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A quantitative study of how capital structure is affected by intangible assets - The Case of Sweden

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Abstract

This thesis examines the effect that intangible assets have on capital structure on the Swedish market, and in doing so contributes to the existing body of research on capital structure and its determinants. The sample consists of 1 065 different firms, from 9 different industries between the period of 2000-2020. We find that intangible assets have a supportive role when it comes to securing debt for all of our proxies for leverage. In addition, we find it hard to find any consistent differences of the association between intangible assets and leverage in different industries. However, we find significant results for the firms active in the industries with the highest sophistication of innovation, indicating that the industries with high levels of innovation will be more likely to use intangible assets in order to secure leverage.

Keywords: Intangible Assets, Capital Structure, Leverage, Tangible Assets, Knowledge-Economy, Industry Comparison, Innovation

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1. Introduction

1.1 Background

The technologic incubation, driven by the increased knowledge of humans, has led to the emergence of valuable digital assets for firms. This has led us towards the knowledge economy (also called the knowledge-based economy), which is recognized as products and services that occur by knowledge-based activities (Powell and Snellman, 2004). The emergence of the knowledge economy becomes evident when looking into the proportion of tangible versus intangible assets on the S&P 500. In 1975, the market value of intangible assets only accounted for 17% of the total market value, whereas in 2020 the same figure had risen to 90% (Tomo, 2020) and according to the World Bank (2007), firms are less dependent on physical assets than before. Today, large portions of firms' intangible assets are not always recognized in the balance sheets but can still constitute a great part of their value. Probably one of the most well known companies, Coca Cola's trademark is estimated to be worth SEK 700 billion in 2007, which was about 60 % of their market capitalization. Other firms, like Nike, BMW and Apple, are estimated to have market values of intangible assets of approximately 70 % of their market capitalization (Melin and Hamrefors, 2007). Reasonably, this comes from changing industries and new technologies, which are harder to define and value in monetary terms and therefore hard to recognize in the firm's balance sheets. In turn, this creates consequences for firms when it comes to securing debt, but also for credit institutes when it comes to granting loans. Therefore, it is important to understand the shift towards the knowledge economy, and will be incremental for businesses when it comes to securing funding. The trade-off theory, tangible assets have been viewed as a more secure and backed collateral due to its redeployability and low transaction cost (Harris and Raviv 1991; Frank & Goyal 2008; Parsons & Titman 2009; Myers, 1984). Providing sufficient collateral will in the view of borrowers not only decrease the likelihood of credit rationing but can also work as a mechanism of signaling the quality of a firm (Stigliz and Weiss, 1981). The challenge of backing funding with intangible assets lies in the reliability of the value in the assets as well as determining how collateral can be utilized by the financier in the case of default. Due to the accounting-complexity in determining the real value of intangible assets, as there in many cases is no clear market where these assets are traded at arm's length, backing funding with a high proportion of intangible assets are associated with a higher cost of capital and will affect the amount of debt demanded

(Tokmakciougle et al, 2007). In connection to this, the redeployability of an intangible asset is implied to have an effect on the cost of debt (Benmelech & Bergman, 2009).

1.2 Problem

Even though capital structure is a well studied field, there is still ambiguity between how the nature of assets influence firms leverage (Frank and Goyal, 2009). This stems from the fact that the trade-off theory and the pecking order theory are predicting adverse directions of the association between leverage and tangibility. The trade-off theory argues that tangible assets lowers the costs of financial distress and, in addition, lowers the problems associated with agency costs. While the pecking order theory predicts that tangible assets are associated with lower information asymmetry, the issuance of equity becomes less expensive leading to a decrease in leverage in the presence of tangible assets (Frank and Goyal, 2009). However, this is not completely clear, since tangible assets can also lead to increased adverse selection and therefore debt becomes relatively cheaper. Due to this, there is still of interest to investigate what effect intangible assets may have on the debt levels for firms.

Moreover, we are going to investigate the Swedish market for public firms. The Swedish market is of interest, since it has not been researched comprehensively in the field of capital structure. However, Skog and Swärd (2015) conducted a study of the Swedish market and found that in Scandinavia, the 30 largest Swedish firms have on average a smaller proportion of tangible assets and on average a higher debt level. Finally, the knowledge economy is emerging, which in turn leads to assets becoming more intangible. While the nature of the assets are adjusting, the capital market also needs to be adjusted, and as suggested by Loumioti (2012), pledging intangible assets are today economically sustainable and, therefore, the importance of intangible assets may have increased during the years for lenders and borrowers. Hence, the technological incubation makes it further interesting to study if intangible assets may have a supporting effect on leverage.

As aforementioned, the values of intangible assets have become clearly predominant in comparison to tangible assets (Tomo, 2020). This raises the question of how intangible assets are acknowledged as collateral from a lender's perspective. The empirical literature on capital structure is inconclusive regarding intangible assets impact on leverage, which is likewise argued by Lim et al (2020). Traditionally, lenders have favored tangible assets to secure debt,

since they seem to be associated with less risk than can be argued to be partially true. However, there are important characteristics of intangible assets to facilitate more debt. It therefore becomes important to examine how the asset-structure of different firms will affect the way a firm is leveraged based on which type of assets are used as collateral.

1.3 Purpose

The purpose of this thesis is to investigate if Swedish firms utilize intangible assets to secure debt. We want to understand if the characteristics of intangible assets are sufficient when securing debt by firms.

1.4 Research question

The research question is the following:

- *Are Swedish firms utilizing intangible assets to secure funding and does this vary across industries?*

2. Theory and hypothesis

2.1 Theoretical framework

2.1.1 Modigliani and Miller theorem

The discussion of the determinants of debt was originally awoken by Modigliani and Miller (1958), when they argued that the capital structure was irrelevant when it comes to the value of the firm. To defend their theory, they developed several assumptions to make their theory hold, which is usually referred to as a perfect capital market (Berk and DeMarzo, 2014). The assumptions are the following:

- Investors are able to trade the same securities at competitive prices and their value is decided on the present value of the future cash flows.
- Taxes, transaction costs and costs for issuing securities are absent.
- Financial decisions do not affect cash flows or do not reveal additional information about the firm which was not known before.

From these assumptions Modigliani and Miller developed their two propositions. The first proposition states that, under the conditions of a perfect capital market, the value of the firm is unaffected by the choice of capital. Thus, increased leverage for a firm will only result in a reallocation of where the future cash flows are being extracted (Berk and DeMarzo, 2014). This means that the increased cash flow today, due to increased leverage, will be offset by decreased cash flows in the future, caused by the increased interest payments in the future. Furthermore, they argued that the total amount of cash flow paid out to equity holders and debtholders is equal to the total cash flow generated by the firm's assets and, therefore, due to the law of one price, the value of the firm should not be affected whether the firm holds debt or equity. Moreover, if the investors are not satisfied with the capital structure of the firm, they can use homemade leverage to obtain their desired capital structure (Berk and DeMarzo, 2014). This means that, if the investor can borrow at the same rate as the firms, the investor can replicate any capital structure of a firm by purchasing shares at margin.

The second proposition is related to the expected return of the firm and suggests that a higher debt-to-equity ratio has a positive linear relationship with expected return. However, the increased expected return is associated with increased risk and therefore leveraged equity has

a higher cost of capital which means that the value is being discounted to a higher degree. This decreases the value of the firm to the same extent as the increased expected return increases the value of the firm (Berk and DeMarzo, 2014). Thus, the capital structure of the firm is irrelevant in a perfect capital market.

However, this perfect world Modigliani and Miller explained was disputed due to the frictions usually observed in practice. Modigliani and Miller (1963) corrected their original proposal with an additional paper and stated that debt has tax advantages, since the interest payments reduce the profit that is being taxed. They do, however, highlight that to maximize the value of the firm, the firm should not be fully financed by debt. Other sources of finance, such as retained earnings, may in some circumstances be cheaper even though taxes are present.

2.1.2 Trade-off theory

Kraus and Litzenberger (1973) developed the trade-off theory from Modigliani and Miller's capital structure propositions. In addition to taxes, they also introduced bankruptcy costs as another imperfection. Taxes were still the driving force for increasing leverage for the firms, but on the contrary to taxes, the risk of bankruptcy is increased by the leverage and, therefore, could implicate additional costs for the firm. Thus, the optimal level of leverage is where the additional value created by tax savings on the margin is offset by the potential costs of bankruptcy. Myers (1984) further developed these thoughts, by introducing that a firm sets a target debt-to-value ratio, which it gradually adjusts until there is a balance between the tax shield and the bankruptcy costs. The reasons why firms gradually adjust towards an optimal debt-to-value ratio is due to the adjustment costs that exist (Myers, 1984). If the trade-off theory holds and there are no costs with adjusting towards the optimal level of debt, the optimal level of debt would be the current level of debt. According to Frank and Goyal (2009), the optimal level of debt is not observable and, therefore, hard to determine. Nonetheless, according to Myers (1984), conclusions can be drawn about the magnitude of the bankruptcy costs. First of all, risky firms seem to borrow less than safe firms, where the "riskiness" of the firm is defined by the variance of the expected market value of the firm's assets. The reason behind this lies in the fact that the cost of bankruptcy is caused by the threat of default. Secondly, firms that hold larger proportions of assets-in-place, with an active second hand market, are also having a higher optimal debt level. Thus, firms that possess specialized assets, intangible assets or growth opportunities will hold less debt. The reason behind this is due to the fact that the loss

of financial distress is not only determined by the probability of default but, also the expected costs of when default occurs. (Myers, 1984)

2.1.3 Pecking order theory

The pecking order, by Myers and Majluf (1984), states that a firm will decide to acquire capital in a predetermined order. Firstly, a firm will use their retained earnings to fund new investments, secondly they will use debt, and lastly equity. The reasoning behind this order is the costs that the different sources of capital will entail. Retained earnings comes directly from the company and, hence, there is no information asymmetry. This as oppose to the both external sources of funding, debt and equity, where the firm has to pay a premium in order to compensate the investors for the perceived risk of not having the same level of information about the firm as inside managers. When comparing the two external sources of funding; debt and equity, the difference in cost for the firm stems from two different sources: Level of information asymmetry as well as claim to assets in case of default. The relationship between debtholders and firms are closer than between a firm and its shareholders, which means a lower level of information asymmetry, in connection with the debtholders having a higher claim of assets if the firm would default, this leads to debtholders demanding lower prices than shareholders does. Thus, explaining the reasoning behind the pecking order theory and the costs that different sources of capital will incur on the firm. (Myers & Majlyf, 1984)

2.2 Previous empirical findings and hypothesis

Earlier studies in the field have examined how the nature of assets affects capital structure to a rather great extent, however, these studies have not been able to depict a clear and consistent relationship, why the effect remains rather unclear (Siblikov, 2009). Titman and Wessels (1988) investigated the explanatory power of the theories among capital structure. More precisely, they examined the determinants which the theories predict are affecting the firm's leverage, where the nature of assets were one of the determinants. They used intangible assets to total assets and gross property plant and equipment plus inventories to total assets, as proxies for measuring the collateralizability. The first proxy had an expected association to be negative and the latter had an expected association to be positive. However, due to lack of significant results, these associations were not possible to confirm. Gaud et al (2005), however, were able to confirm that tangible assets are positively related to leverage. Their result was in line with

the trade-off theory, however, more support is still needed to develop a complete capital structure theory.

