns is then:

$$Daily\ Returns = \left(\frac{\left(\left(\frac{PRCCD_n}{AJEXDI_n} \right) \cdot TRFD_n \right)}{\left(\left(\frac{PRCCD_{n-1}}{AJEXDI_{n-1}} \right) \cdot TRFD_{n-1} \right)} \right) - 1 \qquad (3)$$

To get the monthly returns we have used a STATA-package called ascol. Ascol converts asset returns from a daily to a monthly frequency by computing the products of the daily returns.

3.3.4 Value weighted monthly returns

In some instances, we want to know the value weighted return to avoid concerns that microcaps are overly represented as suggested by Hou, Xue, and Zhang (2020). The value weighted return is the monthly return of a stock multiplied with the weight of the stock in a portfolio. Our portfolio weights are based on market cap, meaning the weight of a stock is the market cap of the company divided by the total market cap of the portfolio. Hence, the formula for the value weighted monthly return of an individual stock will be:

$$\frac{marketcap_{firm,t}}{marketcap_{total\ portfolio,t}} \cdot monthly\ return_{firm,t} \qquad (4)$$

To get the monthly return of a portfolio, we will simply take the aggregate of the weighted monthly return of all the companies in the portfolio.

3.3.5 Short-term debt ratio

Short-term debt ratio (STDR) is the amount of long-term debt maturing in one year or less (dd1) reletive to total long-term debt (dltt) and dd1. Dd1 includes current portion of all items classified as long-term interest-bearing obligations, current portion of finance lease obligations, current portion of hire purchase, loan installments and sinking fund payments. The variable dltt represents interest-bearing obligations due after the current year.

$$STDR = \frac{dd1}{dd1+dltt} \qquad (5)$$

3.3.6 Leverage ratio

We want to use leverage ratio as a control variable for our regressions. We have therefore calculated the leverage ratio by taking the total debt divided by the sum of total debt and market capitalization:

$$LEV = \frac{dd1+dltt}{dd1+dltt+marketcap} \qquad (6)$$

3.3.7 Long-term leverage

By following Friewald, Nagler and Wagner (2022) we make a new variable for long-term leverage (LTLEV) by multiplying the leverage ratio with long-term debt relative to total debt.

$$LTLEV = LEV * (1 - STDR) \quad (7)$$

3.3.8 Short-term leverage

Following Friewald, Nagler and Wagner (2022) we also make a new variable for short-term leverage (STLEV) by multiplying the leverage ratio with the short-term debt ratio.

$$STLEV = LEV * STDR \quad (8)$$

3.4 Fama-MacBeth and Newey-West

We have a panel dataset consisting of different firms over a period of time, meaning we have multiple observations on the same dates. Therefore, we will have a cross-sectional correlation between the firms. This correlation comes with risk of correlation in the error term between the firms as well. We therefore adjust for this following Friewald, Nagler and Wagner (2022) by using the Fama-MacBeth two-step regression (1973).

The first step consists of estimating the cross-sectional regressions for the companies (i) and each factor included in our data set. This estimates each company's exposure to each factor (f_j) for every period (t) in the following model:

$$r_{i,t} = \hat{\alpha}_{i,t} + \sum_j^J \hat{\beta}_i^j f_{j,t} + \hat{\epsilon}_{i,t} \quad (9)$$

The dependent variable is the return for company (i) at time (t) calculated as shown above, $\alpha_{i,t}$ is the constant intercept for company (i). $\widehat{\beta_i^J}$ denotes the factor's estimated coefficient and $f_{j,t}$ represent each company's different factor at time (t).

The second step consist of estimating the coefficient for each risk factor:

$$\widehat{\beta_J} = \frac{1}{T}\sum_{t=1}^T \beta_{j,t} \quad (10)$$

The $\hat{\beta}_j$ is calculated by taking the average of all the slopes from the first stage regression model and is the estimate for each factor in our model.

We test our data for heteroskedasticity by using the Breusch-Pagan test, where we reject the null hypothesis of homoscedasticity on a 1% significance level. Further we control for autocorrelation following Wooldridge (2002), and we reject the null hypothesis of no autocorrelation on a 1% significant level. As we believe we have heteroscedastic and autocorrelated data we follow Newey and West (1987) to calculate HAC standard errors. We use optimal truncation lag as suggested by Stock and Watson (2017).

3.5 Portfolio approach

3.5.1 Portfolios sorted on LEV and STDR

To get the results in part 4.2 we sort the firms into 18 portfolios, based on two ME quantiles (m=1,2), three LEV quantiles (n=1,2,3) and three STDR quantiles (o=1,2,3) as described in figure 1.

Figure 1: Portfolios sorted on ME, LEV and STDR

This figure shows how we have sorted the portfolios. First, we divide firms based on market cap, then on leverage ratio, and finally on short-term debt ratio. In the end we have 18 different portfolios as shown at the bottom of the figure.

The monthly value-weighted return for each portfolio is calculated based on the total market capitalization in each respective portfolio as described in 3.3.4. The average returns (r)

summarized in table 6 are then calculated for ME (low/high), LEV (low/high) and STDR (low/high) as follows[2]:

$$r_{ME,m,t} = \frac{\sum_{n=1}^{3}\sum_{o=1}^{3} r_t^{mno}}{9} \quad (11)$$

$$r_{LEV,n,t} = \frac{\sum_{m=1}^{2}\sum_{n=1}^{3} r_t^{mno}}{6} \quad (12)$$

$$r_{STDR,o,t} = \frac{\sum_{m=1}^{2}\sum_{o=1}^{3} r_t^{mno}}{6} \quad (13)$$

Using value-weighted return we calculate the excess return (R) between the “high” and “low” portfolios. The average excess returns for the market cap-, LEV- and STDR- portfolios are also referred to as the return differentials and are calculated as follows:

$$R_{ME,t} = \frac{\sum_{n=1}^{3}\sum_{o=1}^{3} R_t^{1no} - \sum_{n=1}^{3}\sum_{o=1}^{3} R_t^{2no}}{9} \quad (14)$$

$$R_{LEV,t} = \frac{\sum_{m=1}^{2}\sum_{o=1}^{3} R_t^{m3o} - \sum_{m=1}^{2}\sum_{o=1}^{3} R_t^{m1o}}{6} \quad (15)$$

$$R_{STDR,t} = \frac{\sum_{m=1}^{2}\sum_{n=1}^{3} R_t^{mn3} - \sum_{m=1}^{2}\sum_{n=1}^{3} R_t^{mn1}}{6} \quad (16)$$

3.5.2 Portfolios sorted on STLEV and LTLEV

To get the results in part 4.3 we sort the firms into 18 portfolios, based on two ME quantiles (m=1,2), three LTLEV quantiles (l=1,2,3), and three STLEV quantiles (s=1,2,3) as described in figure 2.

