



Determinants of Debt Maturity Structure: Evidence from European publicly traded firms

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Abstract

I examined the empirical determinants of Debt Maturity Structure on European publicly traded Firms over the 2010-2023 period using a Maturity measure that not only accounts for debt instruments but also for other debt-like obligations present on firms' balance sheets. Therefore, further analysis mixed accounting and market data to assign proxies for textbook hypothesis. I concluded that Debt Maturity Structure varies directly with firm size and Asset maturity within firm and time variation, stating that larger firms with longer-term asset maturities have longer-term debt. Additionally, I found an intriguing relation of Debt Maturity with Credit Rating: I verified a non-monotonic relation within firm, but an opposite relationship (monotonic) when assessing the pooled cross-sectional and time-series data. Lastly, I found strong support for the empirical prediction of a negative relation of Debt Maturity with Earnings Variability, evidencing that more volatile firms, regarding their EBITDA, opt for shorter debt maturities. When conducting sub-sample analysis regarding European Regions and Industrial Groups, results were clearly distinct among region and groups, highlighting country and industry specific Debt Maturity Structure dynamics.

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Sumário

Esta tese estuda os determinantes empíricos da Estrutura de Maturidade da Dívida em empresas europeias cotadas durante o período de 2010-2023, utilizando uma medida de Maturidade que considera não apenas os instrumentos de dívida, mas também outras obrigações de natureza semelhante presentes nos balanços das empresas. Assim, a análise combinou dados contabilísticos e de mercado para atribuir aproximações às hipóteses tradicionais presentes na literatura. Comecei por concluir que a Estrutura de Maturidade da Dívida varia diretamente com o tamanho da empresa e com a maturidade dos ativos, considerando variações dentro da empresa e ao longo do tempo, indicando que empresas maiores e com ativos de longo prazo apresentam dívida de maior maturidade. Adicionalmente, identifiquei uma relação interessante entre a Maturidade da Dívida e a Classificação de Crédito: verifiquei uma relação não monotónica ao analisar variações dentro da empresa, mas uma relação oposta (monotónica) ao considerar os dados agrupados em secções transversais e séries temporais. Por fim, encontrei forte suporte para a previsão empírica de uma relação negativa entre a Maturidade da Dívida e a Variabilidade dos Resultados, evidenciando que empresas mais voláteis, no que diz respeito ao EBITDA, optam por dívidas de menor maturidade. Ao realizar análises em subamostras relativas a Regiões Europeias e Grupos Industriais, os resultados demonstraram-se claramente distintos entre regiões e grupos, destacando dinâmicas específicas da Estrutura de Maturidade da Dívida por país e setor industrial.

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1. Introduction

Since the middle of the last century, a lot of research started to contemplate the determinants of the debt maturity structure associated with the experienced technological evolution specially on data collection, availability and processing of information. In fact, multiple papers approached the determinants of the debt maturity structure, especially in the US corporate setting, and would compare the obtained results with existing debt maturity structure hypothesis. Indeed, understanding the determinants of debt maturity structure is crucial for both corporate finance theory and practice, as it directly influences a firm's financing costs, risk profile, and access to capital. While much of the existing literature has focused on international firms mostly in the U.S and other developed markets, there is a growing recognition of the need to examine the specific characteristics and dynamics of European firms, which are less present in existent literature.

Additionally, the European Union has obviously different dynamics compared to other densely studied regions, such as regulatory frameworks that can shape the financing strategies of firms, distinct challenges, including a wide range of tax systems, financial market conditions, and industry structures, all of which may influence their debt maturity choices differently from their counterparts in other regions. Therefore, not only the pure assessment of European debt maturity structure determinants is the key topic of this paper but also one of the main motivations is to assess and compare how do these determinants might change to previous studies conclusions. Thus, this study aims to bridge this gap by analyzing the key determinants of debt maturity in the European context. Specifically, it examines how factors such as firm size, growth opportunities, earnings per share variation, credit rating, asset maturity, tax rates, term spread and earnings variability, allied with the assessment of both firm, industry and country specific characteristics, impact the maturity structure of debt. By focusing on European firms, this research contributes to a deeper understanding of corporate financing decisions in a region characterized by its economic diversity, regulatory environment, and the recent integration of capital markets across member states.

The remaining of the study is presented in the following structure: section II presents the literature review, where past literature conclusions are considered and analysed, and the development of the chosen debt maturity structure hypothesis; section III addresses the data methodology including the chosen period, group of firms, all the necessary data treatment and lastly the assignment of proxy variables to the developed hypothesis; Section IV presents all

results, including the empirical methods and analysis to debt maturity structure determinants and comparison with different results found in the literature; Lastly, Limitations and Conclusions are respectively presented in section V and VI.

2. Literature Review

Moving into debt maturity structure findings, its research started at the beginning of the 90's in USA particularly when Mitchell (1991) found evidence that firms not quoted on the New York Stock Exchange (NYSE) would be likelier to issue debt instruments not surpassing 20-year maturity, arguing that firms which aren't on the NYSE, where information asymmetry is much more common, opt to shorten debt maturity to reduce adverse selection costs. Guedes and Oppler (1994) later argued that both investment grade firms, usually larger, and firms with high-growth opportunities are more prone to have short-term debt on their balance sheets (maturity less than 10 years) corroborating Diamond's (1991a) prediction that low-rated firms tend to avoid shortening their debt maturity structure to avoid refinancing risk and Stulz (1990) statement that firms with restricted growth opportunities should issue debt with longer maturity. One year later, Barclay and Smith (1995) narrowed down Guedes et. Al (1994) findings and stated that small firms with high-growth prospects have higher proportion of short-term debt (according to the chosen debt maturity measure, under three-year maturity). These findings are also in line with notable textbook Myers (1977) theory which states that when firms have incentives to incur in profitable projects, but its internal resources are insufficient, one way to incur in risky debt while minimizing its agency costs is to shorten the effective maturity of debt. This was proven to alleviate debt overhang since it is expected that the investment returns occur later than the principal repayment of financed debt.

On the other hand, several studies contrast the conclusions presented above. As an example, Titman and Wessels (1988), using a balance-sheet debt maturity method, found that small and medium enterprises have higher proportion of short-term debt in their balance sheets. The authors argue that SME's choose shorter debt maturity structures to reduce exposure to interest rate fluctuations over time, reducing possible costs of issuing long-term debt. Increasing the complexity of debt maturity measure, Barclay and Smith (1995) found that small firms with high-growth prospects have higher proportion of short-term debt (according to the chosen debt maturity measure, under three-year maturity). The authors also argued that their findings were also consistent with Myers' (1977) approach regarding the underinvestment

problem, which is intensified for firms with higher growth opportunities, and that debt maturity plays an important role in the equilibrium between equity and debtholders conflicts of interest.

However, important limitations of the presented studies must be taken in consideration. Through Mitchell (1991) and Guedes and Oppler's (1994) studies, the debt maturity measure chosen was the term-to-maturity of public debt issues, which poorly represents the actual maturity of all debt-like liabilities or obligations firms have on their books. Not only the term to maturity analysis is much stronger for incremental financing decisions and for liquidity risk management but by only analyzing a single debt issue, authors disregard existing liabilities such as bank debt and commercial paper, which take a considerable portion of a firm's debt financing. Lastly, regarding Titman and Wessels (1988) and Barclay and Smith (1995) studies, when measuring proportions of short and long-term debt on the balance sheet it misrepresents the actual debt-like liabilities average maturity, resulting in biased analysis and conclusion.

Considering these limitations, an assessment of the many theories/hypotheses put forward in the literature is necessary for a more thorough understanding of what might determine the debt maturity structure of traded European firms. Four theories on debt maturity structure will be examined in the section that follows. The primary goal of the hypothesis' literature revision is to latter attribute proxies to chosen empirical predictions, allowing for empirical/statistical analysis and discussion, subsequently.

2.1. Debt maturity structure hypothesis

This section of the paper assesses four important debt maturity structure hypotheses, used by former critical literature in the field Stohs and Mauer (1996) paper addressing the same exact topic but for US companies in the 1980's period, being them: agency costs, signaling and liquidity risk, tax and maturity matching.

A. Agency Costs Theory

Regarding this theory, Myers (1977) and later Barnea, Haugen and Senbet (1985) firstly start by stating that the presence of risky debt in corporate high-growth opportunities funding may lead to an underinvestment problem since managers, representing shareholders, may not choose to pursue profitable projects in which a considerable portion of the cash-flows/benefits accrue to the debtholders. By reducing the debt maturity, interest and principal repayments are pushed sooner and agency costs

of debt are reduced, ensuring the pursuit of growth opportunities, leading to the empirical hypothesis that firms with higher growth opportunities tend to issue shorter-term debt and so the empirical prediction is that debt maturity and growth opportunities are inversely related. Indeed, while some studies on European firms cannot find an inverse relation between growth opportunities, such as Dang (2011) and Antoniou et. Al (2006), Stohs et. Al (1996), Graham et. Al (2002) and Shane (2003), with US focused analysis, found that indeed high-growth firms with profitable projects mitigate the underinvestment problem and subsequent agency costs by avoiding long-term debt and recurring to shorter-term debt instruments.

Additionally, Smith and Warner (1979) argue that small firms tendentially experience more agency conflicts such as claim dilutions whenever new debt is issued, although debt with shorter maturity mitigates claim dilution problems. Therefore, all else equal, small firms tend to rely more on short term debt, despite experiencing liquidity and financial distress risk, leading to the second agency cost hypotheses that states that firm size varies directly with debt maturity. While Oskan (2000) and Azevedo and Matias (2019) finds negative relation for size and debt maturity in a UK and European set of firms, respectively, contrasting with the empirical prediction, arguing that larger firms with greater financial flexibility may prefer shorter-term debt to avoid the risk of over-leverage, Allen and Carletti (2013) and Caselli et. Al (2014), respectively for international and European studies, argue that larger firms prefer longer debt maturities mostly due to more favorable rates for long-term financing and economies of scale and diversified risk profile corroborating the stated firm size empirical prediction.

B. Signalling and Liquidity Risk Theories

As a pioneer for the signalling theory, Flannery (1986) states that firm with high degree of information asymmetry can signal and inform outsiders about its quality by the choice of its debt maturity. In fact, picturing a scenario where there are no transaction costs of rolling-over short-term debt, such distinction is impossible since outsiders cannot be influenced by the maturity choice of the debt. Although, if we face an actual scenario of positive roll-over transaction costs, throughout time, financially weaker firms won't systematically support these costs and will migrate into the long-term debt market. Therefore, firms signal their quality type by the recurring choice of

debt maturity, and it is then expected that debt maturity is inversely related to firm's quality. In later but similar studies both Kim, Mauer and Stohs (1995) and Stohs and Mauer (1996) found proving evidence for the hypothesis, revealing that firms with superior growth opportunities signal its quality by issuing shorter term debt. Nevertheless, more recent European analysis performed by Ozkan (2000), found no empirical support for the signalling hypothesis.