One common characteristic of tangible assets is that they are more liquid than intangible assets in the case of bankruptcy. According to Sibilkov (2009), the degree of liquidity in a firm's assets has an ambiguous effect on the leverage. Less liquid assets could be argued to sell with a higher transaction cost and this increases the cost of liquidation, bankruptcy and debt. Therefore, this speaks for a positive effect between asset liquidity and leverage, which has been argued by Williamson (1988) and Shleifer and Vishny (1992). However, Myers and Rajan (1998) and Morellec (2001) argue that this relationship is only positive if managers cannot use their discretion on assets if liquidation is required. When managers cannot do this, Morellec (2001) found that asset liquidity has a negative effect on debt, while Myers and Rajan (1998) argue that the association is rather positive to a certain level and then becomes negative (i.e., the relation is curvilinear). Thus, only when assets are pledged as collateral this effect is predicted to be positive. In addition, this further strengthens the importance of assets being used as collateral when securing debt.

Traditionally, and as already mentioned, tangible assets have been more commonly used as collateral, when securing debt, for several reasons already mentioned (Rajan and Zingales, 1995). However, using intellectual property as collateral has been around for quite some time, but is gaining more interest due to the continuously increasing value of intangible assets (Baldwin, 1995; Bahrick, 1986). The same thoughts are brought up by Loumioti (2012), who found that using intangible assets as collateral has helped alleviate financing frictions as lenders to a higher degree have started to accept intangible assets as collateral. In addition, using intangible assets as collateral was associated with increased cost of debt and increased supply of credits to firms. Nonetheless, their result showed that using intangible assets as collateral is fully economically sustainable on the modern capital market. Similarly, Lim et al (2020) investigated the impact of identified intangible assets on debt through a change in a specific accounting rule. This allowed them to observe reported market values of intangible assets and find that intangible assets were positively related to leverage. Additionally, their result suggested that intangible assets support debt as much as tangible assets do. In the same field, Matemilola and Ahmad (2015) emphasized the importance of both tangible and intangible assets when securing debt for firms. Their result indicates that goodwill as well as fixed assets have a positive effect on total debt and long-term debt, however, the coefficient for fixed assets

is higher than the coefficient for goodwill. In connection to these findings and in terms of using different types of intangible assets as collateral, Mann (2018) finds that specifically patents, due to their inherent liquidity, withhold the attributes of securing funding. Mann (2018) further concludes that intangible assets serving as collateral may in fact have an important economic value. These findings are also in line with Loumioti (2012), who suggested that goodwill reduces information asymmetry between borrowers and lenders and, therefore, alleviates the accessibility of capital for firms. Adding to the importance of the relationship between borrowers and lenders regarding the issue of information asymmetry is, both Boot and Thakor (1994) and Berger and Udell (1995), who emphasize that the longevity of this relationship will alleviate additional funding.

The importance of intangible assets is further stressed by Larkin (2013), who found that powerful brands can generate a positive attitude among consumers can increase the marginal price-setting and, hence, lower the volatility of cash-flows, incurring an increase in the credit rating of firms. In turn, this had an effect on the financial policies by increasing net debt while increasing leverage and decreasing cash holdings. These findings suggest that intangible assets not only need to have an increasing effect on leverage due to the collateralizability, but also due to making cash-flows more predictable, facilitating lenders' ability to provide funding.

What could be concluded is that the empirical literature agrees that if assets are collateralized they foster the issuance of debt, nevertheless, intangible assets that cannot be pledged as collateral may still have a positive effect on cash-flows. Moreover, the proxy for the collateralizability is usually the relation between tangible assets and total assets. The few studies that have investigated how intangible assets influence leverage presents ambiguous results. With this in consideration, we aim to further investigate the relationship of intangible assets on leverage and, thus, our first hypothesis will be;

H_1: The proportion of intangible assets has a positive relationship with leverage

Further, it is evident that different types of firms in different industries will have incumbent preferences when it comes to financing. Industries with a high ratio of tangible assets, i.e., real estate will in general be more leveraged than for example firms in the technology industry that in general are more dependent on intangible and knowledge-based assets. Differences in leverage between industries have been studied to a great extent and are confirmed by many

studies (see for example, Scott and Martin (1975) and Li and Islam (2019)). How the nature of assets influence leverage in different industries seems, however, rather unexplored. Different types of intangible assets will have diverse potential effects on leverage whether or not they will be admissible as collateral or not. For example, Mann (2018) emphasize, that patents are shown to facilitate the issuance of debt. The different characteristics in different industries, such as highly innovative industries, will likely be more dense in intellectual capital, such as for example patents. Therefore, our second hypothesis will aim to investigate the differences that intangible assets may have in terms of securing debt in different industries;

H_2*: The impact of the proportion of intangible assets on leverage has different effects in separate industries*

3. Methodology

3.1 Data

The panel data was collected from Bloomberg for the years the years 2000-2020. There are several benefits of using panel data. The panel data takes into account individual heterogeneity, which is not possible when studying relations cross-sectionally. In addition, it is more informative, adds more variability to the data, saves degrees of freedom and there is usually less collinearity between variables (Baltagi, 2008). The panel data is suitable since it allows for a more dynamic analysis. This is not easily obtained from normal time-series data, since it usually requires a rather large time period (Brooks, 2015). Further, Gaud et al (2005) prefer panel data. They argue that the decisions about capital structure are naturally dynamic making panel data is appropriate to use in these studies. In order to avoid survivorship bias, the sample consists of all public Swedish firms that were active for each given year. The income statement and balance sheet items were collected on an annual basis for the first trading day each year for the firms, with the requirement that the financial information is the latest information filed from Bloomberg. The firms are classified by the Industry Classification Benchmark (ICB) introduced by Dow Jones and Financial Times Stock Exchange. Information which refers to market prices are gathered from the first trading day each year and all the data is gathered in local currency. Financial firms and utility firms were excluded from the sample based on the logic presented by Fama and French (1991)[1] and due to standard practice (Frank and Goyal, 2003). In addition, derivatives of indices and firms were manually excluded. The data sample consisted of some missing values that were omitted, which may have affected the results. There may be several reasons behind the missing values from the sample. One source of the problem may be traced to issues with the detection of certain items by Bloomberg, after observing some companies with missing values while comparing with the filed annual reports. One additional bias to consider while interpreting the results is the fact that the sample consists of only public firms. There could be differences in capital structure determinants among private firms that this omits.

[1]Financial and utility firms may distort the result since the underlying rationale behind leverage is not consistent with other industries. Their financial leverage may be affected by regulators and therefore should be excluded (Fama and French, 2002)

3.2 Variable definition

Leverage has been defined in many different ways in the literature on capital structure. It is important to understand exactly what is meant by leverage, since it may have an effect on the inference that will be drawn from the results. Rajan and Zingales (1995) argue that the appropriate measure depends on the objective of the analysis. The earlier studies have been using a wide range of debt ratios, but there is also a distinction whether book values or market values should be used when defining the debt ratio. However, concluding which type of measure for leverage is superior is beyond the scope of this paper. Although, in line with Frank and Goyal (2009), we intend to explore both book values and market values as well as long-term and total debt. This means that we will study four different dependent variables for leverage; 1) *Total debt to book value of assets* (TDA), 2) *Total debt to market value of assets* (TDMV), 3) *Long-term debt to book value of assets* (LTDA) and 4) *Long-term debt to market value of assets* (LTDMV). We do, however, make some adjustments to the market value of assets, since we do not have the same source of data. If the identical measure would be used, it will result in a large proportion of missing values that may be inappropriate. However, we are nevertheless interested in a broader measure of the market value of assets, since the Swedish market is rather unexplored when it comes to capital structure studies. Debt is used, both total debt and long-term debt, instead of liabilities, since it is assumed to be more appropriate according to Rajan and Zingales (1995). When leverage is constructed with liabilities, the ratio will be influenced by account payables and pension liabilities that are not desired in our objective of understanding capital structure. With respect to this, we will define the market value of assets as the market value of equity and add the book value of total debt. Therefore, the corresponding measure for leverage could be seen as a proxy for the amount left for shareholders if the firm is liquidated. It would be optimal to use the market value of debt, but this was not possible due to data limitations. However, according to Titman and Wessels (1988) this misspecification caused by book value of debt is probably small as market debt and book value of debt are strongly correlated. Further, the reader should bear in mind that this ratio may overstate the amount of leverage and, therefore, may not be appropriate when taking probability of default into account (Rajan and Zingales, 1995).

Moreover, the independent variable of interest for intangibility is *Intangible assets ratio*. *Intangible assets ratio* is simply the item intangible assets exported from Bloomberg divided

by the total book value of assets[2], when we estimate the model with *TDA* and *LTDA* as dependent variables, market value of assets, when estimating *TDEV* and *LTEV*. In addition, to validate the causality of the variable of interest appropriate control variables have been used based on the earlier literature. These are variables that are predicted to influence the capital structure decisions of the firm. *Market-to-book* ratio will be used as control, since it is a commonly used proxy for growth opportunities. Growth opportunities in firms are increasing the cost of financial distress and, therefore, *Market-to-book* should be associated with lower levels of debt. *Profitability* is predicted to influence leverage in an ambiguite way. From a tax and agency cost perspective, more profitable firms will take on more leverage. From a pecking order perspective, internal generated funds infer less costs, why more profitable firms will be less leveraged. Further, *Size* will be used for control and it is expected to be positively associated with leverage, since larger firms are more diversified lowering the probability of default. However, larger firms are expected to be older and, therefore, predicted to have more retained earnings and, hence, the association is inverse from a pecking order perspective. Finally, our last control variable is *Risk,* which is expected to have a negative association with leverage. More volatile cash flows are considered to increase the cost of financial distress, making debt more expensive for more risky firms according to the trade-off theory. However, the pecking order theory predicts the opposite association, since more risky firms are having more problems with adverse selection that increases the cost of equity. (Frank and Goyal, 2009). These variables are selected, since they are argued to be the most significant factors from previous literature (Rajan and Zingales, 2005). The variables of interest are first regressed against each other, and afterwards the controls are added one by one and regressed again. If the significance changes, the direction of the association is changed or the magnitude of the coefficient is rubbed significantly, it will be considered. The control variables are decomposed in Appendix I.

[2] We use a similar definition of intangible assets ratio as Titman and Wessels (1988), who used intangible assets to total assets ratio as well.

3.3 Descriptive data

Table I shows the descriptive statistics for all the variables of interest. The total sample consists of 1 336 firms over the chosen time period. Outliers of the sample were managed by winsorizing by the 5th percentile and the 95th percentile. 5 % in each tail of the data was reasoned to be appropriate after observing the number of outliers.

Table I: Descriptive statistics

The statistics consist of observations between 2000-2020 and have been managed for missing values and outliers. Missing values were removed and therefore the amount of observations are the ones being left. The sample has been winsorized by the 5th percentile and the 95th percentile in order to reduce the problem of extreme values but still be able to keep a sufficient amount of observations.