[2] Both the value weighted average returns and equally weighted returns follows theses formulas. The difference is that the respective returns are calculated differently before this step.

Figure 2: Portfolios sorted on ME, LTLEV and STLEV

This figure shows how we have sorted the portfolios. First, we divide firms based on market cap, then on LTLEV, and finally on STLEV. In the end we have 18 different portfolios as shown at the bottom of the figure.

The monthly value-weighted return for each portfolio is calculated based on the total market capitalization in each respective portfolio as described in 3.3.4. The average returns summarized in table 9 are then calculated for ME (low/high), LTLEV (low/high) and STLEV (low/high) as follows:

$$r_{ME,m,t} = \frac{\sum_{l=1}^{3} \sum_{s=1}^{3} R_t^{mls}}{9} \tag{17}$$

$$r_{LTLEV,l,t} = \frac{\sum_{m=1}^{2} \sum_{l=1}^{3} R_t^{mls}}{6} \tag{18}$$

$$r_{STLEV,s,t} = \frac{\sum_{m=1}^{2} \sum_{s=1}^{3} R_t^{mls}}{6} \tag{19}$$

Using value-weighted return we calculate the excess return (R) between the "high" and "low" portfolios. The average excess returns for the market cap-, LTLEV- and STLEV- portfolios are also referred to as the return differentials and are calculated as follows:

$$R_{ME,t} = \frac{\sum_{s=1}^{3} \sum_{l=1}^{3} R_t^{1ls} - \sum_{s=1}^{3} \sum_{l=1}^{3} R_t^{2ls}}{9} \tag{20}$$

$$R_{LTLEV,t} = \frac{\sum_{m=1}^{2} \sum_{l=1}^{3} R_t^{m3s} - \sum_{m=1}^{2} \sum_{l=1}^{3} R_t^{m1s}}{6} \tag{21}$$

$$R_{STLEV,t} = \frac{\sum_{m=1}^{2} \sum_{s=1}^{3} R_t^{ml3} - \sum_{m=1}^{2} \sum_{s=1}^{3} R_t^{ml1}}{6} \tag{22}$$

4. Results

In the first part of our empirical analysis, we run regressions to see if there is a link between debt maturity and stock returns. Later we explore how debt maturity affect returns by monthly constructing 18 portfolios. The portfolios also help us to control for leverage ratio and size when analysing the effect. In the summary statistics for the different portfolios the returns are both represented as equally weighted (EW) and value weighted (VW), in which the value weighted returns are weighted on the market capitalization inside each portfolio. To analyse the premium associated with refinancing risk we introduce spanning regressions against CAPM, FF3 and FF5. The spanning factors is the excess return between the portfolios with small and big market capitalization, high and low leverage ratio and high and low short-term debt ratio. In the last part of the thesis, we analyse the difference between premia associated with short-term- and long-term leverage. Where both the effect of leverage ratio and short-term debt ratio are studied jointly.

4.1 Regression results

In this part we present our regression results that we have implemented in two ways. First, we run ordinary least squares regressions (Fama MacBeth OLS). Second, we run weighted least squares regressions (Fama MacBeth WLS) to avoid concerns that the data is overly affected by microcaps. We have used market capitalization as weights for the WLS regressions. To emphasise the effect of AZL and microcap firms, we separately run regression controlling for these factors.

Table 1: Summary statistics

The first table of panel A shows our dataset consists of all firms listed on the Japanese stock market from 1990 to 2021. We exclude the financial firms by removing all firms with SIC 6000-7000. In the table "Excluding microcap" we also remove the firms with the 10 percentile lowest market equity. This is a floating assumption, meaning that a company can be excluded in one period, but included in the next. In the table "excluding microcap and AZL" we also remove the firms with almost zero leverage (less than 5% leverage ratio). Panel B shows the correlations between leverage ratio and ST debt ratio for all firms and all firms excluding AZL.

Panel A: Summary statistics

All firms

Variable	Obs	Mean	Std. Dev.	Min	Max
ST Debt Ratio	618292	.297	.23	0	1
Leverage ratio	618292	.252	.214	0	1
Monthly return	618292	.968	39.377	-99.359	29300
Market cap	618292	160026.49	715297.09	.001	42421680

Excluding microcap

Variable	Obs	Mean	Std. Dev.	Min	Max
ST Debt Ratio	556463	.295	.233	0	1
Leverage ratio	556463	.237	.207	0	.987
Monthly return	556463	1.098	41.225	-92.813	29300
Market cap	556463	177617.37	751934.41	2734.8	42421680

Excluding microcap and AZL

Variable	Obs	Mean	Std. Dev.	Min	Max
ST Debt Ratio	429174	.262	.214	0	1
Leverage ratio	429174	.302	.192	.05	.987
Monthly return	429174	1.05	12.598	-92.813	930.303
Market cap	429174	179448.9	783473.01	2734.8	42421680

Panel B: Correlations

Matrix of correlations all firms

Variables	(1)	(2)
(1) Leverage ratio	1.000	
(2) ST Debt Ratio	-0.253	1.000

Matrix of correlations no AZL

Variables	(1)	(2)
(1) Leverage ratio	1.000	
(2) ST Debt Ratio	-0.157	1.000

We want to test if the remaining maturity of debt classified as long-term debt influences equity returns. We start by running a regression where the dependent variable is the equally weighted returns for the individual firms. The independent variables is short-term debt ratio and leverage ratio, including size (ME) as a control variable. The model is specified as displayed in equation 23:

$$Monthly\ return = \hat{\alpha} + \widehat{\beta_1}STDR + \widehat{\beta_2}LEV + \widehat{\beta_3}ME + \hat{\epsilon} \qquad (23)$$

All t-statistics are based on heteroskedasticity and autocorrelation-consistent standard errors (HAC). The HAC is calculated using Newey and West (1987) with truncation lag chosen as suggested by Wooldridge (2002).

Table 2: FMB Regression

This table shows a Fama-MacBeth regression with monthly returns as the dependent variable. In column (i) the independent variable is short-term debt ratio and in column (ii) it is leverage ratio. Column (iii) consists of both short-term debt ratio and leverage ratio as independent variables. Column (iiii) consists of short-term debt ratio, leverage ratio and ME. The results are presented as percentages. We report results for both FMB-OLS- and FMB-WLS regressions. Market equity is used as weight in the FMB-WLS regressions.