Moreover, the current performance of a firm might also affect the funding choices and, ultimately, liquidity risk. Diamond (1991a) study not only accounts for signalling but also adds up liquidity risk associated with the (in)ability to renew short-term debt. Given good operational and financial success, companies may issue more short-term debt and lower their borrowing costs (reducing risk for lenders); nevertheless, given poor performance, they may not receive short-term debt renewals and may wind up liquidated. Later, Diamond (1991b) and more recently Fama et. Al (2002) and Hackbarth (2008) further studies argue that very low credit rating firms usually do not have operational cash-flows stability to sustain issuing long-term debt. In fact, these tend to be involved in privately placed short-term debt, through credit intermediaries, such as banks, allowing for close monitoring and frequent debt renegotiations given the probability of a very low rated firm, often distressed, meeting the interest and capital payments. On the other hand, due very high credit rating firms usually participate a lot in short-term debt placement, such as commercial paper, allowing for management of borrowing costs due to little liquidity risk. Firms with moderate credit rating opt for long-term debt, since its moderate liquidity risk does not allow constant short-term debt renewals. Therefore, an empirical prediction is the non-monotonic relationship of debt maturity with firms' bond rating. Despite both very high and low group relying more on short-term debt, the debt instruments used among the groups is expected to be different.

C. Tax

Kane, Marcus and McDonald (1985) propose a model that incorporates both corporate and personal taxes, bankruptcy costs and flotation costs of issuing new debt. Ultimately, the optimal debt maturity comes as a trade-off between the interest tax shields of debt usage with bankruptcy and flotation costs. According to Kane et al. (1985), optimal debt maturity increases with flotation costs, allowing to spread the

refinancing costs of debt for a longer period, and increases as the tax benefits of debt decrease to ensure that these are not less than the amortized flotation costs, net of bankruptcy costs. Lastly, the authors argue that debt maturity increases as firm value volatility decreases, justified by the unneeded rebalancing of the capital structure, reducing bankruptcy costs. Therefore, Kane et al. (1985) suggest two empirical predictions: debt maturity increase as the effective tax rate decrease and debt maturity increase as firm's value volatility decrease. Although Stohs and Mauer (1996) empirically prove both predictions, with both questionable economic significances, Scherr and Hulbert (2001) and Antoniou et. Al (2006) found positive significant relation of effective tax rate with debt maturity, not following the empirical hypothesis. Moreover, Brick and Ravid (1985) argue that long-term debt interest expenses are higher than short-term and hence firms will extend debt maturity if the yield curve (of interest rates) is upward sloping. They demonstrate that firm value increases (driven by the present value of interest tax shields increase) when allocating greater proportion of debt to the long-term. Later, the same authors Brick and Ravid (1991) state that firms opt for long-term debt issues even when the yield curve is flat or downward sloping, as long as there is interest rate volatility. Kim, Mauer and Stohs (1995) are more conservative in their study but also point the preference for long-term debt issues in the presence of interest rate volatility and upward sloping yield curve. The empirical prediction comes as debt maturity increases as the slope of the term structure increase. The latter was empirically proven by later notable studies, such as Baxter and Christoffersen (2005) arguing that when the yield curve is steep, firms are more likely to choose long-term debt to avoid refinancing risks and Hackbarth (2008) stating that when interest rates are expected to increase, firms are more likely to issue longer debt instruments maturity.

D. Maturity Matching

Morris (1976) propose the maturity-matching principle arguing that a firm should match the maturity of its liabilities to that of its assets. When debt matures before assets do, matching lessens the chance that the cash flows from assets will be insufficient to pay back the principal. Also, when debt matures after assets do, matching ensures principal is paid when cash-flows from assets that matured cease or decrease. Myers (1977) also points out that matching assets and debt's maturity allow for the principal

repayments to follow the decrease in value of the assets in place. The empirical prediction is that debt maturity varies directly with assets maturity. Recent evidence confirms a positive relationship between asset and debt maturity, aligning with the maturity matching principle. Globally, Geelen et al. (2024) in a very recent study show that firms still match debt maturities with asset life while in Europe, Reinartz et al. (2018) find firms similarly adjust debt maturities to reduce maturity gaps, particularly in sectors like Energy & utilities, which is included in our sample.

3. Methodology

Over this segment of the paper, I first explain the selection of firms that constitute the sample and then go through the debt instruments retrieved and its descriptive statistics. Moreover, I explain the debt maturity measure used for the empirical tests and lastly the proxies for each of the debt maturity structure hypothesis.

3.1. Sample of Firms and Debt Instruments

The sample includes European publicly traded firms that constitute the EuroStoxx 600 index over the 2010-2023 period and that meet the following criteria: (1) the necessary data (dependent variables) must be available throughout the whole sample period¹; (2) the debt structure of firms must be publicly disclosed, and only those with ample and sufficient information were included in the data set². Additionally, companies from the Financial and Real Estate sectors were excluded from the sample due to potential issues in applying specific proxies relevant to the study's hypotheses. DataStream (recurring to IBES and WorldScope) was used as the source for accounting and market data required for the proxies in the debt maturity structure hypothesis whereas Refinitiv Eikon was the source for the debt structure information, mostly regarding the instruments' type, issue date, maturity date and issued amount. After applying the criteria for data availability and debt structure disclosure, the final sample comprises 198 firms from the EuroStoxx 600 index, spanning various sectors, including Industrials, Consumer cyclical and non-cyclical, Technology, Healthcare, Utilities &

¹ Issues when retrieving data from DataStream were, for example: movers (joiners or leavers firms) with partial disclosure leaving the index, companies with missing values regarding dependent variables required.

² Despite having accounting and market information required to fit into the sample, some firms did not have available debt structures on Refinitiv Eikon and therefore were unconsidered from the analysis due to the impossibility of getting a coherent debt maturity estimate.

Basic Materials and Energy. This sectoral distribution ensures a robust dataset for analysing debt maturity structures across diverse corporate contexts.

For each firm, information about the active and inactive debt instruments was collected through the debt structure's segment in Refinitiv Eikon. When collecting these, the following restrictions were imposed: for inactive debt instruments, only debt instruments that matured after the end of 2010 fiscal year (first year of the sample)³ and that expired or were converted at maturity were considered, meaning that called debt instruments are not present in the sample; for outstanding debt instruments the only restriction imposed was that the issue date was prior to the 31/12/2023, since this date represents the ending point of our analysis and no further debt issues were therefore considered. To better understand the European's debt issuing state, roughly over the last 14 years, Table 1 represents basic statistics of the debt instruments retrieved based on the previous selection criteria that constitute the sample.

Table 1: Distribution and Descriptive Statistics for pooled sample debt instruments for the 2010-2023 period

InstrumentType	Average length (years)	N° of Instruments	% of total number	Amount	% of total € Amount
Bond	6.11	2965	4.69%	€543,473.30	6.70%
Certificate of Deposit	1.61	3089	4.88%	€106,539.70	1.31%
Commercial Paper	0.25	47627	75.29%	€3,081,632.00	37.98%
Covered Bond	5.110968	149	0.24%	€216,883.40	2.67%
Debenture	13.31405	346	0.55%	€45,576.82	0.56%
Note	7.858824	8909	14.08%	€4,086,366.00	50.36%
Others	12.24441	175	0.28%	€33,433.14	0.41%
		63260	100.00%	€8,113,904.36	100.00%

Note. - Average instrument length is calculated by simply subtracting the maturity by the issued date, all divided by 365 days, differently to further calculations.; <Others= category includes debt instruments such as Stock exchange certificate; spread quoted debenture; percentage quoted debenture; bill; debenture and bank note and others none specified.

³ Additionally, if there were debt instruments issued in 2024 and that matured in the same year, these were also left out of the sample.

The Commercial Paper (CP) category clearly dominates the sample by issue number, with 47,627 issuances recorded. This is consistent with the typical role of Commercial Paper as a form of short-term debt, frequently used by companies to meet liquidity needs and manage working capital. However, when considering the total debt amount, Commercial Paper's contribution is around 38%, indicating that, while CP is issued in large quantities, the average issuance size is relatively small, which aligns with its common use as a short-term financing tool. In this case, companies often issue CP for durations of less than a year (0,25 years), making it a flexible and low-cost option for managing short-term funding needs, but with a smaller face value per issuance. In contrast, Notes, which represent approximately 14% of the total number of instruments issued in the sample, contribute a significantly larger share, around 50%, to the total debt amount issued and registered an average instrument length of roughly 8 years. This suggests that while Notes are issued in lower quantities compared to Commercial Paper, the average issuance size is much larger, reflecting their typical use by firms to fund capital expenditures, expansion plans, or refinancing needs, where larger sums of long-term capital are required. Other instruments, such as Certificate of Deposit, Covered Bonds and Debentures have relatively small representations both in terms of number and amount, each contributing less than 3% to the total issued amount.

3.2. Debt Maturity Structure Measure

For the Debt Structure Maturity Measure, this paper uses the Stohs et. Al (1996) formula that incorporates all forms of liabilities: current liabilities (with a maturity proxy), short-term debt, and long-term debt, addressing limitations found in prior studies, which often examined individual debt issues or simplified proxies such as proportions of short- and long-term debt. Moreover, by incorporating the maturity of debt instruments, the formula accurately reflects all debt-like obligations of a company, providing accurate insights about companies' debt actuality and its debt profile

$$DEBTMAT = \left(\frac{CL + OneYearDebt}{CL + TLTD} \right) \times MCL + \left(\frac{TLTD + OneYearDebt}{CL + TLTD} \right) \times MDT \quad (1)$$

where DEBTMAT is the weighted average maturity of a firm's total liabilities, combining current liabilities (short term) and debt instruments to assess debt maturity; CL (Current Liabilities) represents short-term obligations due within a year, includes liabilities such as accounts payable and short-term loans; OneYrDebt as the portion of debt that is due for

repayment within the next year, highlighting immediate financial obligations; TLTD (Total Long-Term Debt) is the total amount of debt with a maturity beyond one year, representing the firm's long-term borrowing.

Regarding maturity approaches, MCL (Maturity of Current Liabilities) represents an approximation for the current liabilities' maturity. This estimate considers the number of times in a year that current liabilities are refinanced, calculated as the ratio of COGS (cost of goods sold) by current liabilities, aiming for a proxy of amount of production and financing investment in operations, respectively. Afterwards, to get the fraction of the year that current liabilities are outstanding, I simply computed the inverse of the ratio above. For the MDT (Weighted Average Maturity of Long-Term Debt), a weighted average was computed considering the average remaining maturity for each year and for each firm, where maturity is computed at the end of the respective fiscal year for the active instruments at that time as

$$MDT_{ij} = \frac{\sum_{k=1}^K A_k M_k}{\sum_{k=1}^K A_k} \quad (2)$$

where K represents the total number of outstanding instruments for a firm i at the end of the fiscal year j , A the euro amount outstanding and M the remaining maturity for each considered debt instrument.

However, since the debt maturity is assessed at the end of the fiscal year, debt instruments that were issued and matured in the same year were excluded from those roughly 63000 instruments, ending up amounting to 25,689 debt instruments. This heavy instrument exclusion is mainly due to thousands of commercial paper instruments that are often issued and matured mid-year, which are not eligible for our debt structure maturity measure and subsequent analysis.