Variable	Obs	Mean	Std. Dev.	Min	Max
TDA	7 630	0.1771964	0.1828967	0	0.5801173
TDMV	7 496	0.1655404	0.2002908	0	0.6421298
LTDA	7 620	0.126935	0.1564682	0	0.5144421
LTDMV	7 486	0.1176164	0.1647901	0	0.5549092
Intangibles BV	7 527	0.2888342	0.2331139	0.0005929	0.7562771
Intangibles MV	6 453	0.2336977	0.2629301	0.0002687	0.9361383
Tangibles BV	6 496	0.2669759	0.2266009	0.0014621	0.7358804
Tangibles MV	5 738	0.2450713	0.2813949	0.0002683	0.9662634

Source: Bloomberg

The independent variables do in general have a higher magnitude than the dependent variables, but also a larger standard deviation. Moreover, from the minimum and maximum column, it could also be observed that there are no observations with 0 tangible or intangible assets. Table II illustrates statistics of the sample divided into the different industries for all the variables of interest. The industries containing the greatest number of firms are the *Industrials* and *Health care* industries, while *Consumer Staples, Energy* and *Telecommunications* are the industries with relatively small amounts of firms in our sample. For an indefinite reason, Bloomberg was not able to specify a large portion of the firms into any industry. These firms are categorized as *N/A*. This may be a limitation with the sample, since it will be more difficult to analyze differences between certain industries and their capital structure. Further, the most leveraged industry, on average, is *Real Estate* when all measures for leverage are considered. The least leveraged industries, on average, are *Technology* and *Health care,* but the order depends on which measure for leverage is used. Moreover, the industries with the highest proportion of intangible assets are; *Health Care, Technology and Telecommunications* when intangible assets are measured by book values. However, if measured by market values, the industries with the highest proportion of intangible assets are *Consumer Discretionary, Technology* and *Telecommunications*. In contrast, the industries with a the highest proportion of tangible assets

when book values are considered are; *Basic Materials, Energy* and *Real Estate* which is also valid when market values are used.

Table II: Industry statistics

The table displays the mean value for all the variables of interest divided into the different industries after the data have been managed for missing values and outliers. Missing values were removed and therefore the amount of observations are the ones being left. The sample has been winsorized by the 5th percentile and the 95th percentile in order to reduce the problem of extreme values but still be able to keep a sufficient amount of observations.

Industry	Firms	TDA	TDMV	LTDA	LTDMV	Intangibles BV	Intangibles MV	Tangibles BV	Tangibles MV
Basic Materials	50	0.1778390	0.1953327	0.1299174	0.1434986	0.2352921	0.1902152	0.4531743	0.4971298
Consumer Discretionary	125	0.1772803	0.1644719	0.1265922	0.1154208	0.2994427	0.2436422	0.3206405	0.2959338
Consumer Staples	24	0.2277195	0.1671291	0.1730708	0.1244613	0.2344611	0.2156624	0.4055450	0.2965162
Energy	28	0.1579495	0.0916209	0.1080199	0.0574076	0.2828256	0.2216903	0.4138865	0.2471594
Health Care	171	0.0964362	0.0635865	0.0648447	0.0435589	0.3584644	0.2131615	0.1333485	0.0735984
Industrials	171	0.2082370	0.1969421	0.1412429	0.1351861	0.2675666	0.2436204	0.3034626	0.2843724
N/A	576	0.1668515	0.1701038	0.1204175	0.1181397	0.2672541	0.2341859	0.2652773	0.2632375
Real Estate	55	0.4440533	0.4488708	0.3612936	0.3675381	0.0305788	0.0104492	0.4487923	0.5114139
Technology	104	0.0959289	0.0808291	0.0619721	0.0498585	0.3430370	0.2719103	0.1323464	0.1139774
Telecommunications	32	0.1576298	0.1255169	0.1049851	0.082483	0.3560416	0.3052218	0.1806014	0.1461726

Source: Bloomberg

3.4 Model specification

The main model for estimating the effect intangible assets have on leverage is presented in Equation 1. The main model is estimated four times in order to capture the different dependent variables described. In Equation 1, *i* denotes the cross-sectional dimension, which in our case are firms, and *t* denoting the dimension of time, in terms of years. The occurrence of the different proxies of leverage stems from earlier empirical studies which have found different effects depending on which debt is taken into account and if market values or book values have been used. Common for all the models is that the variables are expressed as a ratio. When the denominator in the dependent variable consists of market values, the independent variables will likewise have market values as the denominator to be consistent.

$$Leverage_{it} = \beta_0 + \beta_1 Intangibles_{it} + \sum \beta_{2\to5} Controls_{it} + i.\beta_{6\to14} Industry + \mathcal{E}_{it} \quad (1)$$

In order to decide which estimation method to be used, the Hausman-test and Breusch and Pagan Multiplier test has been conducted. The Breusch and Pagan multiplier test is first applied in order to determine if *pooled estimation* or *random effects estimation* is deemed more suitable for the model (Breusch and Pagan, 1980). The test is significant, which implies that there is variation between groups in the sample and that a *random effects estimation* is more suited for the model. Further, the Hausman-test is conducted to decide if *random effects* or *fixed effects*

estimation is more appropriate (Hausman, 1978). By rejecting the null hypothesis, it is found that the *fixed effects estimation* predicts the most unbiased variables and, hence, the *fixed effects-model* will be used. In addition, it is usually also argued that the *fixed effects model* is more suitable when the sample is not randomly selected and instead constitutes the entire population (Brook, 2015). In our case, we are studying all the public firms in Sweden and, therefore, the *fixed effects model* could be argued to be appropriate.

Further, in order to answer if there is any difference in the association between the proportion of intangible assets and leverage between industries, additional regressions have been estimated. The secondary regression model is presented in Equation 2. The equation is similar to Equation 1, but the industry dummies are excluded since we are conducting the regression for each industry separately.

$$Leverage_{it} = \beta_0 + \beta_1 Intangibles_{it} + \sum \beta_{2\to5} Controls_{it} + \mathcal{E}_{it} \qquad (2)$$

Leverage is the dependent variable and the proportion of intangible assets is the independent variable for firm *i*.

4. Results and Analysis

4.1 Development over time

Visualizing the dependent and independent variables over time will allow for a more comprehensive analysis of the results of this thesis. Starting with the dependent variables, Figure I and II are presenting the two different proxies for leverage measured by book values of assets, i.e *TDA* and *LTDA*. The graphs display the average debt levels of the sample over the time period. Both are illustrating a similar decreasing pattern over the period with a peak at the beginning of the period and lowest at the end of the period. Thus, leverage has decreased for the average firm until the end of the period. The lowest level of debt was observed in 2018 for *TDA* and in 2015 for *LTDA.* However, for both *TDA* and *LTDA,* from 2018 leverage has distinctly started to increase for TDA in particular. Due to the relatively long time horizon, we are able to observe the effects of economic instability. The burst of the IT-bubble can be traced at the beginning of the period. Both total debt and long-term debt were negatively impacted by the event and recovered quickly the following years. The financial crisis of 2007-2008 appears to have had a major impact on both *TDA* and *LTDA* for the average firm. *LTDA* did, however, recover slower than for *TDA* and can be observed in Figure I and II.

Figure I: Total-debt-to-asset ratio

The graph is illustrating the average Total-debt-to-asset ratio between 2000-2020 within the sample. The average is calculated post winsorizing the sample by the 5th percentile and the 95th percentile.

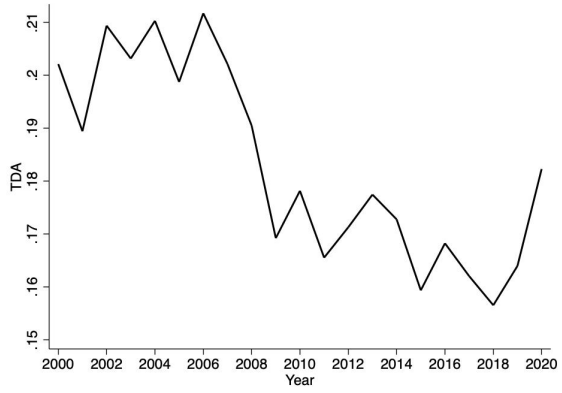


Figure II: Long-term-debt-to-asset ratio

The graph is illustrating the average Long-term-debt-to-asset ratio between 2000-2020 within the sample. The average is calculated post winsorizing the sample by the 5th percentile and the 95th percentile.

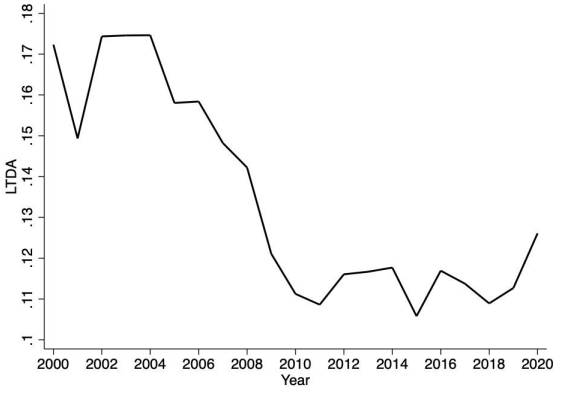


Figure III: Total-debt-to-market-value ratio

The graph is illustrating the average Total-debt-to-market-value ratio between 2000-2020 within the sample. The average is calculated post winsorizing the sample by the 5th percentile and the 95th percentile.

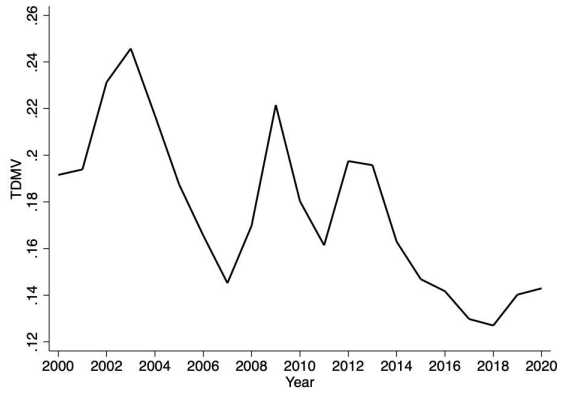


Figure IV: Long-term-debt-to-market-value ratio

The graph is illustrating the average Long-term-debt-to-market-value ratio between 2000-2020 within the sample. The average is calculated post winsorizing the sample by the 5th percentile and the 95th percentile.

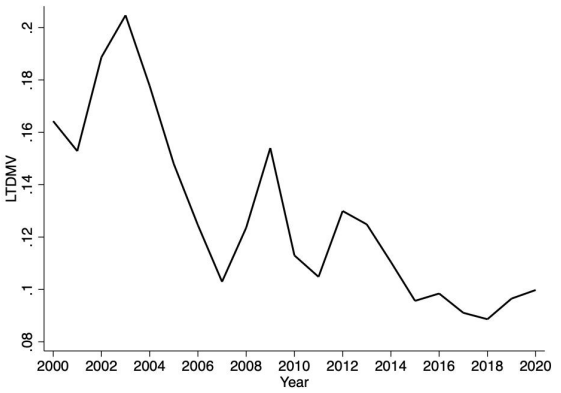


Figure III and IV illustrate the leverage proxies measured by market values of assets, i.e., *TDMV* and *LTDMV*. In general, a similar pattern could be observed where the trend has decreased over the period. Both *TDMV* and *LTDMV* reached their lowest in 2018 and slightly increased towards the end of the period. However, the opposite pattern could be traced regarding the effects of economic instability. The debt levels are heightened during these events and subsequent years after the event before recovering. The potential cause for this is the low market values for firms due to the stock market crashes during these events. Even though the time period we are studying is relatively long, it is nonetheless important to take into account that these events may have an effect on the inference. Also, important to consider is the differences between industries when it regards debt levels. These differences in the different proxies of leverage can be seen in Appendix II. Furthermore, in Figure V and VI the independent variables of interest are presented as averages among all the firms over time. Both proxies of intangible assets ratio have increased during the period. This illustrates the relative increased proportion of intangible assets used by firms and confirms Baldwin's (1995) view about the increased interest of intangible assets and that the trend has not vanished. The increase is more obvious when observing intangible assets ratio measured with book values (Figure V). As can be seen from Figure VI, the effect of economic instability is major when intangible assets ratio is measured with market values. Reasonably, when the economic instability is causing the market values for firms to decline, it inflates the ratio of intangible assets that can be seen from both the burst of the IT-bubble and the financial crisis of 2007-2008. In addition, it is worth noting that the intangible assets ratio measured by book values have been quite stable after the financial crisis, while intangible assets measured by market values have been declining

until the end of the period. Indicating that the financial crisis of 2007-2008 impacted the market values of equity to a large extent relative to book values of assets.