All Firms

	i	ii	iii	iiii
OLS				
STDR	0.187		0.184	0.219
	(1.54)		(1.31)	(1.60)
LEV		-0.045	-0.006	0.004
		(-0.17)	(-0.02)	(0.02)
ME				0.000
				(1.64)
WLS				
STDR	0.404		0.351	0.383
	(2.45)		(1.84)	(2.57)
LEV		-0.497	-0.422	-0.405
		(-1.12)	(-0.90)	(-0.97)
ME				0.000
				(0.75)
Observations	618292	618292	618292	618292

t statistics in parentheses

In table 2 we have conducted the regression on all firms after excluding financial firms. Friewald et al. argue in their study of the US market that debt maturity effects and leverage need to be studied jointly. We have therefore included leverage in our regression to account for the endogeneity of the financing structure for the individual firms (Friewald et al., 2022). Model (i) and (ii) reports the univariate regressions of monthly returns on short-term debt ratio and leverage ratio. Model (iii) includes both short-term debt ratio and leverage ratio jointly. The reported coefficients are time-series averages of the estimated coefficients. Looking at the FMB-OLS regression, we have no significant results at the 5 percent significance level. This means that the t-statistics has a level under 1.96. However, the univariate FMB-WLS regression (i) shows a positive significant coefficient for the STDR (t-stat=2.45), indicating that one unit increase in STDR is associated with a 0.404 percent increase in monthly return. This relationship is insignificant in model (iii) with t-statistics =1.84, but it is significant when including size as control variable (iiii). The coefficient in model (iiii) imply that a one unit increase in STDR is associated with 0.383 percent increase in monthly returns (t-stat=2.57).

Table 3: FMB Regression excluding microcaps

This table shows Fama-MacBeth regressions with monthly returns as the dependent variable. In column (i) the independent variable is short-term debt ratio and in column (ii) it is leverage ratio. Column (iii) consists of both short-term debt ratio and leverage ratio as independent variables. Column (iiii) consists of short-term debt ratio, leverage and ME. Firms with the 10 percentile lowest market equity is excluded from this regression. The results are presented as percentages. We report results for both FMB-OLS- and FMB-WLS regressions, where market equity is used as weights in the FMB-WLS regressions.

All excluding micro

	i	ii	iii	iiii
OLS				
STDR	0.230		0.301	0.327
	(1.84)		(2.05)	(2.28)
LEV		0.208	0.288	0.296
		(0.75)	(0.97)	(1.02)
ME				0.000
				(1.05)
WLS				
STDR	0.406		0.353	0.386
	(2.46)		(1.85)	(2.58)
LEV		-0.497	-0.421	-0.404
		(-1.12)	(-0.89)	(-0.97)
ME				0.000
				(0.75)
Observations	556463	556463	556463	556463

t statistics in parentheses

Microcaps only represent a small portion of the aggregate market capitalization, but a large number of stocks (Hou, Xue and Zhang, 2020). To avoid microcaps to be overrepresented in the regression we remove firms with the 10 percentile lowest market capitalization in table 3. This gives no significant relation in the univariate regression of STDR in the FMB-OLS. STDR is however significantly positive (t-stat=2.46) in the FMB-WLS regression. The coefficient is indicating that a one unit increase in STDR is associated with 0.406 percent increase in monthly returns. When studied jointly, STDR has a positive coefficient with a t-statistic of 2.05 for the FMB-OLS regression. This indicates that a one unit increase in STDR is associated with 0.301 percent increase in monthly returns. However, no coefficient in model

(iii) is significant using FMB-WLS. When including size as control variable the t-statistic increases to 2.28 for STDR in FMB-OLS. The coefficient also increases, now indicating that a one unit increase in STDR is associated with a 0.327 percent increase in monthly returns. STDR is also significant in model (iiii) using FMB-WLS regression with t-statistics= 2.58, implying that a one unit increase in STDR is associated with 0.386 percent increase in monthly returns.

Table 4: FMB regression excluding AZL

This table shows a Fama-MacBeth regression with monthly returns as the dependent variable. In column (i) the independent variable is short-term debt ratio and in column (ii) it is leverage ratio. Column (iii) consists of both short-term debt ratio and leverage ratio as independent variables. Column (iiii) consists of short-term debt ratio, leverage ratio and ME. Firms with 5 % leverage ratio or less are excluded from this regression. The results are presented as percentages. We report results for both FMB-OLS- and FMB-WLS regressions, where market equity is used as weight in the FMB-WLS regressions.

All excluding AZL

	i	ii	iii	iiii
OLS				
STDR	0.329		0.364	0.399
	(2.89)		(3.22)	(3.89)
LEV		0.149	0.194	0.206
		(0.62)	(0.79)	(0.87)
ME				0.000
				(1.56)
WLS				
STDR	0.377		0.389	0.399
	(1.64)		(1.35)	(1.62)
LEV		-0.314	-0.286	-0.296
		(-0.68)	(-0.57)	(-0.73)
ME				0.000
				(0.60)
Observations	485349	485349	485349	485349

t statistics in parentheses

Table 4 emphasizes the big impact removing AZL firms has on the estimated coefficient. We remove firms that have no or little debt, following Friewald et al. (2022), as these will come short in explaining the debt financing effect on returns.

By removing AZL firms, STDR is significant in the univariate regression using FMB-OLS with t-statistics= 2.89. The coefficient indicates that a one unit increase in STDR is associated with 0.329 percent increase in monthly returns. Model (ii) is neither significant in FMB-OLS nor FMB-WLS. Looking at STDR and LEV jointly (iii) in FMB-OLS we get a positive significant coefficient for STDR with t-statistics= 3.22. The coefficient implyes that a one unit increase in STDR is associated with 0.364 percent increase in monthly returns. STDR is not significant for the FMB-WLS regression, while LEV is neither significant in OLS nor WLS looking at model (iii). Controlling for size in model (iiii) gives a higher t-statistics of 3.89 for STDR in the FMB-OLS regression. The coefficient implies that a one unit increase in STDR is associated with 0.399 percent increase in monthly returns. This is however not significant while using FMB-WLS. At the same time LEV is neither significant in FMB-OLS nor FMB-WLS.

Table 5: FMB regression excluding microcaps and AZL

This table shows a Fama-MacBeth regression with monthly returns as the dependent variable. In column (i) the independent variable is short-term debt ratio and in column (ii) it is leverage ratio. Column (iii) consist of both short-term debt ratio and leverage ratio as independent variables. Column (iiii) consists of short-term debt ratio, leverage ratio and ME. Firms with the 10 percentile lowest market equity are excluded from these regressions. Firms with 5 % leverage ratio or less are also excluded. The results are presented as percentages. We report results for both FMB-OLS- and FMB-WLS regressions, where market equity is used as weight in the FMB-WLS regressions.

