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Debt Maturity Structure

An empirical study on the firm specific and macroeconomic determinants of listed Swedish companies' debt maturity structure

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Abstract

The purpose of this thesis is to find the firm specific and macroeconomic determinants that are relevant for listed Swedish companies' debt maturity structure. The hypotheses incorporated in our model are liquidity risk and signaling, agency costs, equity market conditions, tax minimization and gap filling. We also examine whether time or industry have any influence on a company's choice of debt maturity structure or if the decision is made independently. To achieve our purpose, we conduct a quantitative study and we incorporate a qualitative add-on. According to our results, the theories applicable on the Swedish market are the liquidity risk and the gap filling one. With the liquidity risk theory, companies' main concern lies in postponing the refinancing risk, which is controlled by taking on debt of longer maturities. The gap filling hypothesis also has an impact on companies' choice of debt maturity structure as we observe a positive relationship between the government's and companies' debt maturity structure. Finally, we find that companies' choice of debt maturity structure is made on an individual basis, with no importance given to industry trends or structural breaks.

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1. Introduction

A company needs capital to finance new and existing activities. This capital is raised either from debt holders or shareholders, thus leading to a mix of debt and equity within the companies' capital structure. Because debt is tax deductible, it represents a cheaper source of financing than equity. However, debt has its disadvantages, as debt holders are the single claimants that can rightfully force a firm into liquidation. Thus, the two folded effect of debt is a controversial topic that receives a lot of attention from the management, who wants to maximize the value of a company. An important aspect regarding debt financing and hence a tool in controlling the disadvantages and increase the advantages of debt is the choice of short and long-term debt. The mix of short and long-term debt is referred to as the debt maturity structure. A well-balanced debt maturity structure is an opportunity first and foremost for borrowers to handle debt more efficiently, but also a chance for lenders to gain influence over the money invested into the company. From the borrowers' perspective, the adjustments regarding the debt maturity structure have the potential to reduce refinancing risk, increase transparency and exploit tax related opportunities. From the lenders' perspective, the debt maturity structure can be used as a tool to increase monitoring and reduce the potential sub-optimal decisions made by the management.

While the theory on capital structure has received significant attention over the last half of the century, the debt maturity structure has not been examined greatly. Past research in the area of debt maturity structure has been focusing on investigating firm specific determinants, while there is only scarce literature that takes into consideration the macroeconomic determinants. The existing literature offers five main strands of debt maturity theories. The first strand is represented by the liquidity risk and signaling theory and is based on communication inefficiency between insiders and outsiders that is mitigated through the use of the debt maturity structure. The second strand is represented by the agency costs theory and refers to how conflicts between different stakeholders are mitigated through the use of the debt maturity structure. The third strand is represented by the equity market conditions theory and shows how changes occurring in the equity market affect the debt maturity structure. The fourth strand is represented by the tax minimization theory and refers to taxation as a market imperfection and the subsequent deductibility of interest expenses originating from it.

The fifth strand is represented by the gap filling theory and refers to how changes in the government's debt maturity structure are reflected in that of the companies.

1.1 Purpose, contribution and disposition

The purpose of this thesis is to combine the five theoretical strands and find the firm specific and macroeconomic determinants that are relevant for listed Swedish companies' debt maturity structure. By taking this holistic approach, our study is an extension of existing studies. Furthermore, we investigate whether the debt maturity structure is used as a tool by companies to take advantage of the opportunities of debt financing and reduce the risks associated with it. Also, our objective is to see if the results of the quantitative study reflect the actual reasoning of the companies, reasoning that is portrayed in the qualitative add-on. To operationalize our purpose we proceed with the following research question:

How are the liquidity risk and signaling, agency costs, equity market conditions, tax minimization and gap filling theories affecting the choice of the debt maturity structure in listed Swedish firms?

This paper makes the following further contributions. First, it offers an investigation of the Swedish market, which to our knowledge has not been investigated as comprehensively as this before. Second, we estimate an integrated model that incorporates both firm specific and macroeconomic determinants of debt maturity structure. This model enables us to analyze the company in a dynamic environment, rather than as an isolated individual not being affected by macroeconomic factors. Third, we use a cross-sectional model to capture individual company and industry differences and a time-effects model to capture time differences among our sample companies. Fourth, to get a holistic view on the debt maturity structure we complement our quantitative study with a qualitative add-on, where we interview Treasury representatives from SCA and Swedish Match.

The findings reveal that both firm specific and macroeconomic variables are factors when it comes to variation in companies' debt maturity structure. More, our study reveals that it is mainly the liquidity risk and the gap filling theory that are taken into consideration by Swedish companies, when taking decisions regarding the debt

maturity structure, with less emphasize put on signaling, agency costs, equity market conditions and tax minimization. The rest of the paper is organized as follows: Section 2 describes the theories, variables and hypotheses. Section 3 discusses the methodology. Section 4 shows the results. Section 5 presents the analysis. Finally, section 6 presents our conclusions and suggestions for further studies.

2. Theories, variables and hypotheses

This section provides an overview of the theoretical and empirical research within the field of debt maturity structure. The main theories are classified as either firm specific, represented by the liquidity risk and signaling, agency costs, equity market conditions and tax minimization theories or macroeconomic, represented by the gap filling theory. This part provides an argumentation and a testable hypothesis for the relationships between each independent variable and the debt maturity structure. As the same independent variable can represent different theories, we proceed with the classification in the way we believe is the most correct.

2.1 Debt maturity structure

The debt maturity structure of a company is measured as the ratio of the company's long-term debt to total debt. Following accounting conventions, the long-term debt is defined as debt maturing in more than one year, while short-term debt is defined as debt due within the next twelve months. Our definition follows that of Barclay and Smith Jr. (1995).

2.2 Liquidity risk and signaling

The liquidity risk and signaling theories refers to companies' inability to efficiently communicate with investors, which leads to asymmetric information between the insiders (e.g. managers) and the outsiders (e.g. investors). The communication inefficiency leads to the risk that a solvent but illiquid borrower is unable to obtain financing (Diamond, 1991). This risk is called liquidity risk and is associated with companies holding a large amount of short-term debt and therefore being dependent on lenders to refinance their loans in a close and uncertain future. This theory investigates how liquidity risk impacts the debt maturity structure and how this risk is mitigated through the use of long-term debt.

The signaling hypothesis deals with the problem of communication inefficiency, where outsiders are unable to distinguish high quality companies from low quality ones and thus the true quality of the company remains private to insiders. The signaling theory argues that certain decisions made by companies, like the choice of debt maturity structure, reveal information about companies' current and future status more accurately than public statements. The debt maturity structure represents a signal of quality and outsiders take this knowledge into consideration prior to an investment. This signal is then used as a tool to increase transparency, reduce the knowledge gap between outsiders and insiders and signal the inherent value of the company to investors (Berk and DeMarzo, 2007).

Within the liquidity risk and signaling theory the variables leverage, liquidity and firm level volatility show how the management works with reducing liquidity risk and the variable firm quality shows how the management works with increasing transparency and reducing asymmetric information.

2.2.1 Leverage

Financial leverage always implies a risk of bankruptcy since debt holders are the single claimants that can rightfully force a firm into liquidation. Thus, as soon as a company takes on leverage, it has to deal with the risk of bankruptcy and consequently it tries to reduce it to the highest possible extent. Both Morris (1975) and Stohs and Mauer (1996) argue that high leveraged companies are more inclined to take long-term debt, so as to offset the higher probability of liquidity risk and to delay exposure to bankruptcy risk. As the liquidity risk usually occurs when holding short-term debt, Morris (1975) argues that companies that want to decrease the burden of refinancing choose long-term debt. This creates an incentive for more risky companies to issue long-term debt and the expected relationship between leverage and debt maturity structure, from the liquidity risk theory's perspective, is positive, given the possibility for this type of companies to borrow long-term.

However, these findings are contradicted by Myers (1977) and Dennis et al (2000), who argue for a negative relationship between leverage and debt maturity, as a way to deal with agency costs. The authors argue that reducing leverage, as well as shortening the debt maturity, are mechanisms for limiting perverse investment

incentives such as the underinvestment. According to Myers (1977), the underinvestment problem occurs when shareholders have an incentive to reject projects with a positive net present value. This behavior is attributed to the fact that shareholders, in this situation, are not offered a normal return on their investment since the debt holders capture the bigger part of the benefits. Myers (1977) introduces a way to deal with this sub-optimal behavior through shortening the maturity of outstanding debt. Shortening the debt maturity offers debt holders a setting for continuous renegotiating and reduces the risk of sub-optimal investment decisions.

Empirically, Antoniou et al (2006) demonstrate that the relationship between leverage and debt maturity is positive in Germany, France and the UK.

2.2.2 Liquidity

The liquidity of an asset refers to the easiness that asset can be traded on the market. The more liquid assets a company has, the greater is their value when it comes to short notice sale or liquidation. Thus, a company should find it easier to raise external financing against more liquid assets, since liquid assets give lenders greater value in the case of liquidation (Myers and Rajan, 1998). Concluding, a positive relationship between liquidity and debt maturity structure is projected by the liquidity risk theory.