Figure V: Intangible assets ratio book value
The graph is illustrating the average Intangible assets ratio measured by book values for the total assets between 2000-2001. The average is calculated post winsorizing the sample by the 5th percentile and the 95th percentile.

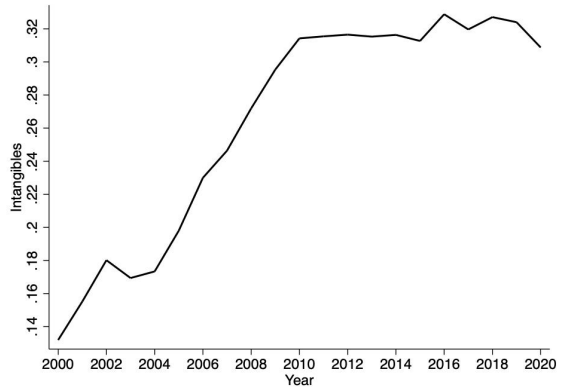
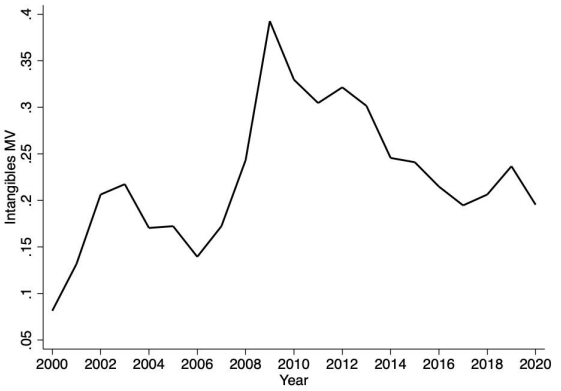


Figure IV: Intangible assets ratio market value
The graph is illustrating the average Intangible assets ratio measured by market values for the total assets between 2000-2001. The average is calculated post winsorizing the sample by the 5th percentile and the 95th percentile.



As with the different proxies for leverage, the proxies for intangible assets do as well vary depending on which industry the firm operates in. The average intangible assets ratio, measured by book values and market values, can be seen in Appendix III for the different industry classifications. The graphical illustrations of leverage and intangible assets make it hard to predict any strict relations between intangible assets and leverage. Although all proxies for leverage have decreased over time, there are fluctuations over the period that are difficult to match with patterns from the average intangible assets over time, since book values differ much from when market values are used. What could potentially be observed are peaks in leverage and intangible assets for assets measured by market values under high economic instability. This indicates that in these periods of uncertainty, when asymmetric information is high, intangible assets have a positive effect on leverage. However, the cause of this could also be traced to large decreases in market values for firms, at least when measured by market values.

4.2 Regression results and analysis

The results of the main regression model (Equation 1) is displayed in Table III below. The results are statistically significant at 1 %. The control variables included in the results table are all at least statistically significant at 5 %. From the results, *intangibles* indicates a positive relationship towards leverage for all the different proxies of leverage as the dependent variable. If *intangibles* are increased by one unit *TDA*, *TDMV*, *LTDA* and *LTDMV* are increased by 0.07,

0.12, 0.03 and 0.08, respectively. In relation to this, the effect seems to be stronger when leverage is measured by *TDMV* and *LTDMV*, thus, when market values are considered, *intangibles* increases leverage even more. Another interesting observation is that *intangibles* seems to have a stronger effect on *TDA* and *TDMV,* which is an indication of different components of short-term debt being supported by *intangibles*. In the literature, the nature of assets is usually proxied by the proportion of tangible assets[3] to total assets and is expected to have a positive relationship to leverage. It therefore makes it reasonable to assume that intangible assets in that case should have a negative impact on leverage. However, our results are suggesting the opposite and, therefore, contradict the traditional view of capital structure and, the trade-off theory, suggested by Myers (1983) and the empirical findings found by Frank and Goyal (2009), Gaud et al (2005) and Rajan and Zingles (1995). However, it is important to consider that different proxies for the nature of assets have been used, compared to the literature above, which may have impacted the results.

[3] Tangible assets are in turn usually measured by gross property plant and equipment plus investories (Frank and Goyal, 2009).

Table III: Main regression model of intangibles as predictor of capital structure

This table presents the result of Equation 2 from the section of methodology. The results are estimated using the OLS regression with the fixed effect model and the time period is between 2000-2020. The sample contains of 1 065 firms when TDA and TDMV are used as dependent variables and 1 064 when LTDA and LTDMV are used as dependent variables. Intangibles are intangible assets divided by book value of total assets when TDA and LTDA are used as dependent variable and while TDMV and LTDMV are used as dependent variable intangibles are defined as intangible assets divided by market value of total assets (see section 3.2 for more information regarding definitions). The variables; ROA, Size and MB are control variables and definitions for these can be seen in section 3.2. Before the regressions are run, all the variables are winsorized by the 5th percentile and the 95th percentile to avoid misleading outliers. * indicates significance at 10 % level, ** indicates significance at 5 % level and *** indicates significance at 1 % level. The t-statistics are presented in the parenthesis.

VARIABLES	TDA	TDMV	LTDA	LTDMV
Intangibles	0.0694***	0.1208***	0.0314***	0.0753***
	(5.391)	(12.326)	(2.889)	(8.778)
ROA	-0.0862***	-0.1307***	-0.0466*	-0.0644**
	(-2.829)	(-4.255)	(-1.807)	(-2.393)
Size	0.0234***	0.0331***	0.0198***	0.0217***
	(8.091)	(11.465)	(8.074)	(8.560)
MB	-0.0023**	-0.0077***	-0.0027***	-0.0059***
	(-2.387)	(-7.384)	(-3.350)	(-6.401)
Risk	0.0006***	0.0009***	0.0003***	0.0005***
	(9.433)	(14.628)	(5.621)	(9.160)
Constant	-0.3754***	-0.5941***	-0.3067***	-0.3737***
	(-4.837)	(-7.611)	(-4.674)	(-5.469)
Observations	5,642	5,642	5,638	5,638
R-squared	0.045	0.162	0.030	0.092
Number of firms	1,065	1,065	1,064	1,064
Industry fixed effects YES/NO	YES	YES	YES	YES

Source: Bloomberg

Our result is more in line with Loumioti (2012), Larkin (2013) and Lim et al (2020), who are all more in favor of the more supportive role intangible assets could have on leverage. The rationale behind our results could be several. One reason, suggested by Lerkin (2013), is that the intangible assets (such as brands) may have positive cash-flow effects for the firm and will, therefore, enhance the credit ratings for the firms and, in turn, decrease the cost of debt. Another possible explanation could be traced to increased liquidity of intangible assets, which could be argued to be reasonable due to increased interest in intangible assets in the recent years. As Myers and Rajan (1998), Shleifer and Vishny (1992) and Williamson (1988) found, high liquidity of assets is associated with more debt, at least if managers cannot use their discretion. Therefore, our results could be argued to indicate that intangible assets can and are in fact used as collateral for securing debt. Furthermore, the emergence of new technology has made it

possible for new markets to open, in order to facilitate trade with intangible assets that can also be a source of increased liquidity. In addition, Myers (1984) emphasized the importance of assets traded frequently at a second-hand market and higher optimal debt levels for firms. In that sense, it is not unreasonable to believe that the characteristics of intangible assets may have changed, which can be attributable to a more mature market for intangible assets, and may not therefore be seen as equally risky as before. Another argument for this contradicting result is supported by Berger and Udell (1995), who found that firms that have a closer relationship with the banks do not need to provide collateral to the same extent as firms that do not have a close relationship with the banks. This close relationship will facilitate monitoring and provide the bank with valuable information. Therefore, collaterals are not needed to the same extent as information asymmetries will be lower if the relationship is close between the bank and the firm. With respect to this, Sweden could be argued to be a bank-oriented nation, with a long history of banking and with the world's oldest Central bank (Riksbanken, 2021). In addition, Boot and Thakor (1994) illustrated with their model that the longer the relationship between the bank and the firm, the requirement of collateral will be lower. Thus, assets that are not possible to collateralize, which is usually more common for intangible assets, could therefore nevertheless be a driver for issuance of debt and could possibly be an explanation for our results for the Swedish market.

According to Frank & Goyal (2009) and the pecking order theory, tangibility of assets decreases information asymmetry and, therefore, equity becomes less costly to issue. Thus, the pecking order theory predicts that firms with more tangible assets should have less debt in relation to equity, firms with more intangible assets should have more debt, since they should be more associated with higher asymmetric information. With this in mind, our results indicate that intangible assets can play a definite role when it comes to securing funding. However, Frank and Goyal (2009) also discuss the ambiguity of the pecking order theory and that the direction of the association is not completely clear. This depends on what intangible assets actually represent. When tangibility represents assets in place, more tangible assets increase adverse selection leading to more debt and, hence, intangible assets should be negatively related to leverage (Frank and Goyal, 2009). The results indicate that intangible assets do, even if un-compared to fixed assets, foster the issuance of debt in all of our four models. By acknowledging the value of intangible assets by creditors accepting it as collateral, it also provides the intangible assets with a claimed redeployability, hence, indicating that a more holistic market for intangible assets should be feasible and is economically sustainable, which

is in accordance with Loumioti (2012). The main regression results from Table III have provided us with enough evidence to be able to reject our first null hypothesis that intangible assets have a negative relationship with leverage and, therefore, intangible assets seem to support leverage.

Further, Tables IV-VII present the results from the regressions estimated by Equation 2. The results display the association between *intangibles* and the different proxies of leverage for each industry. Thus, the results are separating the industries to see if there is any difference between intangible assets as a predictor of capital structure due to different characteristics in different industries. *TDA* and *LTDA* as dependent variables are illustrated in Tables IV and V, respectively, while *TDMV* and *LTDMV* as dependent variables are presented in Tables VI and VII, respectively. Starting with Table IV, which uses *TDA* as the dependent variable, intangible assets are significant at our critical level for *Energy, Health Care, Industrials, Technology* and *Telecommunications.* The coefficients are -0.154, 0.096, 0.135, 0.094 and 0.111. The *Energy* industry is the only industry in which firms seem to have a negative association between intangible assets and leverage.

Table IV: Secondary regressions of intangible assets as predictor of by industry

This table presents the result of Equation 2 from the section of methodology when TDA is used as dependent variable. The independent variable of interest is intangible assets and is defined as intangible assets to total book value of assets. The results are estimated using the OLS regression with the fixed effect model and the time period is between 2000-2020. Before the regressions are run, all the variables are winsorized by the 5th percentile and the 95th percentile to avoid misleading outliers. * indicates significance at 10 % level, ** indicates significance at 5 % level and *** indicates significance at 1 % level. The t-statistics are presented in the parenthesis.