All excluding micro and AZL

	i	ii	iii	iiii
OLS				
STDR	0.426		0.519	0.543
	(3.56)		(4.30)	(4.92)
LEV		0.434	0.514	0.524
		(1.71)	(1.97)	(2.08)
ME				0.000
				(0.92)
WLS				
STDR	0.381		0.394	0.404
	(1.66)		(1.37)	(1.63)
LEV		-0.315	-0.285	-0.295
		(-0.68)	(-0.57)	(-0.72)
ME				0.000
				(0.59)
Observations	429174	429174	429174	429174

t statistics in parentheses

After individually studying the effect of AZL- and microcap firms, we look at the regression after excluding both effects. Again, we can see a change in the estimated coefficients emphasizing the importance of the data selecting. In model (i), our findings imply a positive relation between STDR and returns (T-stat=3.56) when doing FMB-OLS regression. The coefficient signal that a one unit increase in STDR is associated with a 0.426 percent increase in monthly returns. There is, however, no significant relation for the univariate regressions using FMB-WLS. Looking at both STDR and LEV jointly (iii) we get a positive coefficient with a t-value equal 4.30 for the STDR when doing FMB-OLS. The coefficient implies that equity returns increase with 0.519 percent as STDR increases with one unit. LEV is also significant in model (iii) for the FMB-OLS regression with a t-statistic of 1.97. The coefficient suggests that a one unit increase in LEV is associated with a 0.514 percent increase in monthly returns. Including size as a control variable makes the t-statistics for STDR increase to 4.92 in the FMB-OLS regrssion. The coefficient in model (iiii) suggest that a one unit increase in STDR is associated with 0.543 percent increase in monthly returns. For LEV, the t-statistic increases to 2.08, with a coefficient equal to 0.524 in the FMB-OLS regression. In the FMB-WLS regression we find no significant results.

4.2 The Premium for Debt Refinancing Risk

In this section we want to measure the premium associated with debt refinancing risk and how it relates to the Fama-French factors. To do so, we create portfolios sorted by market capitalization (ME), leverage ratio (LEV) and short-term debt ratio (STDR). We will compare the portfolios in terms of both equally- and value-weighted returns. The comparison will show if a higher STDR is compensated with a premium while controlling for size and leverage. We also study how this premium correlates with the systematic risk factors presented by Fama and French (2014). We do a portfolio sorting following Friewald et al. (2022) and Hou, Xue, and Zhang (2020) as described under 3.5.1.

Table 6: Summary characteristics of portfolios sorted on LEV and STDR

In this table, the firms are sorted into 18 different portfolios for each month. The portfolios are sorted by size (small/big), where small/big consists of the firms with the 50% highest/lowest market equity (ME). Further, it is sorted on leverage ratio (low/medium/high), where low/high is the 1/3 firms with lowest/highest leverage ratio (LEV) and medium is the 1/3 firms in between. Finally, it is sorted on short-term debt ratio (low/medium/high), where low/high is the 1/3 firms with the lowest/highest short-term debt ratio (STDR) and medium is the 1/3 firms in between. We have then calculated the monthly equally-weighted- (EW) and value-weighted (VW) returns for the 18 portfolios (2x3x3=18). ME (small/big) is the monthly average characteristic of the 9 small/big portfolios. LEV(low/high) is the monthly average characteristic of the 6 low/high portfolios. STDR(low/high) is the monthly average characteristic of the 6 low/high STDR portfolios. The dataset consists of all non-financial levered firms from 1990 to 2021 listed on a Japanese stock market.

		LEV	STDR	EWR	VWR
ME	Big	.246	.28	1.092	1.084
	Small	.257	.286	0.316	.607
LEV	High	.486	.259	0.789	.916
	Low	.053	.307	0.678	.793
STDR	High	.236	.532	0.829	1.026
	Low	.261	.071	0.515	.696

By studying table 6, we first want to make sure that the different portfolios are comparable. While sorting on ME we see that LEV is 0.246 for the big-portfolio compared to 0.257 for the small-portfolio. Further the STDR is 0.28 for the big-Me-portfolio compared to 0.286 for the small-ME-portfolio. We can therefore conclude that the different ME portfolios has quite equal characteristics when it comes to LEV and STDR. Looking at the LEV sorting we see that the high LEV portfolio has an average STDR of 0.259 compared to the low LEV with 0.307. For the high STDR portfolio the average LEV is 0.236 and for the low STDR the LEV is 0.261. We view the differences between the portfolios as relatively small and therefore conclude that they are comparable.

On average we find that the “big” portfolios deliver higher monthly returns than the “small” with 1.092 percent for equally weighted returns and 1.084 percent for value-weighted returns. Therefore, we get a negative small-minus-big value of -0.776 percent for equally weighted and -0.477 percent for value-weighted returns. This is different from Friewald, Nagler and Wagner (2022) that get a positive value in the US market. It is however consistent with research done by Fama and French (2012) on the Japanese stock markets.

We also find that the portfolio with a high leverage ratio has an equally weighted return of 0.789% compared to 0.678% for the low leverage portfolio. The high-leverage portfolio also outperforms the low-leverage portfolio looking at value-weighted returns. This is consistent with the asset pricing literature both in the US market (Modigliani and Miller, 1958) and the Japanese market (Min, Jiwen and Toyohiko, 2016).

The low short-term debt ratio portfolio has an average equally weighted return of 0.515 percent compared to the high short-term debt ratio portfolio with 0.829 percent. Looking at the value-weighted returns we can also see that the "high" short-term debt portfolio outperforms the "low". This is consistent with the findings done by Friewald, Nagler and Wagner (2022).

4.2.1 Spanning regression of return differentials associated with LEV and STDR

We want to study if the return differentials compensate the stockholders for exposure to systematic risk. We therefore calculate the return differentials (R) between the "high" and "low" portfolios. We use VW returns in these regressions, and the portfolios are sorted as described under 3.5.1. The return differentials for the market capitalization ($R_{ME,t}$), leverage ratio ($R_{LEV,t}$) and short-term debt ratio ($R_{STDR,t}$) are then calculated as described in equation 14, 15 and 16.