However, Myers and Rajan (1998) contradict this relationship by arguing that greater asset liquidity leads to a decrease in the company's capacity to raise external financing. This relationship is attributed to the agency costs theory and occurs because higher liquidity confers managers more freedom of choice; this freedom can result in managers acting in their own favor and at lenders' expense. Thus, a higher liquidity leads to a greater potential for conflict between managers and lenders. Myers and Rajan (1998) argue that management's ability to represent shareholders' interests and commit credibly to an investment strategy can be questioned.

Empirically, Antoniou et al (2006) demonstrate that the association between liquidity and debt maturity is negative for companies in Germany, France and the UK.

2.2.3 Firm value volatility

As the abovementioned variables show, a risk that can lead to a refinancing issue in the future makes the company want to lengthen its debt maturity. The same pattern is identified in the case of firm value volatility, as investors might be reluctant to invest in a company that is experiencing instability. Wiggins (1990) confirms this positive relationship between firm value volatility and debt maturity structure since default risk premiums on debt are higher on long-term debt in companies with a higher volatility in their value. Thus, with this premium charged in high volatile companies on long-term debt, higher tax shields are gained since the interest payments on long-term debt are higher than those on short-term debt.

On the other hand, Kane et al (1985) argues for a negative relationship between firm value volatility and debt maturity structure. As the market value of the company changes and debt remains constant, the equity acts as a cushion. Companies with a high volatility in firm value, naturally have a high volatility in the equity cushion and shareholders' value. The volatility in equity leads to a more unstable capital structure where the leverage ratio is changing accordingly and this obliges the management to continuously rebalance the capital structure to avoid a too high leverage ratio. Conversely, companies with a low volatility in value have a stable amount of debt and equity, which allows for a fixed capital structure. Without being forced to continuously rebalance the capital structure and thus having a lower bankruptcy risk, companies with a low volatility in value have easier access to long-term debt.

The effect of firm value volatility on debt maturity structure is positive for French companies, negative for British ones and insignificant for German ones, as Antoniou et al (2006) report.

2.2.4 Firm quality

The signaling theory argues that certain decisions made by companies reveal information on their current and future status more accurately than their public statements do. As Berk and DeMarzo (2007) claim, actions speak louder than words and the choice of the debt maturity structure is one of these actions. Outsiders use the debt maturity structure as a health indicator and debt holders will take this knowledge into account when investing in a particular company.

Flannery (1986) is the first to examine to what extent the debt maturity structure can be used by insiders to signal the quality of a company when the outsiders' information is less accurate than insiders'. Flannery (1986) presents a model where the author distinguishes between good companies and bad ones, i.e. high quality companies and low quality ones. The author argues that in the case of information asymmetry, at its extreme level, the outsiders treat all companies equally and charge the same premium on issuing long-term debt. This behavior applies to long-term debt exclusively due to a higher risk of defaulting in this case. The default premiums paid by good companies on long-term debt are therefore too high, while the reverse holds for bad companies. Based on this, good companies will suffer when borrowing long-term and therefore prefer to borrow short-term. Bad companies, on the other hand, borrow long-term as they pay a lower default premium than they would have otherwise, if no information asymmetry existed. Bad companies are also reluctant in borrowing short-term, as this brings along the refinancing risk. This refinancing would impose the management to reveal new information to the lenders, which is detrimental for bad companies.

2.3 Agency costs

The agency costs theory refers to those costs accrued due to conflicting interests between various stakeholders. Myers (1977) argues that the existence of debt may in some circumstances change the company's actions. That is, when a company is leveraged, conflicts of interest may arise between shareholders and debt holders, if investment decisions affect them differently. Such a conflict is more likely to occur when the financial distress is high (Berk and DeMarzo, 2007).

We investigate how various types of agency conflicts impact the debt maturity structure and how these costs can be mitigated through the use of short-term debt. Short-term debt opens up monitoring opportunities for lenders as the managers need to approach lenders more frequently to renew it. Agency problems are inherently difficult to measure directly, and hence a more indirect approach is necessary. Past research used variables like maturity matching, firm size and growth opportunities to test for the determinants of debt maturity structure, when it comes to agency costs, and thus we proceed accordingly.

2.3.1 Maturity matching

Maturity matching is a method to handle agency costs since by matching the maturity of debt to the maturity of assets one can control for the risks and costs of financial distress. Morris (1975) is the first to bring up the idea of maturity matching, which rests on the immunization hypothesis. The immunization hypothesis argues that a company should match the maturity of its liabilities with that of its assets in order to reduce interest rate risks and liquidation risks. Maturity matching is therefore a form of corporate hedging that reduces expected costs of financial distress. Thus, the debt maturity structure should be determined by its asset maturity structure (the average number of years of depreciation) because on the one hand, if debt has a shorter maturity than that of the assets, the company may not have enough cash readily available to repay the principal at due date. On the other hand, if debt's maturity is longer than that of the assets, the cash flows coming from assets finish, while the debt payments remain outstanding. Myers (1977) also argues that matching the maturities of assets and liabilities reduces the interest rate and liquidity risk and thereby provides a rationale for value maximization. Therefore, the longer the asset maturity is the longer debt maturities the company should issue.

Nevertheless, there is an observed divergence between theory and practice, as Stulz (1996) points out. The author explains that in practice companies only partially hedge through maturity matching. Morris (1975) demonstrates that a perfect hedge does not exist, revealing in his study on industrial companies that 75 percent of the companies had an average debt maturity greater than average asset maturity. Also, Morris (1975) finds that companies matching the maturities of assets with those of debt had an overweight of long-term debt. In a comparison of the debt maturity choices of companies from UK and Italy, Schiantarelli and Sembenelli (1999) find that debt maturity structure is positively related to maturity matching, which is in line with the predictions of Morris (1975). Fan et al (2010) find no evidence for any clear relationship between maturity matching and debt maturity structure.

2.3.2 Firm size

Firm size has the potential to explain the debt maturity choice of companies, since larger companies have lower asymmetric information due to higher requirements on reporting. Therefore, larger sized companies have easier access to long-term debt.

Ozkan (2000) finds in his study that agency costs are reduced by an increase in the size of a company, which leads to larger companies having more long-term debt as opposed to smaller companies.

2.3.3 Growth opportunities

Several studies identify relationships between company's growth opportunities and debt maturity structure. Growth opportunities has the potential to affect the debt maturity structure since it is associated with numerous future investment decisions for the management of a company. And, an increasing number of investment decisions leads to an increasing potential for underinvestment problems. One way to deal with the potential sub-optimal behavior by of the management team is identified by Myers (1977), who suggests that companies should shorten the maturity of outstanding debt. By having debt that matures before the growth option is exercised, borrowers and lenders can monitor and renegotiate the terms of the contract and thereby reduce potential sub-optimal behavior. Also, Barclay and Smith Jr. (1995) argue for this inverse relation between growth opportunities and debt maturity structure, as a way to control for the underinvestment problem arising from conflicting interest between the management and lenders.

Ozkan (2000) finds a significant negative relationship between the growth opportunities and debt maturity structure. Antoniou et al (2006) report a non-significant relationship in Germany, France and the UK. Also, Fan et al (2010) do not find any significant relationship in their study of an international comparison of debt maturity choices.

2.4 Equity market conditions

Few of the existing studies on debt maturity structure have explained how this is affected by the conditions on the equity market. Our intention is to capture the connection between the equity and the debt markets and incorporate in our study variables belonging to the equity market that might have an influence on the choice of debt maturity structure. This theory argues that variables like the past share price performance and the equity risk premium charged by investors could be used as predictors of the debt maturity structure.

2.4.1 Share price performance

The signaling hypothesis argues that undervalued companies use the issuance of short-term debt as a way to signal their undervaluation. This choice of maturities, however, can also be a result of the past share price performance. Lucas and McDonald (1990) argue that a company that is about to reveal good news will wait to issue securities until the news reach the market and result in an increase in share price. Lucas and McDonald (1990) claim that long-term debt financing demands more information to be revealed by the borrowers so as to assure the lenders of the companies' quality. An increase in share prices is perceived by the investors as a guarantee of that company's financial health and thus, the companies that experience an increase in their share prices will have an advantage over other companies to issue long-term debt or equity.

Empirically, the results have been contradictory. Guedes and Opler (1996) test the idea described by Lucas and McDonald (1990) but their results do not show any statistically significant association between the increase in past share price and the maturity of new debt issues. Deesomsak et al (2004) test the relationship on companies across countries in the Asian Pacific region, but find mixed evidence for it, with significant results in Australia and Singapore, while insignificant in Malaysia and Thailand. This discrepancy can be attributed to the idea that in countries with more developed financial markets, such as Australia and Singapore, information plays a fundamental role in share price performance than in countries with less developed, and thus less efficient, markets such as Malaysia and Thailand. Also, Antoniou et al (2006) find a mixed relationship between the share price performance and debt maturity structure.

2.4.2 Equity risk premium

The equity risk premium is the return in excess of the risk-free rate. Baker and Wurgler (2000) argue that companies issue equity instead of long-term debt when the cost of equity is relatively low and subsequently issue long-term debt instead of equity when the cost of equity is relatively high. In a bad economy, investors are more risk averse and thus the risk premium is higher as investors require a higher rate of return on their investment. The issuance of equity, given a high risk premium is unfavorable and therefore in this case, companies respond by issuing long-term debt,

as the closest substitute to equity. However, in a transition from a bad economy, companies start again to issue equity as the equity risk premium lowers. Thus, the theory predicts that managements trying to maximize the value of a company will raise long-term debt instead of equity when the equity risk premium is high.