Total debt to total assets						
Industry	Intangibles	ROA	Size	MB	Risk	Constant
Basic Materials	-0.0364	-0.0996	0.0295***	-0.0081**	0.0008***	-0.4621***
	(-0.905)	(-0.848)	(4.616)	(-2.167)	(3.599)	(-3.312)
Consumer Discretionary	-0.0165	-0.2297***	0.0524***	-0.0009	0.0010***	-0.9083***
	(-0.563)	(-2.682)	(10.061)	(-0.393)	(5.566)	(-8.277)
Consumer Staples	-0.1280*	0.1336	0.0300**	-0.0041	0.0010**	-0.4211
	(-1.891)	(0.566)	(2.358)	(-0.685)	(2.378)	(-1.588)
Energy	-0.1540**	0.0661	0.0137	0.0204***	0.0006*	-0.1928
	(-2.231)	(0.336)	(1.058)	(4.680)	(1.922)	(-0.738)
Health Care	0.0959***	-0.0271	0.0372***	0.0020	0.0004***	-0.6711***
	(4.571)	(-0.405)	(7.914)	(1.323)	(2.730)	(-7.149)
Industrials	0.1351***	-0.1094	0.0298***	-0.0110***	0.0006***	-0.4648***
	(5.063)	(-1.531)	(7.451)	(-4.307)	(4.341)	(-5.490)
Uncategorized Industry	0.0232	-0.0131	0.0270***	-0.0048**	0.0004***	-0.3877***
	(1.122)	(-0.292)	(7.192)	(-2.559)	(4.260)	(-5.066)
Real Estate	-0.5310	0.5808*	0.0443***	-0.0049	0.0006*	-0.5942
	(-1.603)	(1.693)	(2.805)	(-0.362)	(1.665)	(-1.635)
Technology	0.0942***	0.0060	0.0022	-0.0028	0.0003*	0.0139
	(3.311)	(0.078)	(0.408)	(-1.496)	(1.717)	(0.132)
Telecommunications	0.1111**	-0.1131	0.0126	0.0026	0.0003	-0.1643
	(2.019)	(-0.755)	(1.340)	(0.477)	(0.978)	(-0.821)

Source: Bloomberg

Table V illustrates how *intangibles* are associated with long-term debt measured by book values, thus, when *LTDA* is used as the dependent variable. Statistically significant results were obtained by *Health Care* and *Technology*, and the coefficients are indicating a positive association with *LTDA.* Furthermore, comparing these results with Table IV, it could be observed that the results for total debt (*TDA*) as the dependent variable generated more statistically significant results for more industries compared to long-term debt (*LTDA*). While evaluating the industries that were both statistically significant for total debt and long-term debt, that is *Health Care* and *Technology*, the coefficients were higher when total debt was considered. *Health Care* and *Technology* estimated coefficients of 0.096 and 0.094, respectively, when *TDA* was used. In contrast, the coefficients for *LTDA* were estimated to 0.064 and 0.07, respectively. This indicates that intangible assets have a relatively larger effect on total debt at least when book values are considered. In turn, this further raises the question

mentioned in the results from Equation 1, if intangible assets are influencing short-term debt as well.

Table V: Secondary regressions of intangible assets as predictor of leverage by industry

This table presents the result of Equation 2 from the section of methodology when LTDA is used as dependent variable. The independent variable of interest is intangible assets and is defined as intangible assets to total book value of assets. The results are estimated using the OLS regression with the fixed effect model and the time period is between 2000-2020. Before the regressions are run, all the variables are winsorized by the 5th percentile and the 95th percentile to avoid misleading outliers. * indicates significance at 10 % level, ** indicates significance at 5 % level and *** indicates significance at 1 % level. The t-statistics are presented in the parenthesis.

Long term debt to total assets						
Industry	Intangibles	ROA	Size	MB	Risk	Constant
Basic Materials	-0.0318	-0.0587	0.0212***	-0.0097***	0.0007***	-0.3335***
	(-0.884)	(-0.550)	(3.792)	(-2.850)	(3.791)	(-2.711)
Consumer Discretionary	-0.0162	-0.1886**	0.0467***	-0.0006	0.0007***	-0.8322***
	(-0.618)	(-2.424)	(10.206)	(-0.270)	(4.532)	(-8.595)
Consumer Staples	-0.0575	0.6926***	0.0148	-0.0047	-0.0002	-0.1224
	(-0.881)	(2.982)	(1.322)	(-0.774)	(-0.426)	(-0.520)
Energy	-0.0362	-0.1524	0.0261***	0.0102***	0.0003	-0.4505**
	(-0.676)	(-1.048)	(2.637)	(3.129)	(1.478)	(-2.269)
Health Care	0.0643***	-0.0240	0.0277***	0.0012	0.0002	-0.4961***
	(3.667)	(-0.427)	(7.167)	(0.912)	(1.541)	(-6.398)
Industrials	0.0411*	-0.0107	0.0243***	-0.0066***	0.0004***	-0.3816***
	(1.807)	(-0.176)	(7.167)	(-3.043)	(3.173)	(-5.305)
Uncategorized Industry	0.0193	-0.0181	0.0207***	-0.0027*	0.0002**	-0.2922***
	(1.138)	(-0.495)	(6.598)	(-1.756)	(2.128)	(-4.582)
Real Estate	-0.3163	0.1590	0.0245	-0.0255	-0.0006	-0.1657
	(-0.767)	(0.301)	(1.183)	(-1.378)	(-0.992)	(-0.348)
Technology	0.0704***	0.0277	-0.0006	-0.0021	0.0001	0.0495
	(3.330)	(0.483)	(-0.151)	(-1.498)	(0.926)	(0.632)
Telecommunications	0.0657	-0.1178	0.0134*	0.0030	-0.0000	-0.1958
	(1.533)	(-0.981)	(1.958)	(0.710)	(-0.124)	(-1.325)

Source: Bloomberg

Moreover, Table VI illustrates the results when total debt is measured by market values, thus, when *TDMV* has been used as the dependent variable. The industries which are statistically significant are *Consumer Discretionary, Health Care, Industrials* and *Technology*. The coefficients were estimated to 0.117, 0.114, 0.183 and 0.122, respectively, indicating intangible assets effect on total debt when measured by market values to be positive. In addition, significant results were also obtained for *Uncategorized Industry*. Compared to the regression with *TDA* as the dependent variable, *Health Care, Industrials* and *Technology* are statistically significant in both regressions. Another finding is illustrated by the relatively higher coefficients for *TDMV* than for *TDA*. This indicates that when market values are used for measuring leverage for total debt, intangible assets influence leverage to a larger extent. However, no significance can be attributed to the *Energy* industry, whilst *Consumer*

discretionary indicates a positive significant relationship to leverage compared to when *TDA* was used as dependent variable.

Table VI: Secondary regressions of intangible assets as predictor of by industry

This table presents the result of Equation 2 from the section of methodology when TDMV is used as dependent variable. The independent variable of interest is intangible assets and is defined as intangible assets to total book value of assets. The results are estimated using the OLS regression with the fixed effect model and the time period is between 2000-2020. Before the regressions are run, all the variables are winsorized by the 5th percentile and the 95th percentile to avoid misleading outliers. * indicates significance at 10 % level, ** indicates significance at 5 % level and *** indicates significance at 1 % level. The t-statistics are presented in the parenthesis.

Total debt to market value of assets						
Industry	Intangibles	ROA	Size	MB	Risk	Constant
Basic Materials	0.0327	-0.2054	0.0422***	-0.0204***	0.0016***	-0.7660***
	(0.806)	(-1.440)	(5.616)	(-4.185)	(6.121)	(-4.679)
Consumer Discretionary	0.1165***	-0.0743	0.0482***	-0.0108***	0.0014***	-0.8849***
	(4.771)	(-0.883)	(9.495)	(-4.255)	(8.002)	(-8.240)
Consumer Staples	0.0844*	0.2189	0.0192**	-0.0274***	0.0020***	-0.3191*
	(1.733)	(1.202)	(2.265)	(-5.394)	(5.633)	(-1.761)
Energy	-0.0249	0.0620	0.0243***	-0.0076**	0.0003	-0.3714**
	(-0.666)	(0.467)	(2.707)	(-2.295)	(1.362)	(-2.028)
Health Care	0.1142***	-0.0013	0.0291***	-0.0011	0.0003***	-0.5229***
	(7.255)	(-0.026)	(8.588)	(-0.976)	(2.637)	(-7.727)
Industrials	0.1826***	-0.2279***	0.0298***	-0.0216***	0.0006***	-0.4731***
	(8.815)	(-3.098)	(7.385)	(-7.547)	(4.586)	(-5.500)
Uncategorized Industry	0.0530***	-0.0615	0.0473***	-0.0130***	0.0010***	-0.8095***
	(2.947)	(-1.304)	(12.231)	(-6.240)	(9.511)	(-10.338)
Real Estate	-0.2176	-0.5965	0.0326*	-0.0499***	0.0005	-0.2913
	(-0.166)	(-1.177)	(1.646)	(-2.908)	(0.788)	(-0.634)
Technology	0.1224***	-0.0819	0.0110**	-0.0066***	0.0004**	-0.1722*
	(5.693)	(-1.142)	(2.289)	(-3.263)	(2.554)	(-1.802)
Telecommunications	0.0580	0.0175	0.0160**	-0.0115**	0.0008***	-0.2530
	(1.585)	(0.133)	(2.127)	(-2.159)	(3.089)	(-1.567)

Source: Bloomberg

Lastly, Table VII presents the results when long term debt measured by market values are used as the dependent variable. Statistically significant coefficients were estimated for *Health Care, Industrials* and *Technology,* and the coefficients are 0.091, 0.082 and 0.096, respectively. Similar to *LTDA*, the regression for *LTDMV* indicates that long-term debt measured by market values are influenced by intangible assets positively in the *Health Care, Industrials* and the *Technology* industry. In addition, the similar pattern could be traced to smaller coefficients for when long-term debt measured by market values are considered compared to total debt, and, at the same time, larger coefficients for market values of debt compared to book values of debt for the significant industries (*Health Care* and *Technology*).

Table VII: Secondary regressions of intangible assets as predictor of by industry

This table presents the result of Equation 2 from the section of methodology when LTDMV is used as dependent variable. The independent variable of interest is intangible assets and is defined as intangible assets to total book value of assets. The results are estimated using the OLS regression with the fixed effect model and the time period is between 2000-2020. Before the regressions are run, all the variables are winsorized by the 5th percentile and the 95th percentile to avoid misleading outliers. * indicates significance at 10 % level, ** indicates significance at 5 % level and *** indicates significance at 1 % level. The t-statistics are presented in the parenthesis.