3.3. Proxies for Debt Structure Hypothesis

Over this sub-section, I assign proxies to each previously stated hypothesis, that are eligible to be statistically treated and analysed, allowing for the further interpretation and testing of given results, such as Stohs et Al. (1996) assignment.

A. Agency Cost Hypotheses

Over this hypothesis, two empirical predictions are tested. Firstly, firms' growth options or opportunities are measured by the market-to-book ratio (MV/BV), where a higher ratio indicates more growth opportunities in comparison to a lower one. Market value of assets is calculated as the difference between market and book equity, plus the assets' book value. As stated before, both Mitchell (1993) and Smiths and Watts (1992) suggest that the higher the growth options of a given firm, the more a firm's market value exceeds its book value. Additionally, firm size (SIZE) is represented by the natural logarithm of the firm's market value, at constant 2010 €, using the European Statistical Office PPI (producers price index). According to the review literature, larger firms are expected to have longer debt maturity due to lower agency costs compared to smaller firms.

B. Signalling and Liquidity Risk Hypotheses

Firm Quality is proxied by the change in earnings per share (Δ EPS) scaled by the year ending share price, signalling anticipated changes in firm quality. According to signalling models and Stohs et Al. (1996) assessment, high-quality firms prefer shorter-term debt to display a signal of strength to investors. Moreover, implied credit rating (using S&P long-term foreign rating) is proxied to test the liquidity risk hypothesis following the idea that firms' credit ratings imply feasibility of capital access, with the Diamond (1991b) Hackbarth's (2008) hypothesis predicting a non-monotonic relationship between credit rating and debt maturity. High and very low-rated firms tend to use shorter-term debt, while firms with intermediate ratings use longer-term debt.

C. Tax Hypotheses

Despite mixed literature findings for the tax relation with debt maturity, Kane et. Al (1985) and Stohs and Mauer (1996) argued that there is a negative relationship between the effective tax rate and debt maturity as firms with lower (higher) tax benefits might favor long(short)-term debt. Thus, effective tax rate (TAXRATE) is measured by the ratio of income tax expense to pretax income. Additionally, recall that the same authors argue that asset variability varies indirectly with the debt maturity structure since more stability requires less rebalancing of both the capital and debt structure. My asset variability (VAR) proxy is represented by the standard deviation of the first difference in earnings before interest, taxes, and depreciation, scaled by average book assets. Lastly, concerning the term structure slope (TERM), mixed evidence was found among

the literature regarding the nature of the relation between the latter and debt maturity. Nevertheless, notable papers suggest that a positive slope induces longer debt maturity. The assigned approximation is given by the difference between long-term (10-year) and short-term (1-year) government bond yields.

D. Maturity Matching Hypothesis

Reviewed literature from different time periods, either classical and more recent papers, such as Morris (1976) and Xiong et. Al (2012) and the European country-specific assessment of Antoniou et. Al (2006) argue that firms are expected to match the maturity of their liabilities with that of their assets, leading to a positive relationship between asset and debt maturity. As a proxy for asset maturity (ASSETMAT), I computed a weighted average between current assets and PPE (property, plant and equipment) for each firm and year. The maturity of the current assets was proxied by the ratio between current assets and the cost of goods sold (COGS), with the rationale that operational and production costs support outputs, such as inventory, present in the current assets account. Moreover, the PPE maturity is proxied by the net property, plant and equipment divided by yearly depreciation expenses, assuming a straight-line depreciation method for simplicity purposes.

E. Leverage

Several reviewed papers suggest that leverage and debt maturity are positively related due to the need of mitigating the default and liquidity risk (that are most and jointly caused by higher leverage and short debt maturity) by higher leverage and reducing financial distress costs. The assigned proxy for leverage (LEVERAGE) is the ratio of total debt (long-term and due within one year) by the market value of assets and acts as a control variable for our regression analysis.

3.4. Descriptive Statistics

This section presents the descriptive statistics in 2 formats: across firms and over time (pooled data) and only across firms (averaging all observations within firm). Table 2 provides information about descriptive statistics regarding debt maturity (DEBTMAT), market over

book value (MV/BV), earnings variation (Δ EPS), asset maturity (ASSETMAT), tax rate, earnings variability (VAR), term spread (TERM) and, lastly, leverage. Recall that SIZE is the natural log of the market value of assets and that ratio variables (MV/BV, Δ EPS, ASSETMAT, TAX RATE, VAR and LEVERAGE) are winsorized at the 1 and 99th percentiles, to mitigate possible outlier driven biases.

Table 2: Proxy variables descriptive statistics for 198 firms and for the same over the 2010-2023 period

A. Descriptive statistics across firms over time (N= 2772)	Mean	Std. Dev.	Median	Min	Max
DEBTMAT	3.12	2.77	2.53	0.00	22.03
MV/BV	1.74	0.99	1.43	0.75	6.51
Size	17.20	1.39	17.22	10.84	21.65
Δ EPS	0.00	0.04	0.00	-0.16	0.15
Assetmat	5.70	5.50	4.19	0.30	75.71
Tax Rate	0.23	0.28	0.24	-1.07	1.58
VAR	0.04	0.03	0.04	0.00	0.20
Term (%)	0.91	1.02	0.85	-1.70	9.23
Leverage	0.19	0.12	0.17	0.00	0.69
B. Descriptive statistics across firms (N=198)	Mean	Std. Dev.	Median	Min	Max
DEBTMAT	3.12	2.40	2.38	0.00	14.89
MV/BV	1.74	0.87	1.47	0.75	6.13
firm size	17.20	1.32	17.22	14.13	20.89
Δ EPS	0.00	0.01	0.00	-0.02	0.02
Assetmat	5.70	5.06	4.41	0.45	33.11
Tax Rate	0.23	0.10	0.24	-0.27	0.56
VAR	0.04	0.03	0.04	0.01	1.18
Term (%)	0.91	0.50	0.85	0.26	2.46
Leverage	0.19	0.10	0.18	0.01	0.54

Panel A presents the cross-sectional and time series descriptive statistics for 198 firms while Panel B reports the cross-sectional descriptive statistics for (198 x 14) 2772 observations. Highlighting several statistics, the average debt maturity amount to 3.12 years, a MV/BV ratio of 1.74, an asset maturity of 5.70 years, a tax rate of 23% and a term spread of 0.91% over the entire sample. Additionally, we can observe a quite large outlier on asset maturity (75.71 years), however the removal of the observation does not alter further results. Additionally,

economically unreasonable tax rate observations also are present in the data. To mitigate this issue, I use Stohs and Mauer (1996) approach of dividing the tax rate variable into 2 distinct ones: GTAXRATE which takes the value of TAXRATE if the latter is between 0 and 1 and is 0 otherwise; BTAXRATE which takes is 0 if TAXRATE is between 0 and 1 and takes the value of TAXRATE otherwise. This variable separation ensures that the coefficient statistical significance is unrelated with multicollinearity problems in the dataset.

Table 3 reports the pairwise correlations among all variables for the cross-sectional and time series pooled data. While most of the correlation pairs between debt maturity and other variables shows signs coherent with the stated literature hypothesis with moderately to low pairwise correlations, there is only one exception: the correlation between debt maturity and credit rating is moderately negative (-0.20), evidencing a downward curve (negatively sloped) instead of the predicted upward one. Moreover, there are also strong coefficients that are worth being mentioned, mostly regarding the LEVERAGE coefficient. Firstly, there is a considerably high negative and positive correlation between SIZE and RATING (-0.499). Recall that RATING ranges from 1 to 14, being the former the highest (AA) and the latter the lowest possible rating (unrated). Thus, the lower the credit rating, the smaller is the firm evidencing that lower rated firms are, on average, smaller than higher rated ones. The fact that larger firms are more likely to have an attributed credit rating by credit agencies than smaller ones. Adding up to this, SIZE and Rating Dummy variables are considerably strong positive correlated (0.375), assuring the latest conclusion since larger firms are, on average, more likely to have an assigned credit rating by credit agencies. Furthermore, DEBTMAT presents a notable positive pairwise correlation with ASSETMAT (0.322) and LEVERAGE (0.347) both variables suggesting that firms with higher leverage and longer-term assets are more likely to issue long-term debt. Indeed, ASSETMAT is also moderately correlated with LEVERAGE (0.297) highlighting that firms with longer maturity assets, mainly Property, Plant and Equipment (PPE), commonly associated with industry's capital intensiveness, also have more debt-like obligations on their balance sheets to support ongoing and recurring CAPEX.

Finally, we can notice a solid inverse correlation with MV/BV (-0.472), which is the proxy for growth opportunities, which indicates that firms with more growth opportunities use less leverage, *ceteris paribus*. This gives assurance to the decision to include LEVERAGE as a control variable since there are certainly cases in which high-growth firms are indifferent to debt maturity decisions since they have little or inexistent debt on their balance sheets.

Table 3: Correlation Matrix of dependent and independent variables for the cross-sectional and time series pooled data for 198 firms during the 2010-2023 period

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. DEBTMAT	1.000														
2. MV/BV	-0.035	1.000													
3. SIZE	0.147	0.050	1.000												
4. ΔEPS	0.072	0.015	0.004	1.000											
5. Rating	-0.209	0.067	-0.499	-0.004	1.000										
6. HighBond	-0.193	0.164	-0.379	-0.004	0.919	1.000									
7. LowBond	0.097	0.156	0.324	-0.006	-0.448	-0.212	1.000								
8. Rating Dummy	0.191	-0.172	0.375	0.004	-0.913	-0.989	0.209	1.000							
9. ASSETMAT	0.322	-0.097	-0.053	0.000	-0.054	-0.056	0.000	0.054	1.000						
10. Taxrate	-0.034	0.001	-0.011	0.002	-0.010	-0.008	0.000	0.006	-0.003	1.000					
11. GTAXRATE	-0.022	-0.146	0.134	-0.001	-0.072	-0.085	0.038	0.085	-0.047	0.025	1.000				
12. BTAXRATE	-0.004	-0.028	-0.008	-0.008	0.002	-0.009	-0.006	0.014	-0.001	0.979	-0.177	1.000			
13. VAR	-0.064	0.100	0.006	0.011	0.056	0.041	0.068	-0.026	-0.016	-0.018	0.059	0.041	1.000		
14. TERM	-0.123	-0.033	-0.011	-0.027	0.000	0.001	-0.001	-0.002	0.001	0.017	-0.023	-0.012	0.000	1.000	
15. Leverage	0.347	-0.472	0.056	-0.031	-0.152	-0.250	-0.100	0.269	0.294	-0.045	0.120	0.034	-0.106	-0.010	1.000

Note.- Table 3 reports pairwise correlations for the pooled time-series cross-sectional data (N=2772). The variables are described as follows. DEBTMAT is the book weighted average of firm's debt-like liabilities (current liabilities and debt instruments collected); MV/BV is the market value of assets (book value of assets plus the difference between market and equity values of equity) divided by the book value of assets; SIZE is the natural log of the MV of assets measured at constant 2010 € using the producer price index deflator; ΔEPS is the EPS (earnings per share) difference between two consecutive years scaled by the scaled by year ending Share Price; RATING is a cardinalized variable, where AA=1, A+=2, A=3, ..., NR=14; HighBond equals one if the firm is rated AA and 0 otherwise; LowBond equals 1 if the firm is rated B or unrated and 0 otherwise; Rating Dummy equals 1 if the firm is rated and 0 otherwise; Assetmat is the book weighted average of current assets and PPE (property, plant and equipment); Taxrate is defined as the ratio of tax expenses to pre-tax income; GTAXRATE=TAXRATE if the latter is between 0 and 1 and equals 0 otherwise; BTAXRATE=0 if the latter is between 0 and 1 and equals TAXRATE otherwise; VAR is the standard deviation of the first difference in EBITDA for the period, scaled by the average of book value of assets; TERM is the difference between 10-year and 1-year government bonds yields and, lastly, Leverage is the Total Firm Debt scaled by the MV of assets.