Empirically, Antoniou et al (2006) report mixed results again. The relationship between equity risk premium and debt maturity structure is positive and significant in both Germany and the UK, with a stronger relationship in the UK. The results show an insignificant relationship in France. Antoniou et al (2006) argue that the stronger relationship in the UK is a consequence of a stronger market orientation in the UK economy.

2.5 Tax minimization

Interest on debt is tax-deductible and therefore companies taking on debt create a tax shield. The tax shield creates an incentive for companies to use debt as opposed to equity when designing the capital structure. Thus, taxes and tax-related variables are affecting the choice of capital structure with the purpose of reaching an optimal balance between equity and debt (Berk and DeMarzo, 2007). A company's optimal debt ratio is usually determined by a tradeoff of company's costs and benefits of borrowing. The company takes on debt to take advantage of tax shields until that point where the extra gain from tax shields is equal to the extra loss from bankruptcy and agency costs (Myers, 1984). All in all, taxes affect the debt part of capital structure and tax-related variables interact to offer tax incentives in the debt maturity structure (Antoniou et al, 2006).

The discussion on capital structure, in general, and on the advantage of tax shields, in particular, goes back to Franco Modigliani and Merton H. Miller's irrelevance theory. The Modigliani and Miller (1958) irrelevance theory states that, in equilibrium, the market value of any company must be independent of its capital structure. The Modigliani and Miller theory argues that the main determinant of a company's market value is either cash flow or market-share, not debt. In other words, how a company finances itself should have no relevance to its value, since it has no relevance to its cash flow. The theory holds under a set of conditions referred to as the perfect capital markets conditions, including no taxes, transaction costs or bankruptcy costs.

However, these conditions do not portray the reality and the opponents of the irrelevance theory argue, among other things, that the value of the company can be increased by the use of debt as opposed to equity. The existence of taxes enables interest payments to be deducted from the company's taxable income, which results in a lower cost of capital (Berk and DeMarzo, 2007).

The tax minimization theory is illustrated in our thesis through three variables that show how the management is working with market imperfections such as taxes to reach an optimal balance in the debt maturity structure. These variables are: effective tax rate, term structure of interest rates and interest rate volatility.

2.5.1 Effective tax rate

The discussion of taxes as a market imperfection is continued by Kane et al (1985), who claim that the optimum debt maturity setting involves a tradeoff between the advantage of tax shield and the disadvantages of bankruptcy and flotation cost, the latter represented by the cost arising when issuing debt. On the one hand, given a constant tax shield, an increase in the floatation cost creates an incentive to lengthen the debt maturity so as the amortized floatation cost does not outweigh the benefits of tax shields. On the other hand, given constant flotation cost, a decrease in tax shield would likewise create an incentive to lengthen the debt maturity so as the benefits of the tax advantages are bigger than its disadvantages. The relationship between flotation cost, tax shield and debt maturity leads to a negative relationship between the effective tax rate and debt maturity. Thus, a decrease in effective tax rate leads to a decrease in tax shield which would lead to an increase in debt maturity.

Empirically, Ozkan (2000) does not find the effective tax rate to be significant in explaining the UK companies' choice of debt maturity structure. Deesomsak et al (2004) report mixed results too; a significant relationship is found in Malaysia, while no significant effects are found for the other sample countries: Thailand, Singapore and Australia. Sogorb and Mira (2005) report significant negative results in their study on small and medium Spanish enterprises. Antoniou et al (2006) find a significant positive relationship for German companies, whereas it turns out to be insignificant for UK and French companies. García-Teruel and Martínez-Solano (2006) find that while the effective tax rate is significant, it is of a marginal economic

effect for their sample of Spanish companies. Körner's (2007) tests on a sample of Czech companies result in no significant relation between the effective tax rate and debt maturity structure.

2.5.2 Term structure

To investigate the relevance of taxes, Brick and Ravid (1985) develop a theoretical model on how the term structure of interest rates is related to the debt maturity structure. The authors argue that when the interest rates have an upward slope, companies issue more long-term debt to take advantage of the increase in tax shields. The term structure should therefore be positively related to the debt maturity structure.

Newberry and Novack's (1999) results confirm that companies issue corporate bonds with longer maturities in periods that are characterized by an upward sloping term structure. Anyhow, both Barclay and Smith (1995) and Stohs and Mauer (1996), contrary to predictions, find a negative relationship between term structure and debt maturity: a statistically significant for the former authors while insignificant for the latter ones. Both studies argue against companies actively adjusting their debt maturity structure, in response to the behavior of the term structure, so as to take advantage from increasing tax shields. Antoniou et al (2006) find a positive relationship between the term structure of interest rates and debt maturity structure in Germany and the UK, while insignificant in France, concluding that the results are dependent on the sample period and on the country analyzed.

2.5.3 Interest rate volatility

The tax-timing option refers to the ability of an investor to realize tax credits on capital losses and to defer taxes on capital gains thus creating value on a position in the market and taking advantage of opportunities relating to it. Kim et al (1995) argue that an increase in the debt maturity structure maximizes investors' tax-timing option value. This positive relationship occurs because, according to standard option theory, an increase in volatility increases the value of an option and long-term debt is more sensitive to interest rate volatility than short-term debt. Thus, based on the abovementioned argumentation, companies lengthen their debt maturity structure as the interest rates volatility increase, so as to increase the value of the tax-timing

option. Antoniou et al (2006) find a positive and insignificant relationship between the interest rate volatility and debt maturity structure in France and Germany, while significantly negative for UK companies.

2.6 Gap filling

The majority of theories explaining debt maturity structure focuses on firm-specific determinants and therefore misses out clear-cut implications for aggregate time-series behavior. There is only scarce literature that tries to explain time variation in companies' debt maturity structures by looking at market conditions, such as the general level of interest rates, the slope of the yield curve etc. Stein (1989) explains that market conditions matter in analyzing the debt maturity structure because of the management's value maximizing behavior. The management tries to maximize short-term earnings at the expense of long-term value by borrowing at short-term maturities when the yield curve is upwards sloping, to keep their current interest expense low. Greenwood et al (2010) present an additional theory on the role of market condition as a determinant of the debt maturity structure. Greenwood et al's (2010) theory is based on the timing hypothesis, where managers try to time the maturity of their debt issues to exploit the predictability of bond-market returns. Here, companies issue short-term debt when the expected return on short-term debt is below the expected return on long-term debt and vice versa. Greenwood et al (2010) argue that when the government funds itself with relatively more long-term debt, companies react by filling the resulting gap by issuing more short-term debt and vice versa.

Greenwood et al (2010) base their theory on companies' ability to absorb large supply shocks associated with changes in the maturity structure of government debt. When changes in the maturity structure of government debt occur and the supply of long-term Treasuries goes up relative to the supply of short-term Treasuries, long-term Treasuries offer a greater expected return and companies subsequently issue short-term debt. This idea is based on Greenwood and Vayanos (2008) who investigate whether shifts in the relative supply of long-term bonds affect bond prices and excess returns. The authors predict that an increase in the relative supply of long-term bonds lowers their prices, thus raising their yields and risk premium, relative to short-term bonds. In this scenario, Greenwood et al (2010) argue that corporate issuers, who have to raise a certain amount of debt financing and choose between short or long

maturities, have the capacity to absorb these supply shocks and thus issue short-term debt.

Companies' ability in absorbing large supply shocks is derived by Greenwood et al (2010) from the logic of the Modigliani and Miller's (1958) irrelevance theory. As mentioned before, they argue that companies are indifferent to the capital structure in a world without taxes or costs of financial distress. If then tiny differences in the expected returns are introduced, companies will respond very elastically. This behavior continues until the point where any expected return differentials are eliminated. In a more realistic setting, companies are likely to have well defined preferences over their maturity structures and will think is costly to deviate from this maturity target. However, to the extent that these costs are modest, patterns of corporate debt issuance still respond quite elastically to the differences in expected returns.

The gap filling theory represented through the variables gap filling and time variation in gap filling shows how the corporate debt maturity structure is affected by changes occurring in the government debt maturity structure.

2.6.1 Gap filling

Given the abovementioned reasons, Greenwood et al (2010) predict that companies fill in the supply gaps created by changes in the government financing patterns. When the government issues more long-term debt, companies respond by issuing more short-term debt and vice versa. Given this prediction, the relationship between the government's debt maturity structure and companies' one is negative.

2.6.2 Time series variation in gap filling

By allowing for time-series variation in the size of the government and corporate debt markets, Greenwood et al (2010) make an additional prediction. When the government debt supply is increasing, the gap filling behavior by companies will be quantitatively stronger as the supply shocks give companies incentives for this behavior.