Long term debt to market value of assets						
Industry	Intangibles	ROA	Size	MB	Risk	Constant
Basic Materials	0.0364	-0.0935	0.0294***	-0.0164***	0.0013***	-0.5312***
	(1.014)	(-0.731)	(4.560)	(-3.781)	(5.388)	(-3.759)
Consumer Discretionary	0.0284	-0.1034	0.0431***	-0.0082***	0.0011***	-0.7941***
	(1.293)	(-1.370)	(10.184)	(-3.741)	(6.777)	(-8.792)
Consumer Staples	0.0456	0.2188	0.0120*	-0.0209***	0.0006*	-0.1406
	(0.995)	(1.307)	(1.720)	(-4.308)	(1.684)	(-0.929)
Energy	0.0113	-0.0089	0.0090	-0.0030	0.0000	-0.1236
	(0.421)	(-0.093)	(1.394)	(-1.239)	(0.168)	(-0.937)
Health Care	0.0911***	-0.0151	0.0223***	-0.0002	0.0002*	-0.4062***
	(6.544)	(-0.363)	(8.015)	(-0.186)	(1.722)	(-7.248)
Industrials	0.0821***	-0.0958	0.0216***	-0.0158***	0.0003***	-0.3315***
	(4.372)	(-1.441)	(6.325)	(-6.108)	(2.828)	(-4.496)
Uncategorized Industry	0.0303**	-0.0263	0.0327***	-0.0090***	0.0005***	-0.5447***
	(2.055)	(-0.682)	(10.280)	(-5.268)	(6.418)	(-8.468)
Real Estate	-0.3248	-0.5200	0.0127	-0.0541***	-0.0002	0.1074
	(-0.239)	(-0.967)	(0.647)	(-3.094)	(-0.261)	(0.235)
Technology	0.0963***	-0.0213	0.0077**	-0.0031**	0.0002	-0.1285*
	(5.900)	(-0.397)	(2.195)	(-2.040)	(1.598)	(-1.831)
Telecommunications	0.0265	-0.0587	0.0125**	-0.0090**	0.0002	-0.1827
	(0.861)	(-0.527)	(2.325)	(-2.023)	(1.110)	(-1.526)

Source: Bloomberg

Encapsulating the results, a clear majority of the statistically significant industries are indicating a positive relationship to leverage. As discussed earlier, the trade-off theory is predicting a negative association between intangible assets and leverage while our results are showing the opposite. However, the only results obtained that are in line with the trade-off theory is the one generated from Table IV for the *Energy* industry, when *TDA* is used as the dependent variable. Furthermore, higher coefficients were found when leverage was measured by market values. This question the appropriateness of the proxies. Frank and Goyal (2009) found less reliable results when book values were used for measuring leverage and argued that a possible explanation for this could be traced to that book values are backward looking. Debt is granted based on the firm's ability to repay the debt in the future and, therefore, leverage measured by market values of assets could be seen as a more superior proxy. Moreover, the most robust results are extracted from the *Health Care* and the *Technology* industry since it is statistically significant, and the direction of the association is equal for all proxies of leverage.

We emphasize the results of these industries to the similar environmental characteristics the industries are operating in. These industries are operating in an innovative environment, where new technologies are emerging that requires firms to use patents to protect their competitiveness. The importance of collateral has been highlighted in many empirical studies before (Frank and Goyal, 2009; Rajan and Zingales, 1995; Titman and Wessels, 1988; Gaud et al, 2005). However, the ability to pledge assets to secure debt is by these studies associated with tangible assets and not intangible assets, suggested by our results. However, as argued by Mann (2018), patents are useful for firms when securing financing which in that sense support our results in these industries.

Based on our results from Tables IV-VII, we are able to, even though some of the coefficients are insignificant, observe that the importance of intangible assets can have a diverse effect on leverage, conditional to one specific proxy for leverage. The lion share of the significant coefficients is suggesting a positive association between intangible assets and leverage in the different industries, however, in the *Energy* industry the opposite could be observed from the results. This only applies for when *TDA* is used as the dependent variable, therefore, we would only be able to reject our second null hypothesis based on Table IV, however, when considering the total results this disparity between the associations is not completely evident. Despite the different magnitudes of the coefficients, it is doubtful that the results are able to represent any differences between industries with precision.

4.3 Robustness

Prior to attributing the estimated relationships to any concrete conclusions, it is also important to value the validity of the results. In order to strengthen the causality between leverage and intangible assets, we have introduced appropriate control variables to see if the influence of *intangibles* on leverage persist. The variables used for control were; *ROA, Size* and *Market-to-book-ratio* and *Risk* which are included in the regression results (see Tables III-VII). These variables were introduced one by one to see if the significance of the results remained or if there were any major changes in the coefficients. The allowance of the control variables did neither affect the significance of the results nor caused any major changes to the coefficients. Therefore, the relationship does not seem to be spurious based on the used control variables. This reduces some of the endogeneity concern that important to consider. However, the reader should bear in mind that additional forces may have an impact on leverage, and we have not evaluated whether leverage could have any predicting power to *intangibles* (thus, whether

simultaneous equation bias exists) and is, therefore, important to consider. Furthermore, if the assumptions behind the OLS regressions are not fulfilled then the inference may not be completely correct. This can partially be evaluated by checking the residuals for normality as well as heteroskedasticity. The former to determine if the error-term is normally distributed or not and the latter if the error-term has a constant variance or not. The residuals plotted in histograms can be seen from Figures VII-X for our variables of interest. From this graphical illustration, our sample indicates to have problems with residuals being normally distributed, and all the independent variables are skewed to the right. To further clarify this statement, the Jarque-Bera test for normality was performed and confirmed that the residuals are not normally distributed, and the test can be found in Appendix IV. The violation of the normality assumption should be considered when interpreting the results and could have affected the estimated coefficients. However, this could be argued to not be a severe problem, since our sample is rather large. (Brook, 2015)

Figure VII: Plotted residuals of TDA

The residuals of the main regression with Total-debt-to-assets ratio measured by book values of assets together with a drawn line of a normal distribution. The regressions are performed with winsorized variables by the 5th percentile and the 95th percentile.

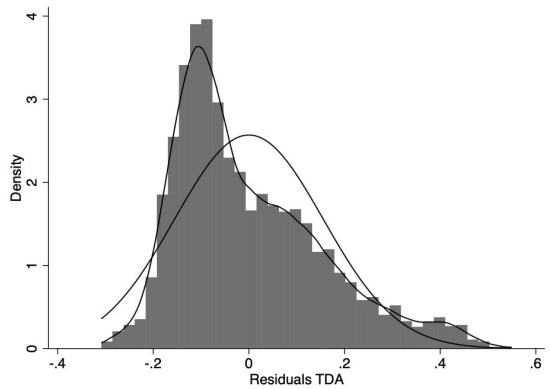


Figure VIII: Plotted residuals of LTDA

The residuals of the main regression with Long-term-debt-to-assets ratio measured by book values of assets together with a drawn line of a normal distribution. The regressions are performed with winsorized variables by the 5th percentile and the 95th percentile.

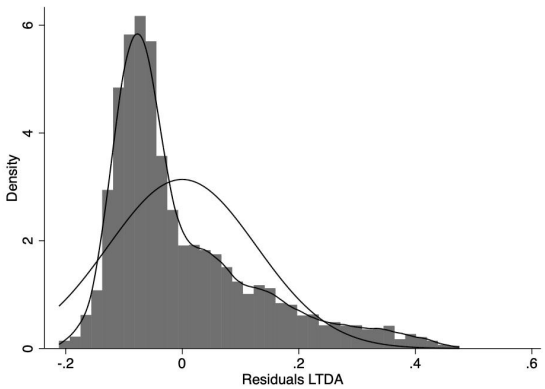


Figure IX: Plotted residuals of TDMV

The residuals of the main regression with Total-debt-to-assets ratio measured by market values of assets together with a drawn line of a normal distribution. The regressions are performed with winsorized variables by the 5th percentile and the 95th percentile.

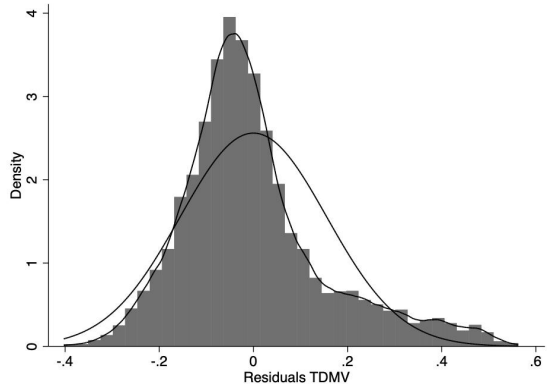
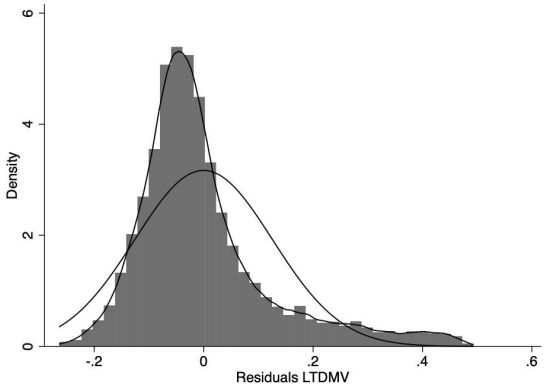


Figure X: Plotted residuals of LTDMV

The residuals of the main regression with Long-term-debt-to-assets ratio measured by market values of assets together with a drawn line of a normal distribution. The regressions are performed with winsorized variables by the 5th percentile and the 95th percentile.



The graphical visualization of the residuals of the dependent variables together with predicted values for the dependent variables are illustrated in Figures XI-XIV. It could be observed from the figures that our data violates the assumption of homoscedasticity. The implications of heteroscedasticity become evident in the standard errors which could be misleading and is also important to consider when interpreting the results. However, the coefficients estimated will still be unbiased and consistent, but they will not be the best linear unbiased estimate. (Brooks, 2015)

Figure XI: Scatter plot of residuals and linear predictions of TDA

This scatter plot is visualizing the residuals together with the linear predictions of TDA for the main regression model presented in Equation 1. Residuals are on the Y-axis and predictions are on the X-axis.

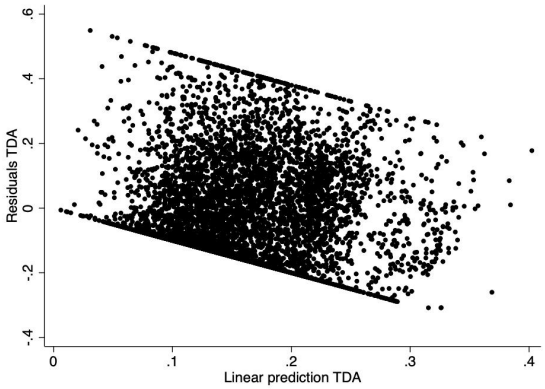


Figure XII: Scatter plot of residuals and linear predictions of LTDA

This scatter plot is visualizing the residuals together with the linear predictions of LTDA for the main regression model presented in Equation 1. Residuals are on the Y-axis and predictions are on the X-axis.

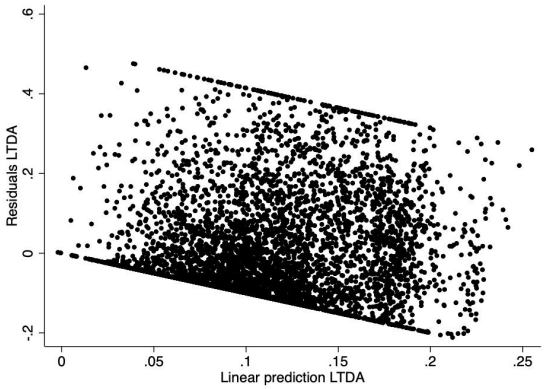


Figure XII: Scatter plot of residuals and linear predictions of TDMV

This scatter plot is visualizing the residuals together with the linear predictions of TDMV for the main regression model presented in Equation 1. Residuals are on the Y-axis and predictions are on the X-axis.