We use Fama-MacBeth two-step regression (1973) with t-statistics based on Newey and West (1987). The HAC standard errors have truncation lag following Stock and Watson (2017). We regress both the return differentials for LEV and STDR against CAPM, the FF3 factor model and the FF5 factor model. The models are given by equation 24 and 25:

$$R_{LEV} = \hat{\alpha} + \widehat{\beta_1} mktrf + \widehat{\beta_2} smb + \widehat{\beta_3} hml + \widehat{\beta_4} rmw + \widehat{\beta_5} cma + \hat{\epsilon} \quad (24)$$

$$R_{STDR} = \hat{\alpha} + \widehat{\beta_1} mktrf + \widehat{\beta_2} smb + \widehat{\beta_3} hml + \widehat{\beta_4} rmw + \widehat{\beta_5} cma + \hat{\epsilon} \quad (25)$$

Table 7: Spanning regression of excess returns for leverage

This table contains results from a Fama-MacBeth spanning regression of excess return from high minus low leverage portfolios. We find the returns by each month sorting firms into 18 different portfolios. The portfolios are sorted by size (small/big), where small/big consists of the firms with the 50% highest/lowest market equity (ME). Further, it is sorted on leverage ratio (low/medium/high), where low/high is the 1/3 firms with lowest/highest leverage ratio (LEV) and medium is the 1/3 firms in between. Finally, it is sorted on short-term debt ratio (low/medium/high), where low/high is the 1/3 firms with the lowest/highest short-term debt ratio (STDR) and medium is the 1/3 firms in between. We have then calculated the monthly value-weighted (VW) returns for the 18 portfolios (2x3x3=18). The dataset consists of all non-financial levered firms from 1990 to 2021 listed on a Japanese stock market. In the spanning regressions column (i) is the CAPM model, column (ii) is the FF3 factor model, and column (iii) is the FF5 factor model. CAPM only consists of the of market (Mkt_RF), while FF3 also include size (SMB) and value (HML). FF5 is an extension of the FF3 with profitability (RMW), and investment (CMA) factors.

	i	ii	iii
constant	-0.023	0.01	-0.002
	(-0.72)	(0.93)	(-0.35)
Mkt-RF	0.151	0.07	0.053
	(3.48)	(3.62)	(3.09)
SMB		0.016	0.006
		(0.96)	(0.50)
HML		0.071	0.067
		(3.74)	(3.55)
RMW			-0.011
			(-1.25)
CMA			0.002
			(0.25)
Observations	347	347	347

t statistics in parentheses

In table 7 we find a significant link between the leverage return differential and the market factor regressing only on the market factor (i). For the FF3 the t-statistics increase from 3.48 in model (i) to 3.62 in model (ii). The coefficient is 0.151 percent for model (i) and 0.07 percent for model (ii), while the t-statistics is lower for the FF5-model(iii) with t=3,09. In difference, Friewald, Nagler and Wagner (2022) do not find a significant link between the leverage premium and the market factor in the US market. There is no significant link between the SMB-factor and the LEV premium in both FF3(ii) and FF5(iii). The premium for LEV has on the other hand a significant link to HML for the FF3 (ii) with t-statistics= 3.74 and loading equal to 0.071 percent monthly. It is also a positive loading of the LEV premium on HML in FF5(iii) with 0.067 percent monthly with t-statistics=3.55. The LEV premium has no significant link to the two extra factors RMW and CMA in the FF5-model (iii). The alpha is also unsignificant for all the regressions on the LEV premium (i), (ii) and (iii).

Table 8: Spanning regression of excess returns for short-term debt ratio against FF

This table contains results from a Fama-MacBeth spanning regression of excess return from high minus low short-term debt ratio portfolios. We find the returns by each month sorting firms into 18 different portfolios. The portfolios are sorted by size (small/big), where small/big consists of the firms with the 50% highest/lowest market equity (ME). Further, it is sorted on leverage ratio (low/medium/high), where low/high is the 1/3 firms with lowest/highest leverage ratio (LEV) and medium is the 1/3 firms in between. Finally, it is sorted on short-term debt ratio (low/medium/high), where low/high is the 1/3 firms with the lowest/highest short-term debt ratio (STDR) and medium is the 1/3 firms in between. We have then calculated the monthly value-weighted (VW) returns for the 18 portfolios (2x3x3=18). The dataset consists of all non-financial levered firms from 1990 to 2021 listed on a Japanese stock market. In the spanning regressions column (i) is the CAPM model, column (ii) is the FF3 factor model, and column (iii) is the FF5 factor model. CAPM only consists of the of market (Mkt_RF), while FF3 also include size (SMB) and value (HML). FF5 is an extension of the FF3 with profitability (RMW), and investment (CMA) factors.

Spanning test of returns R_{STDR}

	i	ii	iii
constant	0.031	-0.01	-0.002
	(1.17)	(-1.11)	(-0.36)
Mkt-RF	0.041	0.03	0.026
	(1.77)	(2.67)	(2.59)
SMB		0.02	0.015
		(2.43)	(1.93)
HML		-0.01	-0.013
		(-0.94)	(-1.24)
RMW			0.007
			(1.46)
CMA			-0.004
			(-0.73)
Observations	347	347	347

t statistics in parentheses

In contrast with the LEV premium, we find no link between STDR and the market factor in model (i) from table 8. However, we find a positive loading of 0.03 percent per month with t-statistics= 2.67 in the FF3-model (ii). In the FF5-modell (iii) the STDR premium also has a positive loading on the market-factor with 0.026 percent monthly and t-statistics= 2.59. In addition, we find a significant positive loading of 0.02 percent per month for the STDR premium on the SMB-factor in model (ii), with t-statistics=2.43. In model (iii) the SMB-coefficient is not significant. The HML factor has no significant link to the STDR premium in either model (i) or (ii). The same goes for the RMW- and CMA-factors in the FF5-model (iii). There is no significant alpha in model i, ii or iii for the STDR premium.

4.3 Premia for Short-Term versus Long-Term Leverage

We now want to study the jointly effect of leverage and STDR from another angle. We believe that if a firm has high leverage ratio, it is likely that the rollover risk will have a bigger impact than for a firm with low leverage ratio ceteris paribus. We therefore follow Friewald et al. (2022) to create the variables LTLEV and STLEV as described in equation 7 and 8. We then sort portfolios based on ME, LTLEV and STLEV as described in 3.5.2. We will compare the portfolios in terms of both equally- and value-weighted returns. This is to see if the stock price is affected differently by STLEV and LTLEV. Finally, we will see how STLEV and LTLEV correlates with the systematic risk factors presented by Fama and French (2014)

Table 9: Summary characteristics of portfolios Sorted on LTLEV and STLEV

In this table the firms are for each month sorted into 18 different portfolios. The portfolios are sorted by size (small/big), where small/big consists of the firms with the 50% highest/lowest market equity (ME). Further we sort on LTLEV (low/medium/high), where low/high is the 1/3 firms with lowest/highest LTLEV and medium is the 1/3 firms in between. Finally, we sort on STLEV (low/medium/high), where low/high is the 1/3 firms with the lowest/highest STLEV and medium is the 1/3 firms in between. We have then calculated the monthly equally-weighted-(EW) and value-weighted (VW) returns for the 18 portfolios (2x3x3=18). ME (small/big) is the monthly average characteristic of the 9 small/big portfolios. STLEV (low/high) is the monthly average characteristic of the 6 low/high portfolios. LTLEV (low/high) is the monthly average characteristic of the 6 low/high LTLEV portfolios. The dataset consists of all non-financial levered firms from 1990 to 2021 listed on a Japanese stock market.