2.7 Hypotheses and measurements

Based on previous research, we choose to test the relationships between the leverage, liquidity, firm value volatility, firm quality, maturity matching, firm size, growth opportunities, share price performance, equity risk premium, effective tax rate, term structure, interest rate volatility, gap filling, time variation in gap filling and the debt maturity structure, as reported in the table below. Based on the theories and empirics presented above, the following hypotheses are deducted. We expect *leverage* to be positively related to debt maturity, *liquidity* to be positively related to debt maturity, *firm value volatility* to be positively related to debt maturity, *firm quality* to be negatively related to debt maturity, *maturity matching* to be positively related to debt maturity, *firm size* to be positively related to debt maturity, *growth opportunities* to be negatively related to debt maturity, *share price performance* to be positively related to debt maturity, *equity risk premium* to be positively related to debt maturity, *effective tax rate* to be negatively related to debt maturity, *term structure* to be positively related to debt maturity, *interest rate volatility* to be positively related to debt maturity, *gap filling* to be negatively related to debt maturity, *time variation in gap filling* to be positively related to debt maturity.

Table I
Variable definition and hypothesized relationship

Theory	Variable	Sign	Formula
Liquidity risk & signaling	Leverage	+	Total Debt / Total Assets
	Liquidity	+	Current assets / Current liabilities
	Firm value volatility	+	$\left\lvert \frac{EBITD_t - EBITD_{t-1}}{EBITD_{t-1}} - \frac{1}{N}\sum_{1}^{N} \frac{EBITD_t - EBITD_{t-1}}{EBITD_{t-1}} \right\rvert$
	Firm quality	–	(Net income + Depreciation) / Net debt
Agency costs	Maturity matching	+	Net PPE / Depreciation
	Firm size	+	ln (Total Assets)
	Growth opportunities	–	MV Equity / BV Equity
Equity market conditions	Share price performance	+	Δ Share price of two consecutive years
	Equity risk premium	+	ROE – Return T-bills
Tax minimization	Effective tax rate	–	Tax expense / Taxable income
	Term structure	+	Yield LT T-bonds – Yield ST T-bills
	Interest rate volatility	+	ln (Stdev of the monthly gov. bond yield over the previous year)
Gap filling	Gap filling	–	LT gov. debt / Total gov. debt
	Time variation in gap filling	+	Gov. debt/GDP

The debt maturity structure of a company is measured as the ratio of the company's long-term debt (WC03251)[1] to total debt (WC03255). The long-term debt is defined as debt maturing in more than one year, while short-term debt is defined as debt due within the next twelve months. Our definition of the debt maturity structure follows that of Barclay and Smith Jr. (1995). Other studies on the debt maturity structure, like Titman and Wessels (1988), have used different measures of the dependent variable, e.g. the ratio of short-term debt to total assets and the ratio of long-term debt to total assets. However, their focus is more on companies' leverage decision rather than on how companies' debt maturity structure varies with companies' characteristics.

Leverage is measured as the ratio of total debt (WC03255) to total assets (WC02999). By having a measure that is using book values of equity compared to market values, the ratio becomes more reliable as it is validated in the annual report. This is in line with the study done by Scherr and Hulburt (2001). Liquidity is measured through the ratio of current assets (WC02201) to current liabilities (WC03101). This way to measure liquidity is useful because it shows the relation between liquid assets and current liabilities, specifically how much a company is holding in liquid assets to cover its current liabilities. This is in line with the definition presented by Antoniou et al (2006). Firm value volatility is measured through earnings volatility. This substitution is a general method applied in empirical studies due to the absence of reliable cash-flow data. Earnings volatility is measured as the absolute value of the change in EBITD (WC18198) between two consecutive years minus the average earnings change in EBITD between two consecutive years during the sample period. This is in line with the definition presented by Stohs and Mauer (1996). Firm quality is calculated as the ratio of net income (pretax income (WC01401) minus income tax (WC01451)) plus depreciation (WC01148) to net debt (WC18199). This describes how much a company can cover of its debt through its earnings from that period. This is in line with the description presented by Antoniou et al (2006).

Maturity matching represents the ratio of net property, plant and equipment (WC02501) to the annual depreciation expense (WC01148). This measure shows the average of the company's assets remaining lifetime. This is in line with the

[1] Datastream Mnemonic code

description presented by Antoniou et al (2006). Firm size is measured by looking at the total assets (WC02999) of a company. We compute the natural logarithm of total assets so as to control for a possible non-linearity in the data and to control for the consequent problem of heteroscedacsticity. This is in line with the description presented by Guedes and Opler (1996). Growth opportunities is computed as the ratio of market value of equity (WC08001) to book value of equity (WC03995). This is in line with the definition given by Barclay and Smith Jr. (1995), Guedes and Opler (1996) and Stohs and Mauer (1996).

Share price performance is calculated as the percentage change of share price (WC05015), adjusted for dividend (WC09504), between two consecutive years. The definition is according to Myers (1984) and Guedes and Opler (1996). Equity risk premium is calculated as the difference between the actual return on equity (WC08372) and the actual return on T-bills[2]. This variable is adjusted for the month of the company's fiscal year-end, as our sample companies have different fiscal year ends (March, April, June, August and December). We lag both variables one year to allow for a time gap between the decision making process and the issuance of debt. This is in line with the definition presented by Antoniou et al (2006).

The effective tax rate is represented by the ratio of tax expense (WC01451) to pretax income (WC01401). The definition follows that of Stohs and Mauer (1996) and Ozkan (2000). The term structure of interest rates is measured as the difference between the yield on a ten-year government bond and the yield on a thirty day T-bill[3]. This variable is adjusted for the month of the company's fiscal year-end. The definition follows the one of Guedes and Opler (1996). The interest rate volatility is measured as the monthly standard deviation of the ten-year government bond yield over the previous year, adjusted for the company's fiscal year-end. We compute the natural logarithm so as to control for a possible non-linearity in the data and the consequent problem of heteroscedacsticity. Both the term structure and the interest rate volatility are lagged one year to allow for a time gap between the decision making process and the issuance of debt. This is line with the definition presented by Antoniou et al (2006).

[2] The information is distributed by Riksbanken, www.riksbanken.se
[3] Ibid.

Gap filling is calculated by the ratio of long-term government debt to total government debt. Long-term government debt is defined as total payments due in more than one year and total government debt is defined as total payments in all future periods[4]. By using the issue date, coupon rate, final maturity and the face value of each security, the payment streams are decomposed on a yearly basis for each outstanding issue into a series of principal and coupon payments. These payment streams are then adjusted for variation in the face value outstanding. Changes in the face value disclose repurchases and reopenings of an existing issue. The aggregate payments due in the following year are then divided by all issues outstanding. This is in line with the definition presented by Greenwood et al (2010). Time variation in gap filling is calculated as the ratio of government debt to GDP[5], since this ratio is a proxy for the size of the government bond market. This follows the definition by Greenwood et al (2010).

3. Methodology

3.1 Sample

We test for a sample of 73 stocks traded on the Swedish Stock Exchange, Nasdaq OMX Stockholm, for the period 2000 to 2010. This eleven year sample period is chosen as we want to investigate the current state and use the last decade to observe trends or structural breaks in the debt maturity structure. We exclude all financial and real estate companies due to specific characteristics of their capital structure that would potentially lead to a distorted result. We also exclude companies that do not report any leverage, as they are not testable. Companies that ceased to exist during the sample period, due to bankruptcy or other exit reasons, have also been removed from our study, as we aim to have a balanced panel data. This action leads to our study being exclusively done on companies that have survived during the sample period. In total, the sample includes 803 observations and the list of companies is found in Appendix A. The financial data was obtained from Thomson Reuters DataStream and the scarce number of missing data was computed manually with financial numbers taken from individual annual reports and public statements. The sample has also been

[4] The information is distributed by Riksgälden, www.riksgalden.se
[5] Ibid.

adjusted for outliers since the data included some extreme cases in observations. Manually, we deleted the observations deviating 98.5 percent from the mean.

3.2 Regression model

We investigate which independent variables have a significant impact on the debt maturity structure, by using a regression model in a panel data framework. In this model we incorporate the following independent variables: leverage, liquidity, firm value volatility, firm quality, maturity matching, firm size, growth opportunities, share price performance, equity risk premium, effective tax rate, term structure, interest rate volatility, gap filling and time variation in gap filling.

$$DM_{it} = \beta_1 + \beta_2 LV_{it} + \beta_3 LQ_{it} + \beta_4 FV_{it} + \beta_5 FQ_{it} + \beta_6 MM_{it} + \beta_7 FS_{it} + \beta_8 GO_{it} + \\ + \beta_9 SP_{it} + \beta_{10} ER_{it} + \beta_{11} TX_{it} + \beta_{12} TS_{it} + \beta_{13} IV_{it} + \beta_{14} GF_{it} + \beta_{15} TGF_{it} + \\ + u_i Dummy_{industry} + u_i Dummy_{company} + \lambda_t Dummy_{years} + v_{it} \qquad (1)$$

where DM = debt maturity structure, LV = leverage, LQ = liquidity, FV = firm value volatility, FQ = firm quality, MM = maturity matching, FS = firm size, GO = growth opportunities, SP = share price performance, ER = equity risk premium, TX = effective tax rate, TS = term structure, IV = interest rate volatility, GF = gap filling, TGF = time variation in gap filling.