Below, Table 4 and Figure 1 report the number of observations and debt maturity by firms' credit rating for the cross-sectional and time-series pooled data. The debt maturity measure is reported for each firm per fiscal year, corresponding to 2772 observations (198 firms times 14 fiscal years). Observing the number of observations distribution, one can notice the high concentration of observations in the BBB rating and in the non-rated (NR) segment. On European markets, a lot of high-dimension firms either opt for not being rated, due to a variety of reasons being high associated costs and scrutiny increase, or do not have significant presence in debt securities issuance markets, which is often a required parameter for credit rating agencies. However, we can still notice 951 observations for BBB, which constitutes the last investment grade rating. According to an article ([ETF Strategy⁴](https://www.etfstrategy.com/making-the-grade-how-risky-are-bbb-bonds-94578/)) BBB- rated bonds increased from 17 to over 50% in the last decade and a lot of these that fit into the investment grade category BBB have indeed lower credit quality than what is assessed by credit rating agencies. Therefore, we could argue that possibly a considerable portion of the 951 observations should be distributed through lower credit ratings and that significantly distorts the debt maturity analysis by rating.

Table 4: Debt Maturity by Credit Rating for 328 Firms during the 2010-2023 period

Credit Rating	AA	A	BBB	BB	B	NR
DEBTMAT	3.30	3.77	2.92	3.34	4.85	2.87
N° Observations	96	553	951	185	14	973

Regarding the average maturity by rating, one could argue that non-rated firms have on average lower debt maturities, nevertheless, this value amounts to almost the same as the BBB rated firms and so, we cannot take elaborate conclusions. Nonetheless, non-rated firms still have the lowest average maturity in our sample. The Diamond's (1991b) empirical non-monotonic prediction between credit rating and debt maturity seems not to be observable, since AA rated firms have on average 3.30 years remaining maturity which is considerably longer than the BBB average maturity, amounting to 2.92 years.

⁴ Link to article <Making the Grade: How risky are BBB bonds=: <https://www.etfstrategy.com/making-the-grade-how-risky-are-bbb-bonds-94578/>

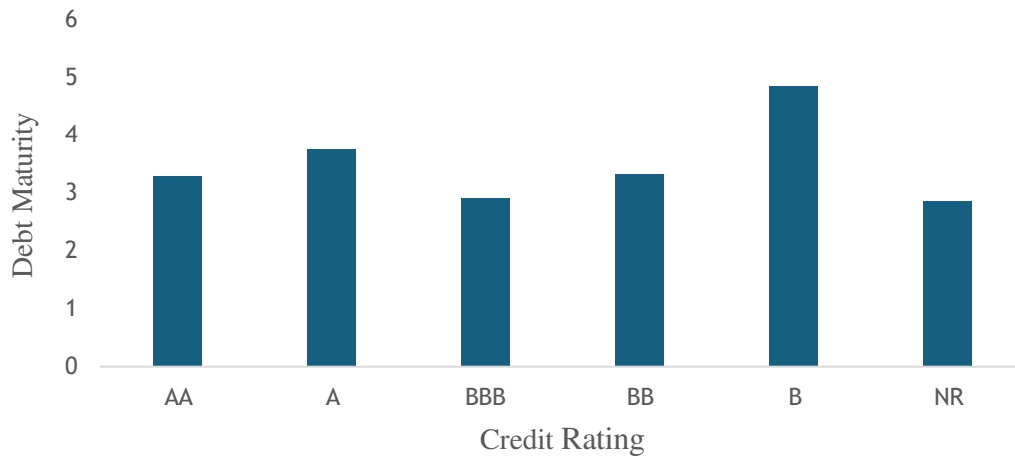


Fig.1: Average Debt Maturity by S&P long-term Firm's credit rating

In fact, not only the inverse U-shaped relation seems not to be observable, but it also seems that there might even be a monotonic relation (evidenced by a U-shaped curve) when considering cross sectional and time series pooled data. To better assess this possible U-shaped relation, I present Figure 2 in which ratings are divided into fourteen sub-ratings, detailing the average maturity by each one of the observable sub-ratings, also testing for debt maturity similarity within credit rating.

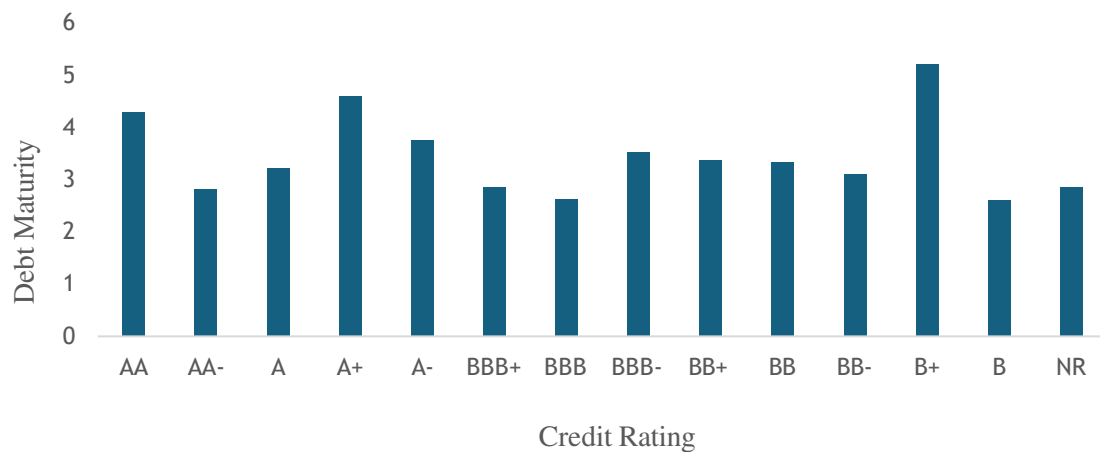


Figure 2: Average Debt Maturity by Firm's credit rating- with S&P long-term rating detailed

By observing the bar chart, the U-shaped relation is not immediately clear: although there is visual evidence that high-rated (AA and A) firms tend to have longer debt maturities on average, and that mid-rated BBB firms, that concentrate a lot of observations, seem to have similar or shorter average maturities than the remaining sample, it seems obvious that there is

in fact evidence that the lowest registered rating and non-rated firms have on average the shortest debt maturities of our sample. In addition, a disparity in debt maturity within credit ratings seems to be observable for most of the ratings (AA, A, BBB and B). For instance, there is a 1 maturity year gap between BBB and BBB-, which remains unexplained by any straightforward rationale.

However, while the analysis of debt maturity by credit rating provides important insights about the monotonicity of debt maturity and credit rating relation, it is also essential to consider that firms' financing decisions can vary significantly across different industry sectors. Given the differing capital structure dynamics, risk profiles, and financing needs, different industries might exhibit distinct patterns in debt maturity by credit rating. To explore this further, I extend the analysis by examining the average debt maturity by credit rating across four major industrial groups. These are: Cyclical- Consumer Cyclical, Basic Materials and Industrials; Defensive- Consumer Non-Cyclical and Healthcare; Energy and Utilities and, lastly, Technology. Thus, Figure 3 provides a breakdown of the average debt maturity by rating within each industrial group to check whether the relationship between credit rating and debt maturity is consistent across industries, or whether distinct industry characteristics lead to different maturity decisions.

Analysing the figure, the monotonicity nature of Defensive industries seems clear since mid-rated firms (BBB and BB) report the lowest average maturities, likely reflecting the stable cash flows and lower risk appetite of these firms. For the Energy & Utilities group, although BBB rated firms exhibit the longest average maturities, high-rated firms do not show the expected non-monotonic pattern, possibly due to their ability to secure long-term debt under favourable terms, given the capital-intensive nature of the industry. In the Cyclical and Technology sectors, however, the relationship between debt maturity and credit rating is more difficult to discern, primarily due to the great variability of debt maturity within adjacent credit ratings. This variability could reflect industry-specific dynamics such as growth opportunities in the Technology sector and the economic sensitivity of Cyclical firms, which both contribute to differing capital needs and financing decisions, thus complicating any definitive conclusions.

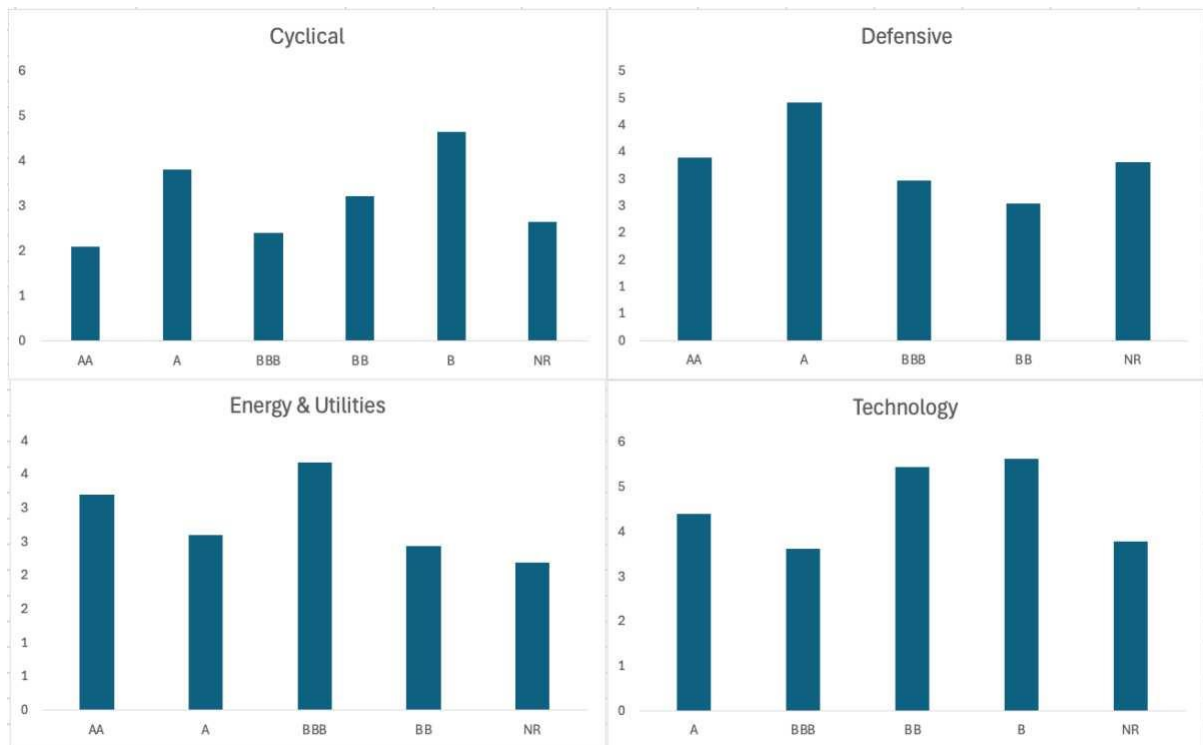


Figure 3: Average Debt Maturity by S&P long-term Firm's credit rating-detailed by industrial groups

Note: Average Debt Maturity and firm's credit rating are respectively represented on the y and x-axis. Some of the industrial groups do not present certain credit ratings and thus these are absent from the x-scale.