		LTLEV	STLEV	Lev ratio	STDR	EWR	VWR
ME	Big	.193	.057	0.250	.294	1.001	1.021
	Small	.197	.065	0.262	.301	.311	.591
LTLEV	High	.398	.063	0.460	.127	.632	.753
	Low	.033	.061	0.094	.535	.715	.877
STLEV	High	.198	.136	0.333	.482	.798	.949
	Low	.191	.007	0.199	.127	.58	.703

We start by making sure that the different portfolios are comparable, by analysing the summary statistics in table 9. We find little difference in average LTLEV and STLEV for the big- and small ME portfolios. Further, for the high-/low-LTLEV portfolios the average STLEV is quite similar. The difference between LTLEV in the high-/low-STLEV portfolios is also small (0.198 compared to 0.191). We therefore believe that the different portfolios are comparable also in this portfolio sorting.

Table 9 shows how portfolios with high ME still outperform the low ME portfolios, with 1.001 percent against 0.311 percent for the EW returns. For VW returns it is 1.021 percent against 0.591 percent. For the STLEV portfolio we find that high outperform low with 0.798 percent against 0.58 in the EW-return. For the VW return it is the same conclusion with high portfolio at 0.949 percent against 0.703 percent in the low STLEV portfolio. This supports our first hypothesis that short-term leverage is compensated with higher returns. Looking at LTLEV we find that returns is lower for the high portfolio compared with the low portfolio. The high LTLEV portfolio has EW-return of 0.632 percent compared to 0.715 for the low LTLEV portfolio. Looking at the VW-returns we find 0.753 percent in the high LTLEV and 0.877 percent in the low LTLEV portfolio. Looking at both LTLEV and STLEV the findings also support our first hypothesis that there is a positive risk premium associated with shorter debt.

4.3.1 Spanning regression of return differentials associated with LTLEV and STLEV

We want to find the premia associated with short-term- and long-term leverage, and we therefore find the return differentials R between the "high" and "low" portfolios. As before, we use the VW returns in these regressions and the portfolios are sorted as described in 3.5.2. The return differentials for the market capitalization $(R_{ME,t})$, LTLEV $(R_{LTLEV,t})$ and STLEV $(R_{STLEV,t})$ are then calculated as described in equation 20, 21 and 22.

We use Fama-MacBeth two-step regression (1973) with t-statistics based on Newey and West (1987). The HAC standard errors have truncation lag following Stock and Watson (2017). We regress the return differentials against the CAPM, the FF3 factor model and the FF5 factor model as given by equation 26 and 27:

$$R_{LTLEV} = \hat{\alpha} + \widehat{\beta_1} mktrf + \widehat{\beta_2} smb + \widehat{\beta_3} hml + \widehat{\beta_4} rmw + \widehat{\beta_5} cma + \hat{\epsilon} \quad (26)$$

$$R_{STLEV} = \hat{\alpha} + \widehat{\beta_1} mktrf + \widehat{\beta_2} smb + \widehat{\beta_3} hml + \widehat{\beta_4} rmw + \widehat{\beta_5} cma + \hat{\epsilon} \quad (27)$$

Table 10: Spanning regression on LTLEV differential

This table contains results from a Fama-MacBeth spanning regression on excess return from high minus low LTLEV portfolios. We find the returns each month by sorting firms into 18 different portfolios. The portfolios are sorted by size (small/big), where small/big consists of the firms with the 50% highest/lowest market equity (ME). Further we sort on LTLEV (low/medium/high), where low/high is the 1/3 firms with lowest/highest LTLEV and medium is the 1/3 firms in between. Finally, we sort on STLEV (low/medium/high), where low/high is the 1/3 firms with the lowest/highest STLEV and medium is the 1/3 firms in between. We have then calculated the monthly value-weighted (VW) returns for the 18 portfolios (2x3x3=18). The dataset consists of all non-financial levered firms from 1990 to 2021 listed on a Japanese stock market. In the spanning regressions column (i) is the CAPM model, column (ii) is the FF3 factor model, and column (iii) is the FF5 factor model. CAPM only consists of the of market (Mkt_RF), while FF3 also include size (SMB) and value (HML). FF5 is an extension of the FF3 with profitability (RMW), and investment (CMA) factors.

Spanning test of returns R_{LTLEV}

	i	ii	iii
constant	-0.029	0.007	-0.005
	(-0.93)	(0.59)	(-1.07)
Mkt-RF	0.092	0.041	0.033
	(2.78)	(2.58)	(2.23)
SMB		0.001	0.003
		(0.06)	(0.27)
HML		0.063	0.060
		(3.65)	(3.65)
RMW			-0.014
			(-1.81)
CMA			-0.000
			(-0.01)
Observations	347	347	347

t statistics in parentheses

We find that R_{LTLEV} has a positive significant loading on the market-factor for the CAPM-model (i), FF3 (ii) and FF5(iii). The loading is 0.092 with t-statistics= 2.78 in model (i) and 0.041 with t-statistics= 2.58 in model (ii). In model (iii) the loading is 0.033 on the market-factor with t-statistics=2.23. This is different from Friewald et al. (2022) which find a negative loading for alle the models. The loading is however only significant in the CAPM-model for the findings done by Friewald et al. (2022). We do not find any significant link between the

SMB-factor and R_{LTLEV} either in model (ii) or (iii). For the HML-factor however we find a significant loading in both model (ii) and (iii). In model (ii) R_{LTLEV} has a positive loading of 0.063 with t-statistics=3.65, and in model (iii) a loading of 0.06 with t-statistics=3.65. We do not find any significant loading on the RMW- or CMA-factors in the FF5-model. The alpha, in our finding, is not significant in any of the models. Friewald, Nagler and Wagner (2022) on the other hand find a significant alpha in the FF3-model. When removing AZL firms, there is no longer a significant loading on the market factor (see appendix), but the other results are the same.