The coefficient estimates: β_2, β_3,…, β_{15} are the parameters which quantify the effect of independent variables on debt maturity. Each coefficient measures the average change in the dependent variable per unit change in a given independent variable, holding all other independent variables constant at the average values (Brooks, 2008).

By using the fixed effects model we allow the intercept in the regression model to differ either on a cross sectional or on a time-series level. The fixed effects model is detected in the splitting up of the error term between u_i, λ_t and v_{it}, where u_i does not vary over time, while λ_t varies over time and therefore we allow for both a cross sectional and a time-series variation. To capture cross sectional variations in the panel data sample we use the cross sectional fixed effects model. By allowing the intercept to vary on a cross sectional level, we can discover differences on an industry and/or a company level. The most popular fixed effects model is the Least Square Dummy

Variable (LSDV) regression model, where dummies account for individualities in the behavior of cross sectional units; in our case for companies and industries (Gujarati, 2003). This model enables us to reject the hypothesis that all companies and/or industries have the same intercepts and thus observe if companies are acting in a similar way along with their industry group or rather on an individual level. The industry categorizations include Fast Moving Consumer Goods, Health Care Equipment and Services, Household Goods, Industrial, Information Technology, Raw Materials, and the Telecom sector. To capture time-series variations in the panel data sample we use the time-fixed effects model. By allowing the intercept to vary on a time-series level, we can discover differences on a yearly basis. The dummy regression is used to capture time variation by including in the regression model a time varying intercept dummy that allows for time specific heterogeneity (Brooks, 2008). This model enables us to reject the hypothesis that all years are identical when it comes to companies' debt maturity structure. We perform in our analysis a redundant fixed effects test, as described by Brooks (2008). This shows if the fixed effects model is important for our study.

3.3 Panel data

Since we examine determinants of the debt maturity structure representative for both cross sectional and time series theories, we use a panel data technique. One advantage of using panel data is that we can address a broader range of issues and tackle more complex problems than with pure cross sectional or time series data only. Not only the number of observations is increasing, in a panel data technique, but we are also capable of measuring effects that occur jointly through the passing of time and through cross sectional variation (Baltagi, 2008). By combining cross-sectional data with time-series data, we increase the degrees of freedom, and thus the power of the test becomes higher. Finally, this way of combining data allows us to mitigate problems of multicollinearity that may arise if time series are modeled individually (Brooks, 2008). There are two types of panel data, balanced and unbalanced. We use a balanced panel and thus the number of time series observations for each cross sectional unit and the number of cross sectional units at each point in time are the same. By using a balanced panel data we exclude companies that due to bankruptcy or other reasons exit the market during the sample period and consequently miss data.

3.4 Methods of estimation

We employ the fixed effects model that allows for individual unobservable differences through entity specific intercept terms, while still utilizing the ordinary least squares method (Brooks, 2008). The pooled ordinary least squares method is the dominant estimation method applied in empirical studies on debt maturity structure, where neither cross-sectional nor time specific differences are captured (Körner, 2007). By using the pooled ordinary least squares method alone, we would make the strong assumption of cross-sectional and temporal differences having no statistically significant effect. Since we believe in the existence of these differences, we employ both the fixed effects model to account for them and the ordinary least squares method. However, several issues regarding the use of ordinary least squares method and fixed effects model exist. The main problems investigated and accounted for are: heteroscedasticity, autocorrelation and multicollinearity (See Appendix B).

3.5 Qualitative add-ons

To complement our quantitative results, we investigate the issue of debt maturity structure even further by conducting a limited qualitative study. One interview is held with the Head of Treasury from SCA, Carl-Axel Olson, and one interview is held with the Heads of Treasuries from Swedish Match, Per Anderberg and Carl Nilsson. These two interviews are held to see how well our model matches the Treasuries' reasoning and also gain further insights from an inside perspective. We choose these companies because, on the one hand, SCA is a mature company and a representative for both the Industrial and Raw Materials companies in our sample selection. As these two industries are the top leading ones in our sample selection, we believe it is of interest to find more about their practice when it comes to the debt maturity structure. On the other hand, Swedish Match is a highly leveraged company and has had a constantly high debt maturity structure throughout the years, which makes it an interesting case.

The questions addressed during the two interviews refer to if and how each individual ratio is affecting the debt maturity structure of their companies and how well our quantitative findings fit with the companies' practice. We look for the reasoning behind the decisions taken in the Treasury department concerning debt maturity structure and our purpose is to find the determinants of this structure that are important for SCA and Swedish Match.

4. Results

This section provides the relationship between the independent variables and the debt maturity structure. Table II describes our sample, Figure I shows the development of the debt maturity structure over our sample period, Table III shows the correlation between the variables and Table IV shows the results from regression model (1). We find that leverage, liquidity, firm value volatility, gap filling and time variation in gap filling along with companies' individual choice of debt maturity structure explain to a 55 percent the listed Swedish companies' choice of debt maturity structure.

As seen in Table II, the regression is based on 73 companies during the period 2000-2010, ending up in 803 observations. 38 percent of the sample is represented by large capitalization companies, 25 percent of the sample is represented by mid capitalization companies and 37 percent is represented by small capitalization companies. 2 companies belong to the Fast Moving Consumer Goods sector, 8 companies belong to the Health Care Equipment and Services sector, 9 companies belong to the Household Goods sector, 39 companies belong to the Industrial sector, 7 companies belong to the Information Technology sector, 7 companies belong to the Raw Materials sector and 1 company belongs to the Telecom sector. The debt maturity ranges from 0 to 1 and has a mean of 0.64 throughout the sample. Leverage ranges from 0 to 0.78 and has a mean of 0.25. Liquidity has a mean of 1.66, implying that on average, our sample companies hold a liquidity cushion. Maturity matching shows that our sample companies' assets have an average remaining lifetime of 6.4 years. The effective tax rate is, on average, 22 percent. The yield curve is, on average, upwards sloping. The gap filling shows that the government, on average, holds almost exclusively long-term debt.

Table II

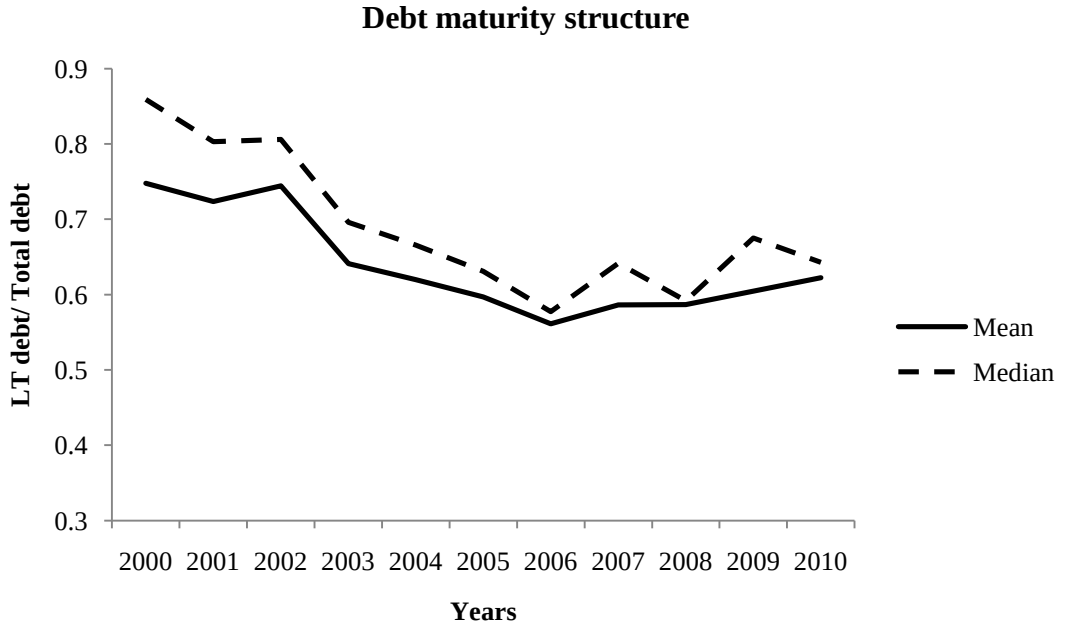
Descriptive statistics of firm specific and macroeconomic variables

DM = debt maturity structure, LV = leverage, LQ = liquidity, FV = firm value volatility, FQ = firm quality, MM = maturity matching, FS = firm size, GO = growth opportunities, SP = share price performance, ER = equity risk premium, TX = effective tax rate, TS = term structure, IV = interest rate volatility, GF = gap filling, TGF = time variation in gap filling.