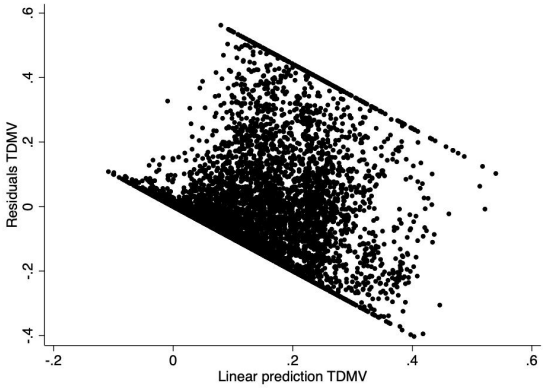
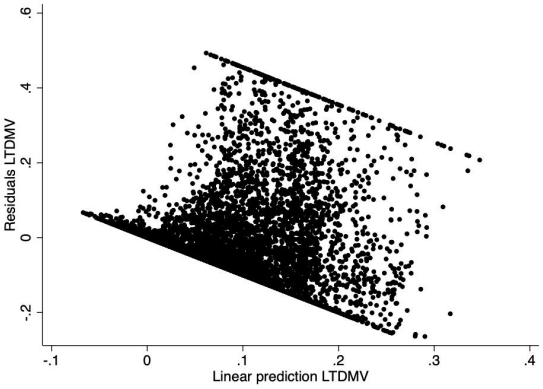


Figure XIII: Scatter plot of residuals and linear predictions of LTDMV

This scatter plot is visualizing the residuals together with the linear predictions of LTDMV for the main regression model presented in Equation 1. Residuals are on the Y-axis and predictions are on the X-axis.



5. Conclusions and further research

5.1 Conclusions

The field of research on capital structure is rather dense, however, how the importance intangible assets will affect this structure have yet to be fully explored, especially the importance of intangible assets. The Swedish market is fairly unexplored in this aspect, why this area becomes important to investigate. In an effort to contribute to this gap, this thesis examines the importance of intangible assets when considering the capital structure among Swedish firms. It is our belief that intangible assets will only continue to grow in importance and utilizing them when determining firm's capital structure will be of key importance. Our first hypothesis regarding if intangible assets do in fact not support the issuance of debt on the Swedish credit market was possible to reject and we do conclude that intangible assets have a positive relationship with leverage. These results are rather contradicting to the traditional capital structure theories, especially the trade-off theory. However, we argue that due to the complex nature of capital markets of today and the emergence of the knowledge-based economy, traditional theories might not be completely suited to explain assets that in many ways did not exist when the theories were composed. The reasoning between why intangible assets increase the amount of leverage available for firms can be argued to be twofold; Firstly, in accordance with both Loumioti (2012) and Lim et. al (2020), the innovation of pledging intangible assets as collateral is something we argue will function as a driver of debt. Secondly, we as well as Larkin (2013) argue that intangible assets will have an incumbent value in the view of creditors as these assets in many cases are of great value for the operations of the firm and hence creates enhanced conditions by, for example, decreasing volatility of cash flows. Moreover, since we have found a stronger relationship between total debt compared to long-term debt, we suspect that intangible assets could influence short-term debt as well. In addition, another interesting finding is the stronger relationship for intangible assets and leverage when market values are considered.

In our second hypothesis, where differences in industries are the focal point, we find our results to be rather inconclusive and not providing us with a clear distinction to whether or not intangible assets foster issuance of debt differently across industries. Only one of our four different models, TDA, generated statistically significant differences between industries and, therefore, we are unable to reject the second hypothesis, even if we can observe tendencies in

some industries in which intangible assets are believed to affect the capital structure decisions more greatly than in others. Finally, the most robust results were generated for the *Technology* and *Health Care* industries, two of the industries with the largest proportion of intangible assets are found to be statistically significant and have a positive relation with leverage.

5.2 Future Research

There is still room for exploring the importance of intangible assets as a determinant of debt. First, it could be interesting to further examine different components of intangible assets and collect a more comprehensive set of data of specific intangible assets. This would be interesting to investigate, since different intangible assets may support different components of debt in various ways and has been evident from our results. Given the inherent nature of different intangible assets, some of them may be more or less suited to be pledged as collateral given their level of redeployability. Second, the Swedish market is rather specific and differs much from the US market, which is fairly explored. It could, in that sense, be valuable to examine other Scandinavian countries to see if differences could be observed. Third, it would be interesting to also investigate whether a difference in cost of capital can be observed when debt is backed by firms with mainly tangible versus intangible assets.

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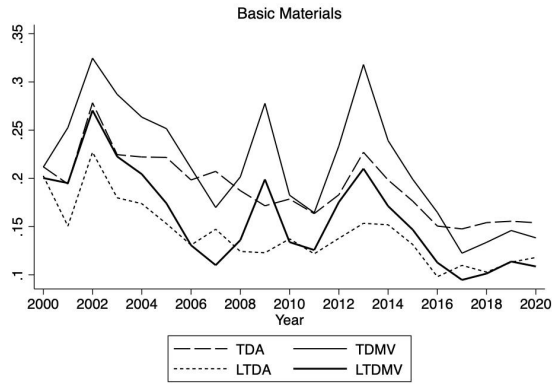
Appendix

Appendix I

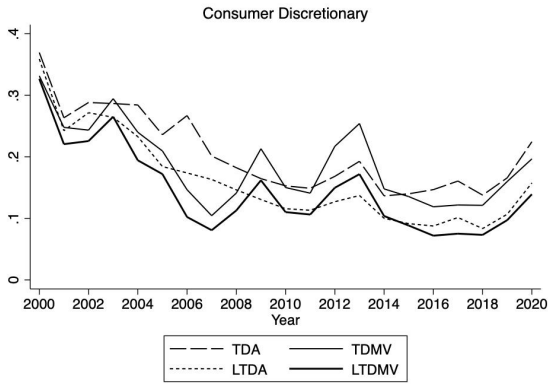
Control variable	Definition
Return on Assets (ROA)	EBITDA/Total Assets
Size	The natural logarithm of Total Assets
Market to Book Value (MB)	Market Value of Equity/Total Assets
Risk	Volatility the last 250 trading days

Appendix II

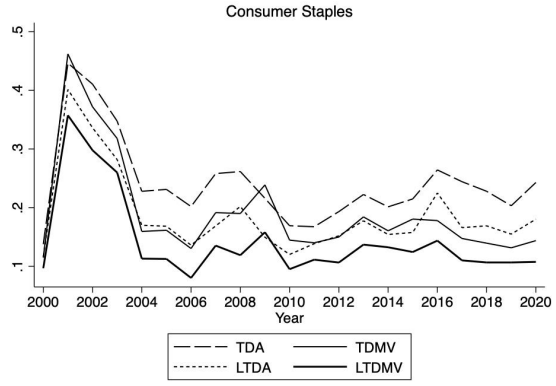
The graph is illustrating the average leverage for each proxy between 2000-2020 in the Basic Materials industry. The average is calculated post winsorizing the sample by the 5th percentile and the 95th percentile.



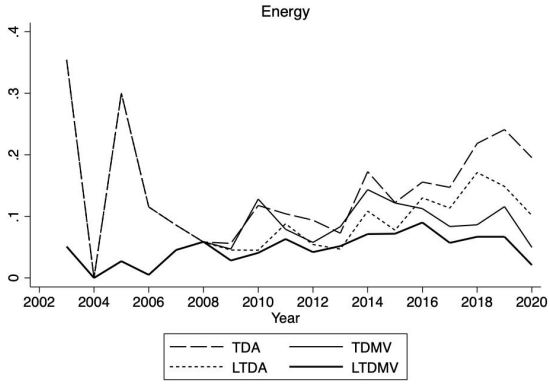
The graph is illustrating the average leverage for each proxy between 2000-2020 in the Consumer Discretionary industry. The average is calculated post winsorizing the sample by the 5th percentile and the 95th percentile.



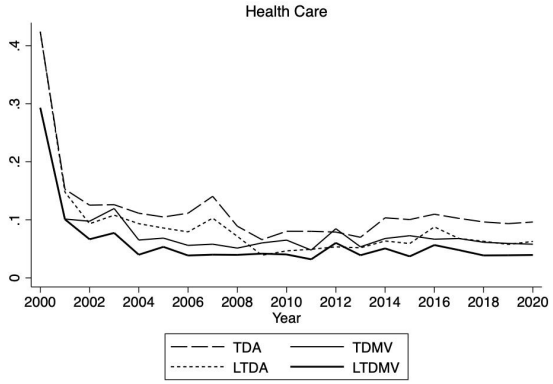
The graph is illustrating the average leverage for each proxy between 2000-2020 in the Consumer Staples industry. The average is calculated post winsorizing the sample by the 5th percentile and the 95th percentile.



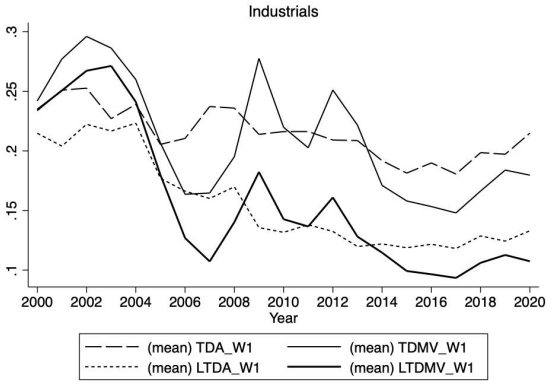
The graph is illustrating the average leverage for each proxy between 2000-2020 in the Energy industry. The average is calculated post winsorizing the sample by the 5th percentile and the 95th percentile.



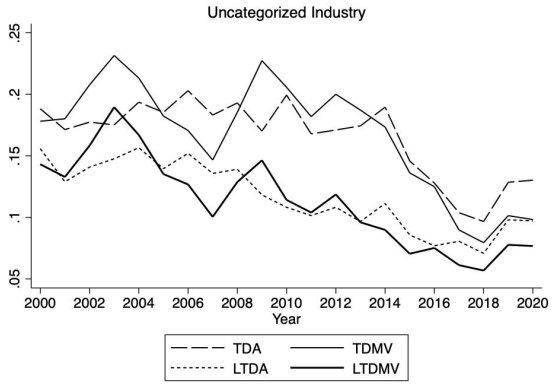
The graph is illustrating the average leverage for each proxy between 2000-2020 in the Health Care industry. The average is calculated post winsorizing the sample by the 5th percentile and the 95th percentile.



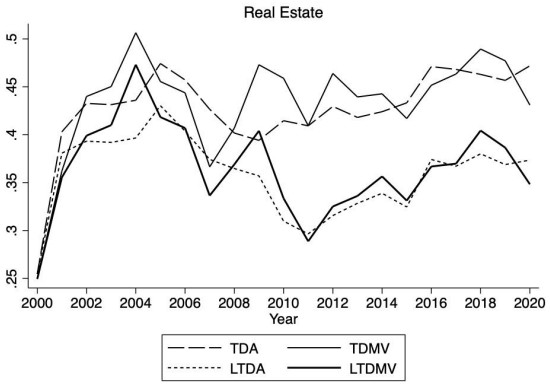
The graph is illustrating the average leverage for each proxy between 2000-2020 in the Industrials industry. The average is calculated post winsorizing the sample by the 5th percentile and the 95th percentile.