Furthermore, I exhibit Table 5 in which the weighted average debt instrument length⁵ (different from our debt structure maturity measure) is assessed by instrument type and by rating, from which we can draw interesting conclusions. The first one concerns the average length of commercial paper: it seems that high-rated and low-rated (including non-rated) firms exhibit the lowest average length with, respectively, around 51, 32 and 69 days. This indicates that for short-term instruments, such as commercial paper, high-rated firms opt for shorter maturities leveraging their strong creditworthiness while low-rated and non-rated firms, with limited access to long-term financing, favour slightly longer maturities to manage liquidity and avoid frequent refinancing under less favourable terms. Interestingly, the complete opposite occurs when addressing the long-term instruments Bonds category: average length decreases from AA to BB, reaching the 3.16 minimum length, but then increases to 5.65 for the non-rated firms. While high-rated firms (AA) leverage their strong credit profile to secure long-term

⁵ Instrument Length is calculated by the difference between Maturity and Issue dates; The averages are weighted by Issued Amounts.

financing at lower costs, low-rated and non-rated firms favour longer maturities to reduce refinancing risk, reflecting limited market access and the need for liquidity stability.

Table 5: Average Debt instrument length upon issuance for all 198 firms pooled during the 2010/2023 period

Instrument Type	Average Length Upon Issuance					
	AA	A	BBB	BB	B	NR
Bond	7.83	5.88	5.45	3.16	4.33	5.65
Certificate of Deposit	0	2.42	0.59	0.76	0	0.19
Commercial Paper (days)	51.47	85.50	95.53	87.90	31.84	69.02
Note	8.43	7.35	7.60	6.84	5.67	7.10
Others	3.62	9.70	9.11	4.32	6.08	4.52

Note: Length is calculated as the difference of maturity to the issue date. All collected debt instruments were pooled and assigned to the respective firm's credit rating.

Moreover, Figure 5 shows the cross-sectional and time series pooled data average of DEBTMAT, DEBTMAT* and ASSETMAT and asset maturity for the 198 firms through the 2010-2023 period. DEBTMAT* solely reports the average maturity of collected debt instruments while both DEBTMAT and ASSETMAT follow the previously defined definitions. The graph shows great dissimilarity between DEBTMAT and ASSETMAT average values, indicating that our debt and asset maturity measures do not appear to match for all the fourteen analyzed years. Additionally, we conclude that all three maturity measures seem quite constant overtime, with little variation through the sample period. After apparently mismatch between debt and asset maturities, I perform an additional assessment to check whether there is a match of debt instruments maturity (DEBTMAT*) with ASSETMAT. Indeed, DEBTMAT* and ASSETMAT are identical throughout the period corroborating the maturity matching hypothesis, but only concerning debt instruments and not the weighted average of the latter and current liabilities maturity.

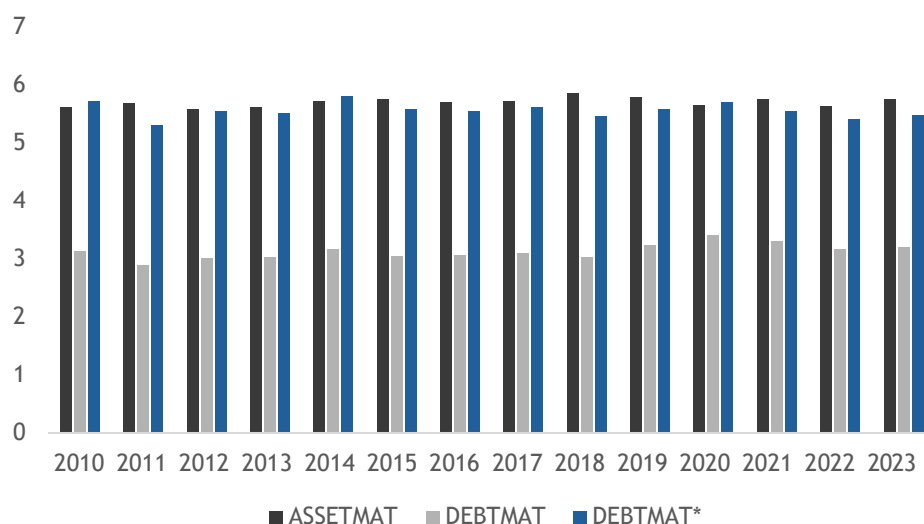


Figure 4: Asset and Debt Maturity Assessment by Fiscal Year

Note: The y-axis presents the average maturities for x-axis respective fiscal years. ASSETMAT represents the average asset maturity, DEBTMAT our Debt maturity measure and DEBTMAT* exclusively the average debt instruments maturity.

4. Results & Empirical Analysis

The study uses multiple regression models- including cross-sectional, pooled time-series cross-sectional and fixed-effects- to test the stated hypotheses about the debt maturity structure. On table 5 regressions (1), (2) and (3) represent respectively firm and year fixed-effects, pooled regression and cross-sectional. In the cross-sectional analysis, 198 time-series averages (per company for each variable) are used for the regression, calculated based on 2772 observations. This approach is useful to minimize the residuals' risk of serial correlation, which may lead to the inflation of the t-statistics on the other regressions performed (with different specifications: pooled cross-sectional & time-series and fixed-effects). Nonetheless, the cross-sectional specification does not include neither the term structure slope (TERM) nor the scaled difference in earnings per share (Δ EPS) since both variables essentially capture the time-series variation in the dependent variable (DEBTMAT).

As opposed to the cross-sectional, the pooled regression specifications take advantage of the cross-sectional and time-series variation in the available data. While the pooled regression assumes homogeneity across firms and does not account for firm specific effects, the industry/firm dynamics of our sample accompanied with exogenous shocks throughout the analysed period seem to weaken this simple regression robustness. Therefore, both industry and firm fixed effects regressions, both also controlling for year fixed effects, were conducted

to further explore debt maturity structure determinants, in a sample where differences across industries and firm specific factors are expected to play a significant part in debt maturity structure dynamics. The key distinction between the pooled and both the fixed effect regressions lies in how they account for year-specific shocks and unobserved industry and firm-specific characteristics.

Moreover, firm fixed effects are essentially included to capture variation within firms and time, controlling for firm heterogeneity, illustrating how firms internal dynamics influence debt maturity structure over time. The stated panel data regressions have 2772 observations (198 firms analyzed over a 14-year sample period). In the firm and year fixed effects regression, earnings variability (VAR) is excluded due to only one observation existing for each firm.

4.1. Regressions Results

In respect of the agency cost hypothesis, on all three regressions, I found either statistically insignificant or wrong sign coefficients for the market-to-book ratio (MV/BV), demonstrating no support to the empirical prediction that growth options (proxied by the ratio) varies indirectly with debt maturity. Nevertheless, similar studies performed on European grounds found similar conclusions between growth opportunities and debt maturity. For instance, Dang (2011) finds no evidence that firms with high growth opportunities shorten debt maturity in the UK and Antoniou et al. (2006) found insignificant and practically nil coefficients in a pooled and then on France, Germany and UK regressions.

Additionally, regarding firm size (SIZE), in the fixed effects regression, I found a significant positive coefficient that implies that when controlling for unobserved firm-specific factors and time-specific effects, the positive relationship between firm size and debt maturity structure suggests that increases in firm size are associated with longer debt maturities within firms. This could reflect that as firms grow, they gain access to better financing terms or are perceived as less risky by lenders, leading to a preference for long-term debt. Indeed, an increase of one standard deviation in firm size results in a 4.14% increase of debt maturity structure, all else the same. On the other, when accounting for variation between firms over time, SIZE has negative coefficients on both pooled and cross-sectional regressions being

Table 6: Fixed-effects, pooled and cross-sectional regressions of debt maturity structure on explanatory variables for 198 firms over the 2010-2023 period

Independent Variables	Hypothesized Sign	(1)	(2)	(3)
MV/BV	-	-0.0363 (0.0787)	0.498*** (0.0534)	0.573*** (0.200)
SIZE	+	0.398*** (0.104)	-0.161*** (0.0395)	-0.150 (0.136)
ΔEPS	-	-0.307 (0.662)	-0.659 (1.096)	- -
Rating	+	0.180* (0.139)	-0.758*** (0.112)	-1.098** (0.438)
Rating^2	-	-0.0160* (0.00953)	0.0478*** (0.00893)	0.0780** (0.0368)
Rating Dummy	N,A	-1.078** (0.532)	2.048*** (0.588)	4.119 (2.527)
assetmat	+	0.0481*** (0.0120)	0.0669*** (0.00867)	0.0687** (0.0315)
GTAXRATE	-	-0.0836 (0.214)	-0.388 (0.322)	-1.122 (2.151)
BTAXRATE	N,A	-0.0316 (0.114)	-0.0234 (0.189)	0.736 (2.229)
VAR	-	- -	-0.125*** (0.0451)	-4.768 (4.665)
Term	+	0.0759 (0.0570)	-3.759*** (1.449)	- -
Leverage	+	5.113*** (0.541)	5.576*** (0.477)	5.533*** (1.833)
Intercept	-	-4.386** (1.814)	4.720*** (0.952)	3.287 (3.648)
Fixed Effects:				
Time	-	YES	NO	NO
Firm	-	YES	NO	NO
Observations	-	2.772	2.772	198
Adjusted R-squared	-	0.7065	0.1297	0.1393

Note.- Table 6 reports ordinary least squares regressions (fixed effects, pooled time series & cross-sectional and purely cross-sectional. The dependent variable (DEBTMAT) is the book weighted average of firm's debt-like liabilities (current liabilities and debt instruments collected). The explanatory variables are described as follows: MV/BV is the market value of assets (book value of assets plus the difference between market and equity values of equity) divided by the book value of assets; SIZE is the natural log of the MV of assets measured at constant 2010 € using the producer price index deflator; ΔEPS is the EPS (earnings per share) difference between two consecutive years scaled by the scaled by year ending Share Price; RATING and RATING^2 are cardinalized variables, where AA=1, A+=2, A=3, ..., NR=14 and its square, respectively; Rating Dummy equals 1 if the firm is rated and 0 otherwise; Assetmat is the book weighted average of current assets and PPE (property, plant and equipment); GTAXRATE=TAXRATE if the latter is between 0 and 1 and equals 0 otherwise; BTAXRATE=0 if the latter is between 0 and 1 and equals TAXRATE otherwise; VAR is the standard deviation of the first difference in EBITDA for the period, scaled by the average of book value of assets; TERM is the difference between 10-year and 1-year government bonds yields and, lastly, Leverage is the Total Firm Debt scaled by the MV of assets. Standard Errors are reported in parentheses. P-values are reported as *** p<0,01, ** p<0,05, * p<0,1.

significant on regression (2). This contrasting result seems coherent with a similar analysis, on a set of non-financial UK firms, performed by Oskan (2000), that found evidence for negative relation between firm size and debt maturity. On the other hand, regression (3) shows an almost symmetric coefficient indicating that within firms, over time, increases in size are associated with higher debt maturity structure with follows the stated empirical prediction. Although significant, the economic interpretation of the latter seems to only very slightly affect debt maturity, *ceteris paribus*, since a one standard deviation increase in size, decreases debt maturity by only 0.64%. Despite following the predicted sign of the hypothesis that states the higher the abnormal earnings (Δ EPS, proxy for firm quality) the shorter the debt maturity of a given firm, all regressions present statistically insignificant coefficients. Unlike other international studies that corroborate the hypothesis (Stohs et. Al, 1996 and Alcock et. Al, 2012), no other support was found for the signalling hypothesis under the European setting.