	Mean	Median	Stdev.	Variance	Kurtosis	Skew.	Min.	Max.	Obs.
DM	0.640	0.690	0.296	0.088	(0.645)	(0.658)	0.000	1.000	803
LV	0.247	0.241	0.148	0.022	(0.563)	0.290	0.000	0.776	803
LQ	1.662	1.456	0.745	0.554	2.659	1.409	0.182	4.945	803
FV	1.098	0.434	2.020	4.080	22.805	4.352	0.000	15.541	803
FQ	0.303	0.265	2.279	5.195	17.989	0.336	(16.833)	15.732	803
GO	1.538	1.330	0.691	0.477	4.471	1.871	0.624	5.630	803
FS	15.204	14.959	1.850	3.422	(0.733)	0.269	10.939	19.417	803
MM	6.382	5.909	3.882	15.066	2.085	1.212	0.000	25.140	803
SP	0.123	0.098	0.495	0.245	0.978	0.707	(0.915)	2.044	803
ER	5.624	9.416	24.494	599.950	6.605	(1.695)	(120.01)	111.512	803
TX	0.221	0.268	0.258	0.066	13.276	(0.919)	(1.552)	1.844	803
TS	1.455	1.527	0.761	0.579	(0.495)	0.243	(0.074)	3.066	803
IV	0.303	0.256	0.129	0.017	2.506	1.838	0.117	0.678	803
GF	0.988	1.022	0.055	0.003	(1.442)	(0.514)	0.900	1.050	803
TGF	47.277	47.899	8.047	64.754	(0.116)	0.547	35.432	64.699	803

Figure I shows that the range of the average debt maturity structure for the sample period is between 0.56 and 0.75, implying that during the sample period the long-term debt has been dominant over short-term debt. As seen in Table II, the average debt maturity throughout the sample is 0.64. During the years 2000 to 2006 the average debt maturity structure shows a downward trend. The low point is reached in 2006 and until 2010 the debt maturity has been stable, however marginally increasing. The peak is reached in 2002, in the debt maturity structure, with companies holding then, on average, 74 percent long-term debt.

Figure I
The development of the debt maturity structure for the sample period



Variable	Measure	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
LT D/Total D	Mean	0.748	0.723	0.744	0.641	0.620	0.597	0.561	0.586	0.587	0.605	0.623
	Median	0.859	0.803	0.806	0.696	0.666	0.631	0.577	0.642	0.592	0.675	0.643

Table III shows that on a 1 percent significance level, the debt maturity structure is significantly correlated with leverage, liquidity, maturity matching, gap filling and time variation in gap filling. Consequently, these variables are expected to represent important variables explaining the debt maturity structure. Independent variables that are correlated above 0.3 and on a 1 percent significance level are term structure and share price performance, interest rate volatility and gap filling, interest rate volatility and time variation in gap filling, share price performance and gap filling.

Table III

Correlation matrix

** significance at 1 percent level, * significance at 5 percent level

DM = debt maturity structure, LV = leverage, LQ = liquidity, FV = firm value volatility, FQ = firm quality, MM = maturity matching, FS = firm size, GO = growth opportunities, SP = share price performance, ER = equity risk premium, TX = effective tax rate, TS = term structure, IV = interest rate volatility, GF = gap filling, TGF = time variation in gap filling.

	DM	TX	TS	IV	LV	LQ	FV	FQ	GO	FS	MM	SP	ER	GF
DM														
TX	(.003)													
TS	.032	.029												
IV	.077*	.026	.120**											
LV	.335**	(.031)	(.097)**	-.015										
LQ	.306**	.014	.053	.064	(.143)**									
FV	.004	(.031)	.044	.011	(.049)	(.040)								
FQ	(.028)	.014	(.009)	(.054)	(.006)	.019	(.043)							
GO	(.002)	.100**	.148**	(.017)	(.132)**	.203**	(.064)	.083*						
FS	.086*	.132**	(.025)	(.004)	.069*	(.158)**	(.002)	.050	.013					
MM	.162**	.047	(.029)	.021	.251**	.019	(.002)	.003	(.125)**	.227**				
SP	.031	.164**	.437**	(.073)*	(.014)	.046	.016	.022	.244**	.070*	.062			
ER	.012	.204**	(.075)*	.068	(.106)**	(.009)	(.178)**	.073*	.124**	.272**	.166**	.222**		
GF	.139**	(.011)	(.099)**	.391**	.055	.057	.049	(.046)	(.242)**	(.013)	(.003)	(.327)**	(.045)	
TGF	.156**	.045	.276**	.334**	.010	.176**	.037	(.026)	.021	(.068)	.040	.179**	(.018)	.144**

Table IV

The influence of independent variables on the debt maturity structure

** significance at 1 percent level * significance at 5 percent level

Adjusted R^2 value is reported. Our results are based on regression (1):

$$DM_{it} = \beta_1 + \beta_2 LV_{it} + \beta_3 LQ_{it} + \beta_4 FV_{it} + \beta_5 FQ_{it} + \beta_6 MM_{it} + \beta_7 FS_{it} + \beta_8 GO_{it} + \beta_9 SP_{it} + \beta_{10} ER_{it} + \beta_{11} TX_{it} + \\ + \beta_{12} TS_{it} + \beta_{13} IV_{it} + \beta_{14} GF_{it} + \beta_{15} TGF_{it} + u_i Dummy_{industry} + u_i Dummy_{company} + \lambda_t Dummy_{years} + v_{it}$$

where DM = debt maturity structure, LV = leverage, LQ = liquidity, FV = firm value volatility, FQ = firm quality, MM = maturity matching, FS = firm size, GO = growth opportunities, SP = share price performance, ER = equity risk premium, TX = effective tax rate, TS = term structure, IV = interest rate volatility, GF = gap filling, TGF = time variation in gap filling. The regression is based on 73 companies during the period 2000-2010, ending up in 803 observations.

Independent variable	Equation (1)
Intercept	(.552)*
Leverage	.708**
Liquidity	.155**
Firm value volatility	.013*
Firm quality	(.003)
Maturity matching	.002
Firm size	.013
Growth opportunities	.010
Share price performance	(.013)
Equity risk premium	(.001)
Effective tax rate	.014
Term structure	.015
Interest rate volatility	(.026)
Gap filling	.477**
Time variation in gap filling	.002*
Adjusted R^2	55.1 percent
N	803

Leverage has a strongly positive and significant influence on the debt maturity structure. This is consistent with Morris (1975) and with the suggestion that companies that hold more debt lengthen its maturity in an attempt to control for the refinancing risk and the cost of financial distress. Liquidity has a positive and significant influence on the debt maturity structure. This relation indicates that companies with high liquidity are able to raise long-term debt as the liquid assets give creditors greater value in a potential liquidation. Firm value volatility has a positive and significant influence on the debt maturity structure. This result supports the liquidity risk theory and reveals companies' attempts to avoid possible liquidation when having a high volatility in value. The relationship is also in line with Wiggins' (1990) theory, that companies with high volatility in firm value are targeting the higher tax shield from having more long-term debt. The gap filling has a positive and

significant influence on the debt maturity structure. The sign is contradictory to theory and against the argumentation that companies issue cheaper short-term debt when the government issues long-term debt. The time variation in gap filling has a positive and significant influence on the debt maturity structure. This is consistent with theory and with the prediction that when government debt supply is large, gap filling by companies will be quantitatively stronger.

The insignificant variables in regression (1) are firm quality, maturity matching, firm size, growth opportunities, share price performance, equity risk premium, effective tax rate, term structure and interest rate volatility. However, the discussion regarding these variables should be taken more as an indication of their relationships with debt maturity, but since it is insignificant it should be treated with caution.

Firm quality has a negative and insignificant influence on the debt maturity structure. The negative sign is an indication that Swedish companies are following the signaling theory and that debt maturity structure is used as a tool by insiders to signal the quality of a company to outsiders. A reason for the insignificant coefficient could be attributed to the measurement of firm quality. Another measure of firm quality is through credit ratings, which is used by Diamond (1991). Maturity matching has a positive and insignificant influence on the debt maturity structure. The sign is an indication that Swedish companies match the maturities of assets and liabilities. Firm size has a positive and insignificant influence on the debt maturity structure. The sign indicates that Swedish companies are experiencing the benefits associated with larger firm sizes, i.e. lower transaction costs, easier access to capital markets and lower information asymmetries, all of which being relevant when issuing long-term debt. A reason for the insignificant result could be attributed to the measurement of firm size. Another measure of firm size is companies' total sales, which is used by Scherr and Hulburt (2001) and Fan et al (2010). Growth opportunities has a positive and insignificant influence on the debt maturity structure. This is contradictory to theory that predicts an inverse relationship and against the argumentation that companies experiencing high growth opportunities deal with the underinvestment problem by issuing short-term debt. A reason for the insignificant coefficient could be attributed to the measurement of growth opportunities. The market to book value is a result of several things, like accounting principles, and therefore difficult to isolate to a

companies' growth opportunities solely. Share price performance has a negative and insignificant influence on the debt maturity structure. This is contradictory to theory and against the argumentation that companies issue long-term debt after an increase in share price. Equity risk premium has a negative and insignificant influence on the debt maturity structure. This is contradictory to theory that value enhancing managers raise long-term debt, instead of equity, when the equity premium is high. The effective tax rate has a positive and insignificant influence on the debt maturity structure. This is contradictory to theory and against the hypothesized relationship between flotation cost, tax shield and debt maturity. The term structure has a positive and insignificant influence on the debt maturity structure. The sign indicates that Swedish companies lengthen their debt maturity as the slope of the term structure increases. Interest rate volatility has a negative and insignificant influence on debt maturity structure. This is contradictory to theory and against the argumentation that companies lengthen their debt maturity as the interest rate volatility increases so as to increase the value of the tax-timing option.