Table 11: Spanning regression on STLEV differential

This table contains results from a Fama-MacBeth spanning regression on excess return from high minus low STLEV portfolios. We find the returns each month by sorting firms into 18 different portfolios. The portfolios are sorted by size (small/big), where small/big consists of the firms with the 50% highest/lowest market equity (ME). Further we sort on LTLEV (low/medium/high), where low/high is the 1/3 firms with lowest/highest LTLEV and medium is the 1/3 firms in between. Finally, we sort on STLEV (low/medium/high), where low/high is the 1/3 firms with the lowest/highest STLEV and medium is the 1/3 firms in between. We have then calculated the monthly value-weighted (VW) returns for the 18 portfolios (2x3x3=18). The dataset consists of all non-financial levered firms from 1990 to 2021 listed on a Japanese stock market. In the spanning regressions column (i) is the CAPM model, column (ii) is the FF3 factor model, and column (iii) is the FF5 factor model. CAPM only consists of the of market (Mkt_RF), while FF3 also include size (SMB) and value (HML). FF5 is an extension of the FF3 with profitability (RMW), and investment (CMA) factors.

Spanning test of returns R_{STLEV}

	i	ii	iii
constant	0.019	0.009	0.007
	(0.96)	(1.48)	(1.26)
Mkt-RF	0.037	0.033	0.034
	(1.36)	(2.29)	(2.42)
SMB		0.018	0.003
		(1.79)	(0.39)
HML		0.017	0.012
		(2.00)	(1.46)
RMW			-0.007
			(-1.35)
CMA			0.008
			(2.21)
Observations	347	347	347

t statistics in parentheses

For R_{STLEV} we do not find a significant loading on the market-factor in regression (i) in table 11. However, in regression (ii) we find a positive loading of 0.033 percent on the market-factor with t-statistics = 2.29. The loading we report for R_{STLEV} on the market-factor is approximately the same as we found for R_{LTLEV} in table 10. We also find a positive significant loading of 0.017 percent on the HML-factor with t-statistics = 2.00 in model (ii). In model (iii) the loading is 0.034 percent on the market-factor with t-statistics = 2.42. There is no significant loading on SMB-, HML or RMW-factors in model (iii). We find a positive loading of 0.008 percent on the CMA-factor with t-statistics= 2.21. The alpha is not significant in any of the models. When removing AZL firms, there is a positive loading on SMB, but no longer a significant loading on the CMA factor (see appendix). The other results are approximately the same.

Table 12: Regression on Premium Differential

This table contains results from a Fama-MacBeth spanning regression on excess return from the return differential of the long-term and short-term leverage premium. We find the returns each month by sorting firms into 18 different portfolios. The portfolios are sorted by size (small/big), where small/big consists of the firms with the 50% highest/lowest market equity (ME). Further we sort on LTLEV (low/medium/high), where low/high is the 1/3 firms with lowest/highest LTLEV and medium is the 1/3 firms in between. Finally, we sort on STLEV (low/medium/high), where low/high is the 1/3 firms with the lowest/highest STLEV and medium is the 1/3 firms in between. We have then calculated the monthly value-weighted (VW) returns for the 18 portfolios (2x3x3=18). The dataset consists of all non-financial levered firms from 1990 to 2021 listed on a Japanese stock market. In the spanning regressions column (i) is the CAPM model, column (ii) is the FF3 factor model, and column (iii) is the FF5 factor model. CAPM only consists of the of market (Mkt_RF), while FF3 also include size (SMB) and value (HML). FF5 is an extension of the FF3 with profitability (RMW), and investment (CMA) factors.

Spanning test of returns Premium

	i	ii	iii
constant	0.048	0.003	0.012
	(1.31)	(0.19)	(1.26)
Mkt-RF	-0.056	-0.007	0.001
	(-1.39)	(-0.37)	(0.06)
SMB		0.017	0.001
		(1.42)	(0.06)
HML		-0.046	-0.048
		(-2.50)	(-2.76)
RMW			0.007
			(0.78)
CMA			0.008
			(1.12)
Observations	347	347	347

t statistics in parentheses

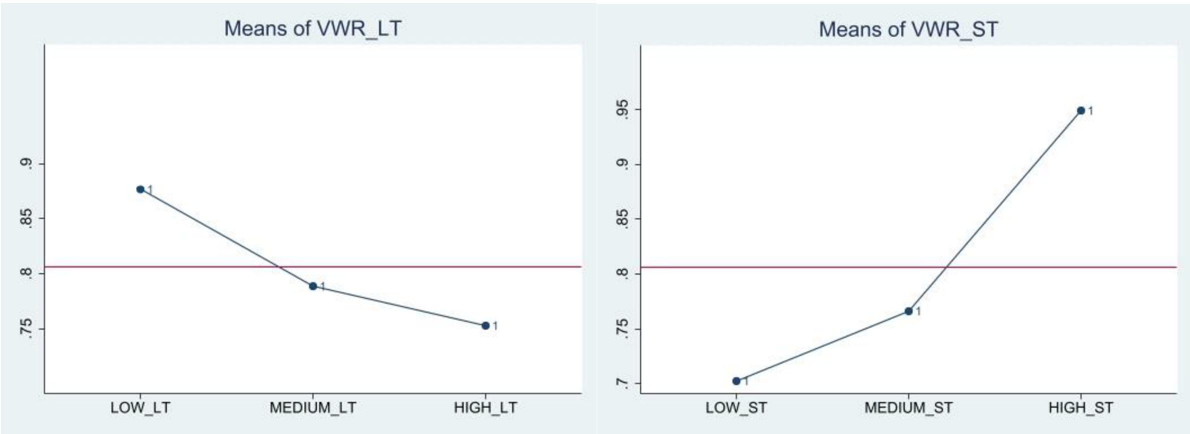
Table 12 reports the return differential for the long-term- and short-term leverage premiums, as displayed in the equation:

$$R_{STLEV} - R_{LTLEV} = \hat{\alpha} + \widehat{\beta_1} mktrf + \widehat{\beta_2} smb + \widehat{\beta_3} hml + \widehat{\beta_4} rmw + \widehat{\beta_5} cma + \hat{\epsilon} \quad (28)$$

The regression yields no significant effect for the market model (i). However, for the FF3 factor model (ii) there is a significant negative loading for the "high minus low" factor with a t-statistic of -2.50. In addition, the FF5 factor model produces a significant negative result for the HML factor with a t-statistic of -2.76. This reflects our findings from table 10 and 11, that R_{STLEV} is less exposed to the HML factor than R_{LTLEV}. The constant is positive for all models as we would expect, but it is not significantly different from zero. From these results we cannot explain the higher returns for STLEV by either systematic or unsystematic factors.