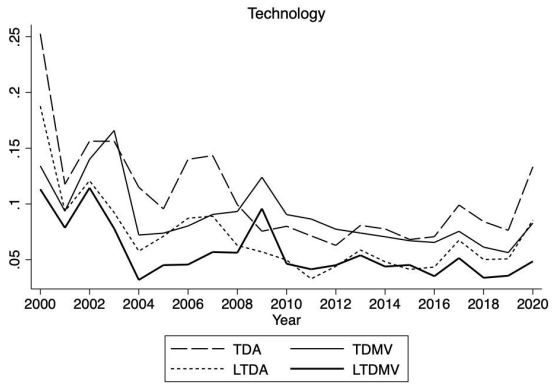
The graph is illustrating the average leverage for each proxy between 2000-2020 in the Uncategorized industry. The average is calculated post winsorizing the sample by the 5th percentile and the 95th percentile.



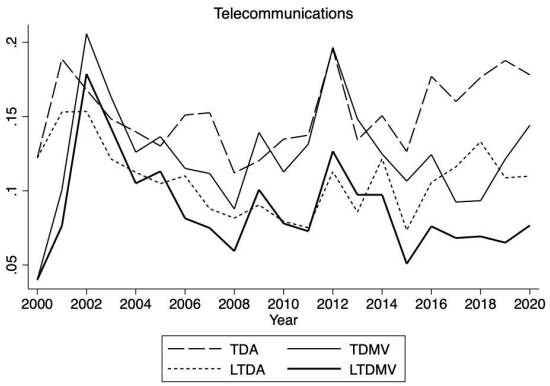
The graph is illustrating the average leverage for each proxy between 2000-2020 in the Real Estate industry. The average is calculated post winsorizing the sample by the 5th percentile and the 95th percentile.



The graph is illustrating the average leverage for each proxy between 2000-2020 in the Technology industry. The average is calculated post winsorizing the sample by the 5th percentile and the 95th percentile.

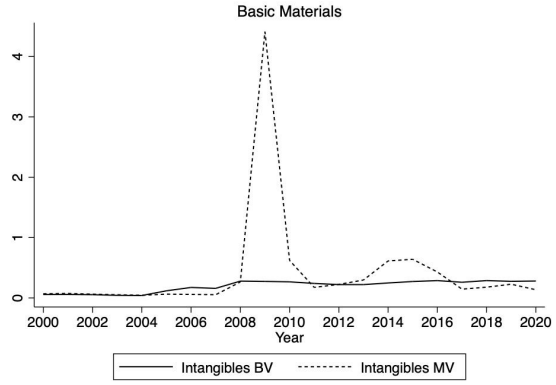


The graph is illustrating the average leverage for each proxy between 2000-2020 in the Telecommunication industry. The average is calculated post winsorizing the sample by the 5th percentile and the 95th percentile.

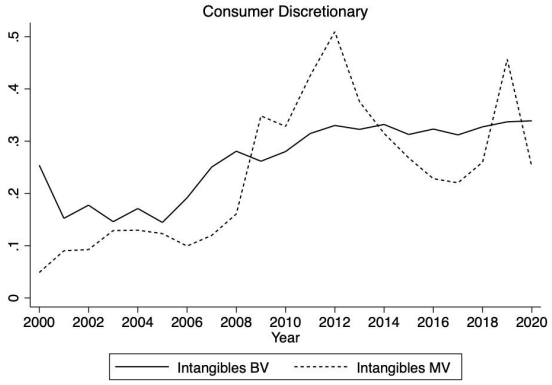


Appendix III

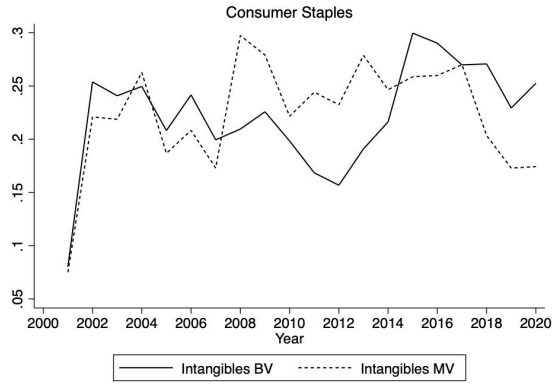
The graph is illustrating the average intangible assets ratio measured both by book values and market values between 2000-2020 in the Basic Materials industry. The average is calculated post winsorizing the sample by the 5th percentile and the 95th percentile.



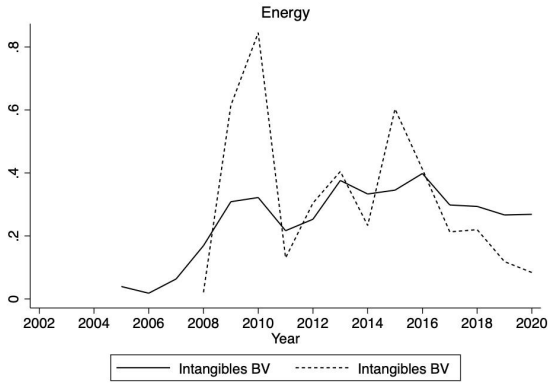
The graph is illustrating the average intangible assets ratio measured both by book values and market values between 2000-2020 in the Consumer Discretionary industry. The average is calculated post winsorizing the sample by the 5th percentile and the 95th percentile.



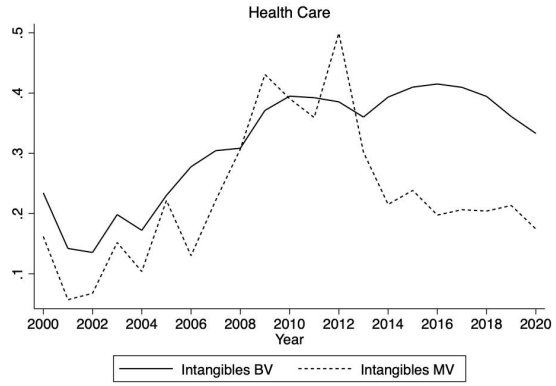
The graph is illustrating the average intangible assets ratio measured both by book values and market values between 2000-2020 in the Consumer Staples industry. The average is calculated post winsorizing the sample by the 5th percentile and the 95th percentile.



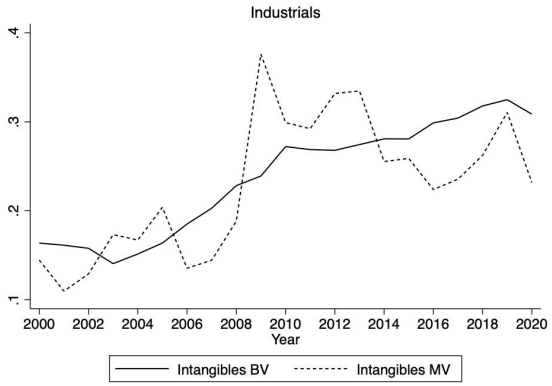
The graph is illustrating the average intangible assets ratio measured both by book values and market values between 2000-2020 in the Energy industry. The average is calculated post winsorizing the sample by the 5th percentile and the 95th percentile.



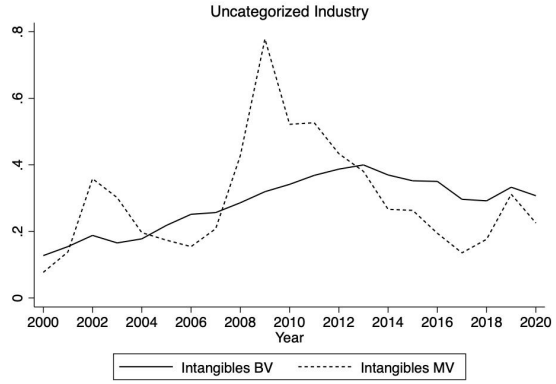
The graph is illustrating the average intangible assets ratio measured both by book values and market values between 2000-2020 in the Health Care industry. The average is calculated post winsorizing the sample by the 5th percentile and the 95th percentile.



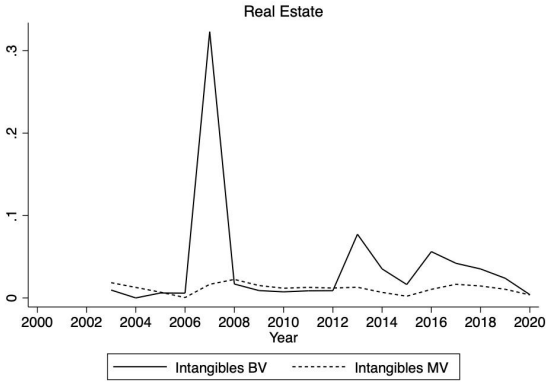
The graph is illustrating the average intangible assets ratio measured both by book values and market values between 2000-2020 in the Industrials industry. The average is calculated post winsorizing the sample by the 5th percentile and the 95th percentile.



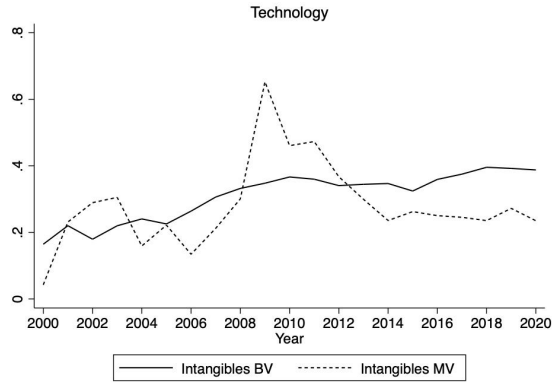
The graph is illustrating the average intangible assets ratio measured both by book values and market values between 2000-2020 in the Uncategorized industry. The average is calculated post winsorizing the sample by the 5th percentile and the 95th percentile.



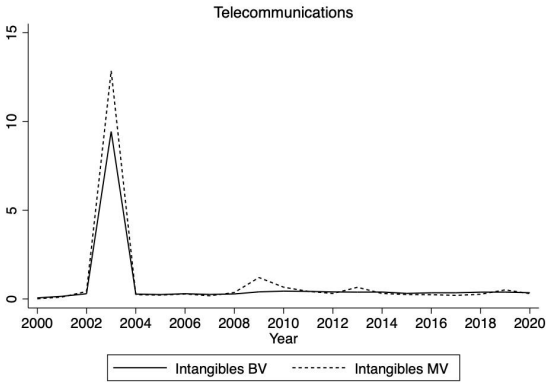
The graph is illustrating the average intangible assets ratio measured both by book values and market values between 2000-2020 in the Real Estate industry. The average is calculated post winsorizing the sample by the 5th percentile and the 95th percentile.



The graph is illustrating the average intangible assets ratio measured both by book values and market values between 2000-2020 in the Technology industry. The average is calculated post winsorizing the sample by the 5th percentile and the 95th percentile.



The graph is illustrating the average intangible assets ratio measured both by book values and market values between 2000-2020 in the Telecommunication industry. The average is calculated post winsorizing the sample by the 5th percentile and the 95th percentile.



Appendix IV

Jarque-Bera normality test		
	Chi-Square	P-value
TDA residuals	949	0.000
TDMV residuals	2151	0.000
LTDA residuals	2212	0.000
LTDMV residuals	4522	0.000