Regarding the dummies employed, our model shows that the intercepts on a company individual basis vary significantly one from another and we can therefore, on a company level, reject the hypothesis that all companies have the same intercept. Thus, companies are individually deciding how to form their debt maturity structure and are, according to our model, to a very limited extent affected by factors such as industry and year. The industry-dummy indicates minor differences between industries when it comes to the relevant determinants of the debt maturity structure. The industry that is mostly consistent with our general model is the Industrial sector, but also the Health Care Equipment and Services sector and the Household Goods sector. According to our results, our model is least applicable on the Information Technology sector. We lack results on the Telecom and Fast Moving Consumer Goods sector since these samples are too small and thus not enough data is employed to draw a reliable conclusion. The year-dummy indicates minor differences between years when it comes to the relevant determinants of the debt maturity structure. There are no significant changes on a yearly basis and thus, a radical change in company's debt maturity structure, for example during the recent financial crisis, is not depicted by our model. Since we reject the hypothesis that all companies have the same intercept, the importance of the fixed effects model is proven.

5. Analysis

In our model, we have five significant independent variables that in combination with the fact that companies choose their debt maturity structure on an individual basis explain in proportion of 55 percent listed Swedish companies' choice of debt maturity structure. Three of the variables, the leverage, liquidity and firm value volatility, are part of the liquidity risk theory while the other two, gap filling and time variation in gap filling, belong to the gap filling theory. Hence, our results prove that both firm specific and macroeconomic variables are influencers when it comes to variation in companies' debt maturity structure. The theories that provide insignificant results are signaling, agency costs, equity market conditions and tax minimization.

The liquidity risk theory is the single most important firm specific theory that portrays the determinants of the debt maturity structure of listed Swedish companies. Leverage, liquidity and firm value volatility all report significant influence on the debt maturity structure. Carl Nilsson and Per Anderberg from Swedish Match argue that Swedish companies' objective in general and Swedish Match's in particular is to avoid the refinancing risk to the highest possible extent. They claim this is the case because companies have learnt from past mistakes, as during the 90s many companies went bankrupt because they held a high amount of short-term debt and had problems in refinancing this debt during downturns. This past experience and the earlier crisis during the last decade, which resulted in liquidity problems, have made Swedish companies more reluctant to risk and thus reducing the refinancing risk gained a lot of attention. Carl-Axel Olson's description of the liquidity risk in SCA is in line with the one done by the representatives of Swedish Match regarding their company. He argues that the refinancing risk is subject to a lot of attention compared to other factors like agency costs. This occurs as more mature and bigger companies, with an already established reputation, are less affected by potential agency costs. Liquidity risk, on the other hand, is something that affects all companies no matter the reputation, size or maturity stage. The credit crunch, brought on by the recent financial crisis, is an example of this and made all companies aware of the importance of having access to continuous refinancing.

The first variable in the liquidity risk theory is leverage and our findings imply that highly leveraged companies lengthen their debt maturity so as to reduce the liquidity risk and postpone the bankruptcy risk. Swedish Match is characterized by having a high level of leverage during the sample period. Being in this situation, Swedish Match is exposed to refinancing risk and, consistent with our findings, deals with this by actively lengthening its debt maturity structure.

The second variable in the liquidity risk theory is liquidity and our findings imply that companies with higher levels of liquidity have longer debt maturities. In theory, liquidity has partly negative connotations, causing managers to take sub-optimal decisions. However, Carl-Axel Olson explains that investors are looking at the liquidity back up of a company, the liquidity cushion, as a sign of its independence and as a way to avoid immediate refinancing needs. This cushion enables the company to deal with unexpected fluctuations in cash flows, do acquisitions or pay dividends. A stable and mature company as SCA has the policy to keep ten percent of annual sales in liquidity reserves, which again proves its precaution.

The positive relationship between the third and last variable in the liquidity risk theory, firm value volatility, and debt maturity implies that Swedish companies with a high volatility in earnings issue long-term debt to avoid the liquidity risk. This is yet another indicator of a company's eagerness to avoid the refinancing risk associated with having both short-term debt and high volatility in firm value. The reason for why we believe that Wiggins's (1990) theory on maximizing tax shields is of less relevance than the liquidity risk is due to Carl-Axel Olson's arguments regarding the small weight companies put on the tax minimization aspect, reasoning presented later in the analysis.

The gap filing theory is represented by the gap filling and the time variation in gap filling variables, both having a significant influence on the debt maturity structure. We observe a strongly positive relationship between the issue of long-term government bonds and the companies' debt maturity structure. This behavior contradicts the gap filling theory and instead claims that both companies and the government are issuing debt of the same maturity at the same point in time. A reason for this could be that companies' actions regarding their debt maturity structure serve

as a mirror of government's actions regarding the debt maturity structure. When the economy is going well, the government responds by issuing long-term debt and companies act accordingly. This happens because a bullish economy is adequate for lengthening the debt maturity structure and prosperous companies within this economy have access to long-term debt. Regarding the positive and significant relationship between time variation in gap filling and debt maturity structure, our results are in line with the theory that when a supply shift occurs in the government share of total debt, the behavior of the companies is significantly stronger, although of marginal effect. This behavior proves the mirror effect and shows the immediate response done by companies.

We proceed by examining the differences across individual companies, years and industries. Out of these three divisions, the one showing significant differences in units is the company division. Thus, companies are choosing their debt maturity structure on an individual basis. According to Carl Nilsson, this happens since each company has its own business model, own thinking and own experiences. Because of each company's independent choice, it is difficult to track significant changes in the debt maturity structure occurring during the financial crisis, since all companies are handling the crisis in their own way. Carl-Axel Olson argues that a reason for the inexistent change in the debt maturity structure is also a result of Swedish companies being well-equipped when the credit market crashed in 2008. Because of the low credit margins experienced before the crisis, companies actively lengthened their debt maturity structure. Again, Per Anderberg emphasizes that this behavior is in line with the policy of the Swedish Match Treasury, designed to actively mitigate the refinancing risk. This thinking has resulted in a well-prepared, thus longer debt structure, when the crisis hit the Swedish market.

A possible explanation for the irrelevance of the signaling theory could be attributed to the fact that a large proportion of our sample companies are mature and stable companies with an already established and good reputation and therefore the need to signal their quality is smaller. In addition, Carl Nilsson does not find any reasons for the debt maturity acting as a signaling tool to investors. Contradictory to theory, Carl-Axel Olson argues the relationship between firm quality and debt maturity structure is positive and that investors regard long-term debt as an indicator of health

and short-term debt as a warning sign, as it implies a risk regarding refinancing in the future. Carl-Axel Olson sees only one reason for issuing short-term debt and that would be when this is cheaper than long-term debt, hence in the case of an upward sloping yield curve.

We also observe that listed Swedish companies are not affected by variables included in the tax minimization theory, when it comes to decisions regarding their debt maturity structure. One reason for companies not following the argumentation of the tax minimization theory is that, in practice, companies take into consideration only to a certain extent the benefits resulting from tax shields when making the choice between short-term and long-term debt, as opposed to when making the choice between equity and debt. Carl-Axel Olson argues that even in the case of upward sloping yield curves, the reason for issuing long-term debt is not due to tax shields and thus, this theory is not considered by Treasury when deciding upon the debt maturity structure. Furthermore, other empirical studies examining this theory have difficulties in confirming its predictions.

More, listed Swedish companies are not affected by variables from the equity market conditions theory, when it comes to decisions regarding their debt maturity structure. Theory claims that long-term debt, regarding the share price performance variable, is a substitute for equity and, regarding the equity risk premium variable, an alternative for it when the cost of equity is high. However, our contradictory results might show that this is not the case on the Swedish market.

Additionally, we observe that Swedish companies are not affected by variables from the agency costs theory, when it comes to decisions regarding their debt maturity structure. This lack of interest towards management's potential sub-optimal behavior can be due to the fact that Germanic economies are characterized by less bankruptcy costs than Anglo-Saxon economies. In Sweden, a North Germanic country, there is a stronger emphasis placed on long-run relationships between companies and external creditors, than in Anglo-Saxon countries. This fact diminishes the occurrence of bankruptcy and lessens the need for tools to handle sub-optimal behavior. Thus, variables representative for the agency costs theory do not have a significant influence on the debt maturity structure. Also, the fact that Sweden is a code law country could

be another reason for the insignificant influence of these variables. In a code law country, as opposed to a common law one, the relationship between various stakeholders is closer and that increases the transparency and leads to less asymmetric information, thus creating smaller potential conflicts among them (Antoniou et al, 2006). A third and final market related reason for the irrelevant role that agency costs play could be due to Sweden being a bank-orientated system as opposed to market-orientated system. A bank-orientated system relies on the bank-industry connections, such as those between owners and creditors, to be better established and more concentrated than in a market-orientated system, like the UK one. By being a bank-orientated system, the underinvestment problem and other potential conflicts of interests between various stakeholders are mitigated (Sjögren, 1994).

Finally, one variable that we would have expected to be significant is maturity matching because it acts as a hedge function against interest rate fluctuations and the liquidation risk. Nevertheless, Carl-Axel Olson argues that Sweden, a country rich in natural resources has consequently many companies with very long asset maturity structures. Since the Swedish market rarely issues debt with maturities that match those of these types of assets, such as forests, it is impossible to match the asset maturity structure to the debt maturity structure. The proportion of companies holding assets with longer maturities in our sample, such as those operating in the Industrial and Raw Materials sectors might not be representative for the population. Also, this variable might be more important for insurance companies and banks, sectors not included in this sample.