On the liquidity risk hypothesis, I found negative and positive significant coefficients for S&P long-term rating (RATING) and rating squared (RATING²), respectively, on both the cross-sectional and pooled regressions. This aligns with the previous description/evidence reported over Figure that on this European sample, the predicted non-monotonic relation between credit rating and debt maturity seems not to be proved. In fact, our results indicate that firms with lower credit rating opt for shorter debt maturity structures until a certain credit rating, shifting for an increasing trend as credit rating deteriorates. In the case of the pooled regression, the function's minimum (turning point) is 7.92, meaning that debt maturity decreases until BBB- (approximately, credit rating BBB- =8) and then shifts trend and increases as credit rating decreases.

However, when controlling for firm and time fixed-effects the non-monotonic relation of credit rating and debt maturity is significantly verified, but only at 10% confidence interval, highlighting the role of firm-specific dynamics. The results point out that debt maturity increases as RATING increase (positive sign for RATING) but at decreasing rate. The function's maximum is 5.63 (5.63 is in between A- and BBB+). The economic interpretation of the following states that, one S&P rating deterioration increases debt maturity by 0.18 years, though the rate of debt maturity's increase only diminishes a little, by nearly 0.02 years (14 days), for each consecutive rating deterioration within firms. Despite non-comparable analysis for the same period and geography, the latter conclusion follows Diamond's (1991b) empirical

prediction and are coherent with Stohs et. Al (1996) results over firm fixed effects specification.

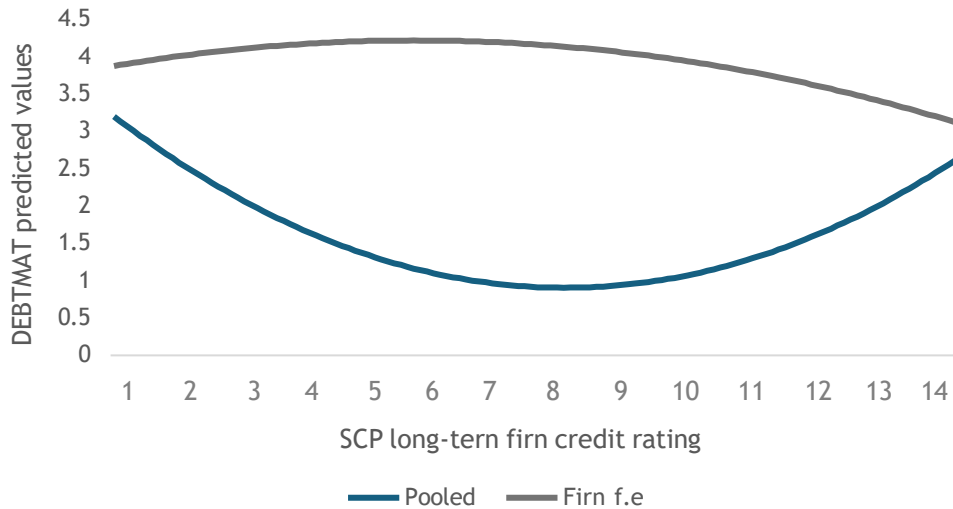


Figure 5: \hat{y} predicted values of DEBTMAT as a function of RATING and RATING² for the pooled and fixed-effects regressions.

Note: Other regressions inputs were held constant by their mean values to only observe firm credit rating related variation. Recall that AA=1, AA-=2, A+ =3,..., NR = 14.

Figure 5 measures the predicted values of debt maturity as a function of both rating and rating squared, holding the other variables constant by their mean values, for both the pooled and the year and firm fixed effect regressions, highlighting the (non-) monotonic relation of debt maturity and credit rating when within firm variation and time invariant characteristics are accounted (or not). Comparing both trends, the pooled regression predicted trend seems more sensitive to changes in credit rating, indicating that cross-sectional variation between firms gathers more response of debt maturity in function of credit rating. On the contrary, the fixed effects regression expresses a flatter trend given by the reduction of the influence of individual firm characteristics, indicating more predictability of debt maturity in function of credit rating, when firm and year dynamics are controlled.

Moving into the maturity matching hypothesis, all regression's coefficients (ASSETMAT) follow the hypothesized sign, having positive significant coefficients at 1% for the pooled and fixed effect and 5% for the cross-sectional regressions and therefore, we can conclude that asset maturity is clearly a debt maturity structure determinant. Nonetheless, the actual economic

effect of the regressions coefficients seems weak: for the pooled regression, a 1-year increase in asset maturity results in a slight increase of 0.067 years in debt maturity, indicating that the asset maturity effect, despite significant, is not an amplifying determinant of debt maturity structure. The achieved results are coherent with both international and European literature over different samples and periods. More recently, on Belgium and the UK, Heyman et. Al (2008) and Ozkan (2000) found similar significant results.

Moreover, I found varied support for the tax hypothesis, in what regards to the effective tax rate and the earnings variability. The tax rate variable (GTAXRATE) follows the empirical prediction that as tax rate decreases, there is an increase on the debt maturity structure. However, results are not significant for all regressions. On the other hand, for the pooled regression, there is a significant negative coefficient that follows the inverse relation between earnings variability (VAR) and debt maturity structure, when capturing firm variation, over time. However, a one standard deviation increase in the earnings variability, decreases slightly debt maturity by 0.6%. Concerning term structure (TERM), except for a statistically insignificant positive coefficient when controlling for firm fixed effects, there is no support for the empirical prediction that the slope of the term structure is positively related to the debt maturity structure. My analysis found quite the opposite: an inverse relation between the term structure and debt maturity, given by the negative coefficient, significant at 1%.

To sum up, weak support was found for the tax hypothesis, since only earnings variability followed the empirical prediction whereas the other proxies (TERM and GTAXRATE) are either statistically insignificant or have the wrong sign. Our mixed results are supported by other papers that also found either mixed or no support for the hypothesis. Internationally, recent studies by Orman and Koksal (2017) – Turkey- and Platikanova (2017) – United States- found no support for the tax hypothesis and that one standard deviation increase in effective tax rate increases debt maturity structure by 1.8% to 7.4%, respectively. Stohs et. Al (1996) on a comparable assessment, but almost three decades prior, also registered mixed support for the tax hypothesis.

Lastly, I found a positive coefficient for the control variable leverage (LEVERAGE) in all regressions, significant at 1% confidence level. I found that leverage takes an important role in mitigating wrong statistical results. The proxy for growth opportunities (MV/BV) significantly (at 1%) follows the agency cost empirical prediction when LEVERAGE is not included in the pooled regression. This suggests that the control value mitigates omitted variable biases in our

results. This positive relation is in accordance with the prediction that firms extend the debt's maturity when leverage increases to mitigate both refinancing and liquidity risk.

4.2. European Regions Sub-Sample Analysis

In this sub-section, I perform a more specific analysis of debt maturity structure across different European regions (Southern, Central, Nordics, Western and UK) not only to compare results with the broad sample, but to also assess possible differences in the debt maturity's determinants across regions and its accordance with the previously stated debt maturity theories. The table above presents time and firm fixed effects regressions for all regions. By splitting the original sample, we can account for the heterogeneity in economic, cultural, and financial conditions across European Regions, allowing for a more granular analysis that helps identify region-specific drivers of debt maturity, which would be masked in a broader analysis.

In the first place, the agency cost theory proxy for growth opportunities (MV/BV) seems coherent with the overall fixed effects regression due to the presence of insignificant or wrongly signed coefficients for all European Regions. Nevertheless, over the same hypothesis, the proxy for firm size (SIZE) significantly follows the empirical prediction in Southern and Western Europe and the UK, meaning that over these regions, within firm, an increase in size directly leads to an increase in debt maturity. In fact, considering UK, a one standard deviation increase in SIZE leads to a 7.47% increase in debt maturity. For the other regions, it appears that SIZE does not play a significant role in debt maturity dynamics.

Regarding the liquidity risk hypothesis, I found opposite statistically significant evidence for the (non-)monotonic relation of credit rating and debt maturity. While on the Western Europe regression, a one letter deterioration in the S&P foreign long-term rating led to a 1.77 increase in debt maturity, while its rate of increase diminished by 0.12 years for each deterioration, following the empirical hypothesis, on Southern Europe the results are contrary to what was found over the latter region. Regarding, Spain, Italy and Portugal I found a monotonic relation of credit rating and debt maturity, expressing that either very high and low rated firms tend to have higher debt maturity- by one rating deterioration, maturity decreases by nearly 1 year, increasing by 0.07 years for each consecutive deterioration. Additionally, within firm, the fact that there is an assigned rating to a firm in a certain year, seems to decrease the debt maturity by 5.55 and increase by 4.11 years for Western and Southern Europe, respectively, compared to when no rating is assigned to a firm. For the signalling hypothesis, results follow the broad

sample as the proxy for firm quality (Δ EPS) coefficient remains insignificant or with the wrong sign for all regions.