Figure 3: LTLEV vs. STLEV

This figure contains the mean VW excess return for the three LTLEV groups and the three STLEV groups. We find the returns each month by sorting firms into 18 different portfolios. The portfolios are sorted by size (small/big), where small/big consists of the firms with the 50% highest/lowest market equity (ME). Further we sort on LTLEV (low/medium/high), where low/high is the 1/3 firms with lowest/highest LTLEV and medium is the 1/3 firms in between. Finally, we sort on STLEV (low/medium/high), where low/high is the 1/3 firms with the lowest/highest STLEV and medium is the 1/3 firms in between. We have then calculated the monthly value-weighted (VW) returns for the 18 portfolios (2x3x3=18). The dataset consists of all non-financial levered firms from 1990 to 2021 listed on a Japanese stock market.



In the end, we want to illustrate the relationship between LTLEV and STLEV. In figure 1 we can see that a higher LTLEV is related to a decrease in VW excess returns. In contrast, a higher STLEV indicates an increase in VW excess returns. This is consistent with our first hypothesis, which states that "there is a positive risk premium associated with shorter debt maturity". It is also consistent with related research by Friewald et al. (2022) in the US.

5. Robustness tests

Our analysis provides mixed signals for the relation between STDR, LEV and returns. Using Fama-MacBeth regression (1973) (FMB) we correct the standard errors for cross-sectional correlation. At the same time, the standard errors are heteroskedasticity- and autocorrelation-consistent (HAC) based on Newey and West (1987), where the HAC standard errors have truncation lag following Stock and Watson (2017). We also run Fama-MachBeth Weighted Least Squares (FMB-WLS) to avoid that our regressions are overaffected by microcaps.

We study the link between returns, LEV and STDR when individually controlling for microcaps and AZL firms. The FMB-OLS regressions give a significant link for both LEV and STDR while looking at them jointly after removing both microcaps and AZL. Adding size as a control variable increases the robustness of our findings. However, when we control these results using FMB-WLS we do not find any significant link. This weakens the robustness for the rest of the findings in our thesis.

Doing portfolio sorting we find on average that firms with high LEV yield higher returns than firms with low LEV. We also find that companies with a high STDR yield higher returns on average than firms with low STDR. Using value-weighted returns gives the same conclusion as equally weighted returns. This is consistent with the relation found in the FMB-OLS regression, strengthening the robustness for our analysis. It is also consistent with previous research done by Friewald et al. (2022). To strengthen the robustness, we look at STDR and LEV jointly in the factors LTLEV and STLEV. This confirms our findings that higher short-term leverage is associated with higher returns. We also find evidence suggesting that higher long-term leverage reduces returns.

The spanning regressions of the excess returns gives a significant loading on FF5 for both leverage and STDR. The return premium difference does not give any significant alphas, giving mixed signals for our conclusion. Controlling for almost zero leverage firms in the spanning regressions gives the same conclusion.

6. Conclusion

In this thesis, we have studied the role of debt maturity for the premium of equity returns. To do so we have decomposed the firm's leverage into short-term- and long-term leverage. Short-term leverage is defined as debt maturing in one year or less, and long-term leverage as debt maturing in more than one year.

Our empirical analysis reveals that ST debt ratio has a positive relation to returns when controlling for leverage after removing AZL firms in the regressions. Furthermore, if we remove microcaps and AZL firms, both ST debt ratio and leverage ratio positively impact returns. These findings are consistent with the notion of debt rollover risk. Investors require a premium for firms with a higher short-term debt ratio because of their higher refinancing risk.

After establishing that there is a premium in conjunction with debt maturity, we use portfolio sorting techniques to analyse the premium in detail. When looking at the average value-weighted returns for the portfolios, higher LTLEV is related to a decrease in returns and higher STLEV indicates an increase in returns. This finding is also reflected in the average returns for ST debt ratio. The portfolio with a high ST debt ratio has a greater average return than the low portfolio.

Further, we regress the portfolios against the capital pricing models CAPM, FF3 and FF5 to study the exposure to systematic risk. The excess returns for both the leverage ratio and the ST debt ratio can be explained by the market factor. In addition, leverage has a positive loading on the HML factor and ST-debt ratio has a positive loading on the SMB factor. We did not find a significant alpha for either leverage ratio or ST debt ratio. We find that the excess returns for short-term- and long-term leverage are not exposed significantly different to the market factor. Long-term leverage and short- term leverage is positively exposed to the HML-factor, but long-term leverage has a much higher coefficient. Further we do not find any significant alphas for neither short-term- or long-term leverage.

Our first hypothesis states: "There is a positive risk premium associated with shorter debt maturity". In our findings there is an equity premium related to short-term debt in regressions, and we report higher average returns for short-term leverage compared to long term leverage based on portfolio sorting. We are however not able to confirm our second hypothesis and explain the higher returns trough difference in exposure to systematic risk.

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Appendix

Spanning test of LTLEV excluding AZL firms

	i	ii	iii
Mkt-RF	0.0610	0.0172	0.0168
	(1.69)	(1.27)	(1.35)
constant	-0.0137	0.00333	-0.00386
	(-0.47)	(0.26)	(-1.08)
SMB		-0.00299	-0.00371
		(-0.20)	(-0.29)
HML		0.0515	0.0458
		(3.38)	(3.25)
RMW			-0.0123
			(-1.39)
CMA			0.00543
			(0.86)
Observations	6246	6246	6246

t statistics in parentheses

Spanning test of STLEV excluding AZL firms

	i	ii	iii
Mkt-RF	0.0631	0.0476	0.0393
	(2.33)	(3.26)	(2.76)
constant	0.0417	0.0118	0.00547
	(1.66)	(1.58)	(0.87)
SMB		0.0349	0.0239
		(2.72)	(2.55)
HML		0.00881	0.00454
		(0.77)	(0.40)
RMW			-0.00659
			(-1.00)
CMA			0.00340
			(0.79)
Observations	347	347	347

t statistics in parentheses

Spanning test of premium excluding AZL firms

	i	ii	iii
Mkt-RF	0.00213	0.0305	0.0226
	(0.05)	(1.38)	(1.08)
constant	0.0554	0.00851	0.00933
	(1.39)	(0.54)	(0.95)
SMB		0.0378	0.0276
		(2.08)	(1.63)
HML		-0.0427	-0.0413
		(-2.19)	(-2.28)
RMW			0.00569
			(0.61)
CMA			-0.00203
			(-0.36)
Observations	6246	6246	6246

t statistics in parentheses