6. Concluding Remarks

The debt maturity structure of a company is described in previous research as an efficient tool to minimize the risks associated with debt but also increase the level of benefits arising from it. A balanced debt maturity structure is, from the borrowers' perspective, a way to reduce refinancing risk, increase transparency and exploit tax related opportunities. From the lenders' perspective, the debt maturity structure is used as a tool to increase monitoring and reduce managements' potential sub-optimal decisions.

This paper identifies the determinants of the debt maturity structure in listed Swedish companies. Our determinants originate in either firm specific or macroeconomic theories. Several conclusions emerge from our study and we find that the liquidity risk theory and the gap filling theory are the two theories that significantly influence the debt maturity structure. This in combination with our finding that companies choose their debt maturity structure on an individual basis explains to a 55 percent the listed Swedish companies' choice of debt maturity structure.

Regarding the liquidity risk hypothesis, the determinants that report significant results are leverage, liquidity and firm value volatility. The positive impact of the leverage ratio implies that highly leveraged companies lengthen their debt maturity so as to reduce the liquidity risk and postpone the bankruptcy risk. The positive impact of liquidity ratio also proves companies' active behavior to counteract liquidity risk. The liquidity cushion that companies rely on, in the case of unforeseen events, represents a proof of this behavior. The positive impact of firm value volatility is yet another indicator of a company's eagerness to avoid the refinancing risk associated with having both short-term debt and a high volatility in firm value. The importance of the liquidity risk theory and the implications it has on the debt maturity structure is confirmed by the actions done by SCA and Swedish Match Treasuries.

Furthermore, the determinants of the gap filling theory that report significant results are the gap filling and the time variation in gap filling. We observe a strongly positive relationship between the government's debt maturity structure and the companies' debt maturity structure, saying that both companies and the government are issuing debt of the same maturity at the same point in time. This relationship implies that government's actions considering the debt maturity structure serve as a mirror for companies.

Finally, we find no significant relationship between the debt maturity structure in Swedish companies and the determinants belonging to the signaling, agency costs, equity market conditions and tax minimization hypotheses. These findings are in line with the arguments put forward by representatives from SCA and Swedish Match.

6.1 Limitations and further studies

We hope that this study is successful in generating views and hypotheses, some of which may form a foundation for future studies. Some limitations of our study exist. Firstly, our study may suffer from survivor bias as we are doing a regression on a balanced panel data and thus excluding companies that do not have complete data for the sample period that we are investigating. Another limitation is the fact that variables used in this study have alternative measurements that can influence the outcome. Finally, the existence of heteroscedacsticity can have an impact on our results.

From a quantitative methodology perspective, we suggest for future studies to expand the macroeconomic aspect, by including more variables in the analysis. Also, it would be interesting to do a cross-country analysis regarding the debt maturity structure in Scandinavian countries to see in what ways Sweden is different from the other countries. From a qualitative perspective, we suggest for further studies to investigate, in a case-study format, the individual adjustments done on a company level, with respect to the debt maturity structure.

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Appendix

A. Selection of companies

Table V
Selection of the companies included in the analysis

Company	Industry	Company	Industry	Company	Industry
Active Biotechnology	Health Care Equipment & Services	Getinge	Health Care Equipment & Services	Readsoft	Information Technology
Addnode	Information Technology	Geveko	Industrial	Rederi AB Transatlantic	Industrial
AF	Industrial	Gunnebo	Industrial	Rorvik Timber	Industrial
Assa Abloy	Industrial	Haldex	Industrial	Rottneros	Raw Materials
Atlas Copco	Industrial	Hexagon	Industrial	Saab	Industrial
Axfood	Fast moving consumer goods	Hoganas	Raw Materials	Sandvik	Industrial
B&B Tools	Industrial	Holmen	Raw Materials	SCA	Raw Materials
Beijer Alma	Industrial	IBS	Information Technology	Scania	Industrial
Bilia	Household goods	Industrial & Financial Systems	Information Technology	Seco Tools	Industrial
Biophausia	Health Care Equipment & Services	JM	Household goods	Sectra	Health Care Equipment & Services
Bong Ljungdahl	Raw Materials	Kabe Husvagnar	Household goods	Securitas	Industrial
Brio	Household goods	Lundbergforetagen	Raw Materials	Semcon	Industrial
Cardo	Industrial	Meda	Health Care Equipment & Services	Skanska	Industrial
Cision	Industrial	MTG	Household goods	SKF	Industrial
Concordia Maritime	Industrial	Modul 1 Data	Information Technology	Skistar	Household goods
Consilium	Industrial	NCC	Industrial	Ssab	Raw Materials
CTT Systems	Industrial	New Wave Group	Household goods	Sweco	Industrial
Duroc	Industrial	Nibe Industrier	Industrial	Swedish Match	Fast moving consumer goods
Elanders	Household goods	Nolato	Information Technology	TELE2	Telecom
Electrolux	Household goods	OEM International	Industrial	Trelleborg	Industrial
Elekta	Health Care Equipment & Services	Opcon	Industrial	VBG Group	Industrial
Elos	Industrial	Partnertech	Industrial	Volvo	Industrial
Ericsson	Information Technology	Peab	Industrial	Xano Industri	Industrial
Feelgood Svenska	Health Care Equipment & Services	Profilgruppen	Industrial		
G&L Beijer	Industrial	Q-Med	Health Care Equipment & Services		

B. Tests

Heteroscedacsticity

The error term variance should be constant and independent of the value of the independent variables or the expected value of the dependent variable. Heteroscedasticity is assumed to exist if:

$$nR^2 > x^2_{(1,\alpha)}$$

And R^2 is the coefficient of determination from the following regression:

$$e_i^2 = a_0 + a_1 \hat{y}_i$$

On a 5 percent significance level test we have $x^2_{(1,0,05)}$=3, 84. The null hypothesis is rejected if nR^2> than 3,84. We detect heteroscedasticity for 6 (interest rate volatility,

leverage, liquidity, maturity matching, gap filling, time variation in gap filling) out of our 14 variables. We adjusted them by computing the natural logarithm of that variable; however only one of the variables (interest rate volatility) was fixed for this problem, so there is still hetereoscedacsticity in our model. This might negatively affect the interpretation of our results.

Autocorrelation

The error term should be uncorrelated with itself over time, so that knowing the size of the residual at period t-1 will not help predict the residual at period t. We have used the Durbin Watson test where we plotted the residuals against time and the residuals day t(y) against day t-1(x).We got a Durbin Watson coefficient of 1,05; a coefficient below 1 is seen as alarming.

Multicollinearity

The tolerance level shows how much of the variation in the dependent variable is strictly attributable to that specific independent variable. The tolerance levels of all the variables are in the range of (0,627; 0,984) which means that there is a low degree of intercorrelation between the independent variables. Problems occur when the tolerance level goes below 0.1.

Table VI
Collinearity statistics

Variable	Tolerance	VIF
Effective tax rate	0.93	1.075
Term structure	0.72	1.399
Interest rate volatility	0.74	1.347
Leverage	0.86	1.159
Liquidity	0.87	1.147
Firm value volatility	0.95	1.058
Firm quality	0.98	1.017
Maturity matching	0.84	1.188
Firm size	0.85	1.173
Growth opportunities	0.82	1.219
Share price performance	0.63	1.595
Equity risk premium	0.75	1.330
Gap filling	0.71	1.407
Time variation in gap filling	0.79	1.274

Normality statistics

Many practical procedures rely on the assumption that the sample data is following a normal distribution. We decided to test for the normality of our data through a

Bowman Shelton (B) test on a 5 percent significance level, where the assumption that we have a normal distribution is valid if B > 4.27.

Where B is calculated as:

$$B = n\left[\frac{Skewness^2}{6} + \frac{(Kurtosis - 3)^2}{24}\right]$$

$$Skewness = \frac{\sum_{i=1}^{n}(x_i - \bar{x})^3}{ns^3}$$

$$Kurtosis = \frac{\sum_{i=1}^{n}(x_i - \bar{x})^3}{ns^4}$$

Table VII
Normality statistics

Variable	Skewness	Kurtosis	B
Effective tax rate	(0.919)	13.276	3646.085
Term structure	0.243	(0.495)	416.526
Interest rate volatility	1.838	2.506	460.113
Leverage	0.290	(0.563)	436.051
Liquidity	1.409	2.659	269.535
Firm value volatility	4.352	22.805	15657.933
Firm quality	0.336	17.989	7532.428
Maturity matching	1.212	2.085	224.594
Firm size	0.269	(0.733)	475.974
Growth opportunities	1.871	4.471	541.033
Share price performance	0.707	0.978	203.717
Equity risk premium	(1.695)	6.605	819.482
Gap filling	(0.514)	(1.442)	695.545
Time variation in gap filling	0.547	(0.116)	365.036

The B's of all explanatory variables are higher than 4.27 as noticed from Table VII and thus, the normality assumption is validated.