Table 7: Fixed-effects regressions of debt maturity structure on explanatory variables for European Regions based on a 198 firm sample from the 2010-2023 period

Independent Variables	Central	Nordics	UK	Western	Southern
MV/BV	-0.233 (0.191)	0.216 (0.142)	0.189 (0.152)	-0.214 (0.207)	0.586 (0.442)
SIZE	0.134 (0.298)	-0.332 (0.203)	0.482*** (0.153)	1.213*** (0.330)	1.429*** (0.390)
Δ EPS	-0.620 (1.227)	1.287 (1.149)	-0.622 (1.790)	-0.798 (1.837)	-0.259 (1.245)
Rating	-0.250 (0.243)	-0.142 (0.325)	0.265 (0.301)	1.772*** (0.434)	-0.996*** (0.278)
Rating ²	0.00884 (0.0160)	0.00696 (0.0221)	-0.0206 (0.0205)	-0.122*** (0.0323)	0.0705*** (0.0194)
Rating Dummy	-0.0447 (0.950)	0.0477 (1.178)	-1.384 (1.051)	-5.548*** (1.990)	4.411*** (1.196)
assetmat	0.0649 (0.0478)	0.0282** (0.0122)	0.0406 (0.0258)	0.251** (0.0989)	0.0785 (0.0604)
GTAXRATE	-0.00444 (0.567)	-0.301 (0.370)	-0.171 (0.410)	0.0836 (0.563)	-0.0676 (0.374)
BTAXRATE	0.134 (0.338)	0.317 (0.200)	-0.128 (0.201)	-0.127 (0.315)	-0.391** (0.193)
Term	-0.259 (0.167)	0.251* (0.139)	- -	0.0970 (0.157)	-0.140 (0.119)
Leverage	1.665 (1.129)	6.918*** (0.905)	5.827*** (1.117)	7.844*** (1.574)	6.818*** (1.784)
Intercept	2.267 (5.112)	7.491** (3.760)	-6.134** (2.624)	-20.41*** (5.727)	-25.35*** (7.004)
Observations	686	602	616	616	238
Adjusted R-squared	0.7126	0.7209	0.7789	0.6206	0.8167

Note: Table 7 reports firm and year fixed effects for European Regions. Central corresponds to Germany, Austria and Switzerland; The Nordics to Denmark, Norway, Finland and Sweden; Western to France, Belgium, Ireland and Netherlands; Southern to Portugal, Spain and Italy. The dependent variable (DEBTMAT) is the book weighted average of firm's debt-like liabilities (current liabilities and debt instruments collected). The explanatory variables are described on Table 6 and no new variables were introduced. Standard Errors are reported in parentheses. P-values are reported as *** $p < 0,01$, ** $p < 0,05$, * $p < 0,1$.

Moving on to the Asset Matching hypothesis, we found positive and significant results for both the Nordic countries and the Western Europe regions. While significant, the economic significance for the Nordic countries' asset maturity coefficient seems almost inexistent since an 1-year increase in asset maturity leads to a small increase in debt maturity of about 0.03 year. On Western Europe, the same increase in debt maturity leads to an increase of 0.25 year in debt maturity.

For the tax hypothesis, little evidence was found that supported the underlying empirical predictions. Only the proxy for the term structure slope was found significant with the hypothesized sign, for the Nordic Countries (Denmark, Sweden, Finland and Norway) revealing that debt maturity increases as the slope of the term structure also increases.

As summary, this region-specific analysis of debt maturity structure across Europe reveals significant differences in how various determinants influence debt maturity, highlighting the importance of regional heterogeneity. Mixed evidence was found for the agency cost hypothesis, since growth opportunities, as proxied by the MV/BV ratio, do not significantly impact debt maturity in any region, firm size (SIZE) plays a key role in Southern Europe, Western Europe, and the UK. The findings on the liquidity risk hypothesis show a non-monotonic relationship in Western Europe, but an inverse U-shaped curve (monotonic relationship) in Southern Europe, indicating that credit ratings influence debt maturity differently across regions. Additionally, while the Asset Matching hypothesis only holds in the Nordics and Western Europe, the tax hypothesis has little support, except for the term structure slope in the Nordic countries, which shows a positive relationship with debt maturity. This analysis shows discrepancies from the broad sample assessed before, underscoring the need for a region-specific approach when studying debt maturity determinants.

4.3. Industrial Groups Sub-sample Analysis

Having analysed the determinants of the debt maturity structure for both the whole European and respective regions sample, this section will cover the study of the determinants of debt maturity structure by industry classification. This section's motivation lies in the fact that different industries face unique financial, operational, and market conditions that can significantly influence their debt maturity decisions and, therefore, we can assess whether there are sector-specific determinants (such as firm size and growth opportunities or asset maturity), which may affect firms' preferences for short- or long-term debt. It is expected that each industrial group has unique characteristics that will yield in varied coefficients signs, significance and empirical support of the underlying debt maturity structure theories. I've performed four firm and year fixed effect regressions analysis, each for the respective industrial group: Cyclical (Consumer Cyclical, Basic Materials and Industrials), often highly sensitive to economic cycles; Defensive (Consumer Non-cyclical and Healthcare), with more cash flow stability, less dependent on the demand; Energy and Utilities, highly capital intensive and with

long-term investment horizons; lastly, Technology, more volatile cash-flows with rapid innovation cycles.

Regarding the agency cost hypothesis, I found statistically significant results for the growth opportunities proxy (MV/BV) both the Defensive and the Energy and Utilities industrial groups: negative for the Defensive group, following the empirical prediction that states the inverse relation of growth opportunities and debt maturity structure (one standard deviation increase in MV/BV, decreases debt maturity by nearly 16%), and positive for Energy and Utilities disproving the same prediction. The reasoning for this difference in industries might be explained by Defensive sector's growth opportunities not requiring heavy capital investment (compared to the Energy & Utilities sectors), since these are usually about incremental innovation or expanding existing lines of business, and short-term debt may be sufficient to finance these initiatives without needing to commit to longer maturities. In the Energy and Utilities sector growth usually comes from long-term highly capital intensive projects, explaining the need for longer debt maturity to finance the latter.

For firm size (SIZE) both the Cyclical and the Defensive registered positive and significant results expressing that, within firm, there is a direct relation of firm size and debt maturity. In the defensive and cyclical industrial group, respectively, cash flow stability and perceived lower risk of the sector might lead increasing in size firms to pursue long-term debt possibly due to the ability to lock in lower interest rates and to repay debt over time.

Although the signalling hypothesis remains insignificant for all sectors, on the liquidity risk hypothesis only the Cyclical firms proved Diamond's (1991) non-monotonic prediction of the credit rating and debt maturity's relationship. This can be due to the more volatile nature of the industrial group, where credit ratings better assess the risk of each firm, and very high rated firms value short-term debt (preferring commercial paper and short-term debt instruments) to remain flexible to financing adjusts while low rated or unrated firms, due to its uncertainty and volatility, require constant monitoring and assessment and are often pushed to indulge in shorter term debt.

Concerning the asset matching hypothesis, coefficients for the asset maturity proxy (ASSETMAT) remain positive and statistically significant for all industrial groups, except for the defensive sector. The overall coherence with the empirical prediction among groups enlighten us that firms tend to match the maturity of its assets and debt obligations and, indeed, there is a positive relation between both- for the technology group, an increase of 1 year in the

asset maturity, within firms, increases debt maturity by 0.37 years. Lastly, I found no support for the tax hypothesis empirical predictions (for all the proxies) for all the different industrial groups and leverage (LEVERAGE), which was included as control variable, is mostly significant at 1% and follows the predicted direct relation of leverage and debt maturity.

Table 8: Fixed-effects regressions of debt maturity structure on explanatory variables for Industrial Groups based on a 198 firm sample from the 2010-2023 period

Independent Variables	Cyclical	Defensive	Energy & Utilities	Technology
MV/BV	0.00681 (0.138)	-0.827*** (0.191)	0.471** (0.223)	0.0247 (0.174)
SIZE	0.388*** (0.136)	0.758** (0.299)	-0.0194 (0.327)	0.413 (0.307)
ΔEPS	0.146 (0.969)	-0.619 (1.832)	-0.237 (1.263)	-1.110 (1.914)
Rating	0.627*** (0.208)	-0.251 (0.317)	-0.101 (0.377)	-0.131 (0.531)
Rating^2	-0.0482*** (0.0134)	0.0254 (0.0245)	0.00756 (0.0306)	0.0104 (0.0350)
Rating Dummy	-2.705*** (0.679)	1.205 (1.581)	0.617 (1.978)	0.746 (1.709)
assetmat	0.0440*** (0.0137)	0.110 (0.0678)	0.0517* (0.0268)	0.366*** (0.131)
GTAXRATE	0.105 (0.333)	-0.398 (0.585)	-0.256 (0.405)	-0.734 (0.519)
BTAXRATE	0.188 (0.199)	0.0624 (0.318)	-0.265 (0.204)	-0.0718 (0.239)
Term	0.0287 (0.0830)	0.130 (0.116)	-0.0586 (0.132)	0.234 (0.220)
Leverage	6.592*** (0.803)	-2.177 (1.349)	5.721*** (1.339)	6.834*** (1.575)
Intercept	-4.439* (2.289)	-9.580* (5.251)	0.666 (6.178)	-6.540 (5.723)
Observations	1.386	602	420	364
Adjusted R-squared	0.6658	0.6585	0.853	0.6955

Note: Table 7 reports firm and year fixed effects for Industrial Groups. Cyclical corresponds to Consumer Cyclical, Basic Materials and Industrials; Defensive to Consumer Non-Cyclical and HealthCare. The dependent variable (DEBTMAT) is the book weighted average of firm's debt-like liabilities (current liabilities and debt instruments collected). The explanatory variables are described on Table 6 and no new variables were introduced. Standard Errors are reported in parentheses. P-values are reported as *** p<0,01, ** p<0,05, * p<0,1.

5. Robustness Analysis

On this section, Table 9 presents five different specifications for both the time series and cross sectional and the fixed effects regressions, aiming to test for the results' robustness in the previous analysis conducted. Several models were built specifically for the analysis,

specially checking for the monotonic relation's robustness of credit rating and debt maturity (which disproves the empirical prediction for the liquidity risk hypothesis), the impact of industry dummies consideration and, the growth opportunities relation with debt maturity and lastly, persistence of both coefficients signs and statistical significance when different time periods, within our sample, are considered.

On models 1 to 4, I test the robustness of the credit rating and debt maturity's relation on both the pooled and the firm and year fixed effects regressions by substituting the proxies for the liquidity risk hypothesis. Models 1 and 2 test the pooled results whether 3 and 4 assess the robustness of the fixed effects regression. Instead of the RATING and RATING² variables, I created two dummy variables: HIGHBOND- equals 1 if the firm is rated AA and 0 otherwise; LOWBOND- equals 1 if the firm is rated B or unrated and 0 otherwise. These new variables test the monotonic nature of the relation and, empirically, a negative relation is expected between the new variables and debt maturity, illustrating the non-monotonic relation. Recall that results were distinct when firms' variation over time is considered versus the firm and year fixed effects specifications. On model 1 and 2, results prove the monotonic relation between credit rating and debt maturity only when RATEDUM is included since both HIGHBOND and LOWBOND are significantly positive. On the other hand, for the fixed effects regression, over models 3 and 4, the non-monotonic relation is demonstrated by significant negative coefficients for both independent variables, once more, only when considering RATEDUM- ceteris paribus, firms rated AA (B or unrated) have on average shorter debt maturity by 0.14 (0.43) years than firms rated A, BBB and BB. Model 5 estimates the pooled regression performed in Table 6, but accounting for industry fixed effects to confirm and evaluate its relevance for the debt maturity structure. Although the Industry F-statistic is significant at 1%, there is only a slight explanatory power increase when considering within industry variation- Adjusted R squared increases from 12.97% to 15.6%- suggesting that firm-specific characteristics mostly explain the variation of the dependent variable. However, we can say that industry characteristics have some relevance on the debt maturity structure.

Table 9: Alternative Regressions specifications to assess robustness of specific variables for 198 firms over the 2010-2023 period

Independent Variables	Model 1	Model 2	Model 3	Model 4	Model 5	2010-2013	2014-2019	2020-2023
MV/BV	0.533*** (0.0537)	0.534*** (0.0536)	-0.0457 (0.0786)	-0.0443 (0.0786)	0.400*** (0.0552)	-0.686*** (0.248)	-0.217* (0.128)	0.0581 (0.131)
SIZE	-0.0863** (0.0376)	-0.0865** (0.0375)	0.398*** (0.103)	0.402*** (0.103)	-0.151*** (0.0397)	1.441*** (0.323)	0.611*** (0.184)	0.323 (0.281)
ΔEPS	-0.732 (1.107)	-0.725 (1.105)	-0.332 (0.662)	-0.333 (0.662)	-0.688 (1.083)	-1.031 (0.690)	-0.175 (1.062)	-0.961 (0.705)
Rating	-	-	-	-	-0.723*** (0.116)	-0.247 (0.223)	0.864*** (0.268)	0.105 (0.311)
Rating^2	-	-	-	-	0.0444*** (0.00911)	0.0125 (0.0158)	-0.0597*** (0.0191)	0.00106 (0.0192)
HIGHBOND	0.832*** (0.265)	0.817*** (0.264)	-0.13 (0.345)	-0.135** (0.345)	-	-	-	-
LOWBOND	-0.506*** (0.106)	1.483** (0.647)	-0.00277 (0.133)	-0.430* (0.401)	-	-	-	-
Rating Dummy	-	2.029*** (0.652)	-	0.474*** (0.421)	1.693*** (0.591)	1.082 (0.937)	-2.585** (1.088)	0.783 (0.964)
assetmat	0.0684*** (0.00870)	0.0701*** (0.00870)	0.0473*** (0.0120)	0.0473*** (0.0120)	0.0926*** (0.0106)	0.0269 (0.0492)	0.0252 (0.0214)	0.0760** (0.0377)
GTAXRATE	-0.315 (0.325)	-0.293 (0.324)	-0.107 (0.214)	-0.112 (0.214)	0.0964 (0.325)	0.0554 (0.307)	0.369 (0.305)	-0.0931 (0.251)
BTAXRATE	-0.0136 (0.191)	-0.00594 (0.190)	-0.0308 (0.114)	-0.0321 (0.114)	-0.0160 (0.187)	0.0250 (0.182)	-0.0461 (0.143)	-0.0197 (0.142)
VAR	-3.705*** (1.430)	-4.233*** (1.438)	-	-	-3.247** (1.528)	-	-	-
Term	-0.107** (0.0455)	-0.110** (0.0454)	0.0673 (0.0569)	0.0689 (0.0569)	-0.0902** (0.0454)	-0.00378 (0.0510)	0.346*** (0.122)	-0.259 (0.164)
Leverage	5.392*** (0.472)	5.178*** (0.476)	4.830*** (0.514)	4.913*** (0.519)	5.371*** (0.492)	3.137*** (1.111)	4.252*** (0.928)	0.922 (1.071)
Intercept	2.696*** (0.677)	0.726 (0.925)	-4.921*** (1.717)	-4.556*** (1.747)	4.693*** (0.950)	-20.68*** (5.375)	-8.702*** (3.205)	-4.653 (5.023)
Industry F-statistic					29.01***			
Observations	2.772	2.772	2.772	2.772	2.772	594	1.386	792
Adjusted R-squared	0.1119	0.1180	0.729	0.730	0.156	0.946	0.808	0.921

Note: Table 9 presents several alternative regressions to assess the robustness of results. The dependent variable (DEBTMAT) is the book weighted average of firm's debt-like liabilities (current liabilities and debt instruments collected). The explanatory variables are described on Table 6. Added variables are described as follows: LOWBOND equals 1 if the firm is B rated or unrated and 0 otherwise; Highbond equals 1 if the firm is AA rated. The industry F-statistic tests the null hypothesis that a set of industry dummy variable coefficients equals zero. Standard Errors are reported in parentheses. P-values are reported as *** p<0,01, ** p<0,05, * p<0,1.

Lastly, I conduct a robustness analysis to evaluate the stability and consistency of the results from the pooled regression when divided into three distinct time periods: 2010-2013, 2014-2019, and 2020-2023. The primary goal is to assess whether the relationships observed in the overall fixed effects model hold true under different periods, each marked by specific macroeconomic conditions. The time periods division of the sample is based on significant shifts in economic conditions that are likely to have influenced debt maturity dynamics.

Succinctly, the first period, 2010-2013, captures the immediate aftermath of the 2008 global financial crisis and the European sovereign debt crisis, whereas the second represents a phase of economic recovery marked by relatively stronger growth, low interest rates, and more stable financial conditions. Finally, the period 2020-2023 captures the profound disruptions caused by the COVID-19 pandemic marked by economic instability and uncertainty and subsequent recovery efforts. The growth opportunities proxy (MV/BV) has its coefficient's sign and significance change over the established time-periods, showing that the registered statistical insignificant coefficient over the 2010-2023 fixed effects regression is overall justified. Regarding firm size (SIZE), we can observe a robust pattern due to the observance of positive coefficients for all periods, significant on 2010-2013 and 2014-2019, at 1% confidence level. All Firm quality (Δ EPS) and Tax (with the exception of TERM) proxies remain insignificant for all periods in accordance with the general analysis. Additional, regarding the monotonicity of the credit rating and debt maturity, it seems that the economically turbulent periods do not follow the non-monotonic relation observed previously, when within firm variation is accounted, since only the recovery and development period of 2014-2019 registered significant results. Moreover, and dissimilar to the 2010-2023 results, while the asset maturity matching registered positive but insignificant results (excepting for 2020-2023), the slope of the term structure (TERM) is positive and significant as empirically predicted for the growth after crisis period.

6. Limitations

While this study provides valuable insights into the determinants of debt maturity structure across European firms, several limitations should be acknowledged. Firstly, and although the analysis is based on a sample of publicly traded companies, within the EuroStoxx 600, several companies were excluded due to criteria concerns and this may lead to a biased representation of the entire spectrum of firms across Europe. Moreover, the fact that the Eurostoxx 600 was chosen, completely excludes smaller and privately held companies- these often exhibit different financing behaviours, and their exclusion may limit the generalizability of the findings to the broader corporate landscape in Europe.

Second, although the study examines key determinants such as firm size, growth opportunities, tax rates, and industry characteristics, the cross-sectional nature of the data and the relatively limited time frame (2010-2023) may not fully capture the long-term dynamics of debt maturity decisions, particularly in response to significant economic events or regulatory

changes. The COVID-19 pandemic and the global financial crisis significantly altered financial markets and corporate financing behaviour, and while this study attempts to account for these events, their full impact on debt maturity choices might not be entirely captured.

Additionally, the analysis does not account for firm-specific factors such as managerial preferences, corporate governance structures, or country-specific regulations that could also play a significant role in determining the debt maturity structure. These factors are difficult to quantify and may contribute to unexplained variations in debt maturity choices. Also, the use of accounting proxies for certain variables, such as growth opportunities and firm size, constitute a limitation since these may not fully capture the complexities of these factors. For instance, growth opportunities are typically proxied by measures like market-to-book ratio, but this measure may not adequately reflect the actual investment potential or future prospects of firms, especially in industries with intangible assets or rapidly evolving business models. Lastly, concerning the approximations, the interaction effects between these variables is only slightly explored and given that the multivariate nature of debt maturity decisions suggesting that future research could explore these interactions more rigorously using advanced econometric techniques, such as dynamic panel models or structural equation modelling.

Finally, one notable limitation in this study is the exclusion of bank loans from the analysis of debt maturity structure, focusing solely on marketed or issued debt instruments. While it is known that bank loans are a key component of corporate financing, particularly in the European Union where they represent a substantial portion of corporate debt, comprehensive and consistent data of bank loans maturity is indeed limited and the capital repayments difficult its assessment, causing this necessary compromise given the challenges in obtaining consistent data across the diverse European market. Nevertheless, this exclusion does not undermine the overall findings but highlights a gap in the available data. In the EU, the reliance on alternative financing sources, such as corporate bonds and equity, has increased, particularly among larger firms, in which I focused in this paper and thus the analysis still offers a clear picture of European traded firms' debt maturity decisions. Future studies could include bank financing into the analysis once more granular data becomes available, particularly to better understand the overall debt maturity dynamics of (smaller) European Firms.

7. Conclusion

This study investigates the empirical determinants of debt maturity structure across 198 European firms as a whole and specific regional and industrial groupings, within the 2010-2023 period. The chosen measure of maturity weights not only the one from the debt instruments but also from current liabilities, which provides a more comprehensive look into the debt-like obligations present in corporations. Several hypotheses were tested through assigned proxies, including the agency cost, signalling and liquidity, asset matching and tax theories. Despite conducting different regressions, firm and year fixed effects was mostly chosen for interpretation and results discussion. An overall assessment of debt maturity was firstly performed, followed by industry and regions subsample analysis in which displayed results enforce industry and region-specific dynamics when studying debt maturity structure due to disparity of results, even evidencing contrasting results among studied groups.

Regarding the agency cost hypothesis, mixed support was found that corroborates the prediction in which debt maturity is used to mitigate agency conflicts between equity and debtholders. While firm size was found to vary directly with debt maturity, following both textbook Myers (1977) and recent European analysis performed by Caselli et. Al (2014), I found no support for the growth opportunity proxy inverse relation with debt maturity. Despite conflicting with the stated hypothesis similar more recent European studies, such as Dang (2011) and Antoniou et al. (2006), have also found no support for the empirical hypothesis. However, there is a suspicion that these might happen due to the strong inverse correlation between leverage and growth opportunities, enlightening that firms with high presence of growth opportunities (with low leverage) show little or no need to moderate agency conflicts with debt maturity.

Moving into the signalling and liquidity risk theories, I also found moderate support these empirical predictions. While the signalling theory kept unproven in the conducted analysis, throughout different assessments, the liquidity risk yielded quite interesting results. I found a monotonic relation between credit rating and debt maturity in cross sectional time series data and an inverse U-shaped curve when assessing variation within firms and time (firm and year fixed effects), suggesting that as firms deteriorate in credit ratings, debt maturity increases but at a decreasing rate for each consecutive downgrade, proving Diamond (1991b) empirical prediction. Moreover, the asset matching hypothesis is strongly supported by the results indicating that firms tend to align the maturity of their debt with the maturity of their assets,

despite low economic significance being consistent with findings from both international and European studies, such as Heyman et al. (2008) and Ozkan (2000).

Lastly, weak support was found for the tax hypothesis, since only earnings variability followed the empirical prediction whereas the slope of the term structure and the effective tax rate do not suggest that firms consider the term structure to benefit from interest tax shields and increase debt maturity as the effective tax rate decreases. Even so, results follow recent international studies by Orman and Koksal (2017) and Platikanova (2017) that reach similar conclusions on comparable assessments.

In conclusion, while this paper offers valuable insights into the determinants of debt maturity structure in Europe, it opens several avenues for future research that could further enhance our understanding of European corporate financing decisions. By jointly comprehending the bank loans maturity for a richer debt maturity approach, macroeconomic variables could be also used to better understand debt maturity dynamics within time periods or economic shocks and industry and regions specific financing patterns could also be deeply explored to respond to the great variation among industry and regions results found in the explored dataset.

8. References

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