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R&D Intensity and Intangible Assets Effect on Capital Structure

An Empirical Analysis of the IT Services Industry

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Abstract

In the 21st century, firms aim to meet consumer preferences in an absurdly rapid manner with new technological products and solutions. Innovation from R&D investments has become increasingly important to meeting this demand. Furthermore, as more firms become technology-minded, intangible assets constitute growing parts of their total assets. In this thesis, we analyse the effect of these increasingly important factors (i.e., R&D intensity and intangible assets) on capital structure for the IT services industry.

In addition to analysing intangible assets and the R&D intensity effect, we also investigate the impact of macroeconomic factors on capital structure. We include commonly known determinants of capital structure as control variables in a panel data regression to a sample of 808 globally listed IT services firms. Country-specific R&D tax subsidy rates work as a natural experiment, and we utilize this in a two-stage least squares (2SLS) estimation to establish a causal relationship between R&D intensity and debt and equity issuance. The results are analysed in light of theories and empirical studies related to capital structure.

Our findings suggest that IT services firms tend to have lower leverage ratios than other industrial companies from G7 countries, and that the standard determinants of capital structure have the same effect on leverage that previous studies have indicated. By including macroeconomic factors, we observe a countercyclical debt ratio among IT services firms. Regarding intangible assets, we find a positive relationship to leverage ratio, debt and equity. This relationship implies that creditors view such assets as collateral, thus supporting a higher leverage ratio. We document that firms with high R&D intensity tend to issue more equity and less debt, thereby lowering their overall leverage ratio. However, the results are not robust for firm-fixed effects, and we cannot fully conclude that R&D intensity and intangible assets effect debt or if they are part of determining the capital structure of listed IT services firms.

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This thesis is written as a part of the five-year master's degree at the Norwegian School of Economics (NHH) and comprises 30 credits of our major in Financial Economics. The process has been both compelling and challenging, where data collection and compilation has been the most time-consuming. Through our study, we have gained valuable insight into the capital structure of the IT services industry.

We find the capital structure for IT services firms to be complex. With little tangible assets to be used as collateral, and with risky R&D investments, acquiring funds from external sources can be challenging. With our study, we aim to broaden the understanding of how such firms finance themselves and their projects.

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Table of Contents

1. Introduction

Intangible assets are a significant and growing part of a firm's total assets. Research has established that tangible assets are one of the main determinants of leverage, as they can be used as collateral. Compared to tangible assets, the literature regarding the effect of intangible assets is more limited. It is not clear what companies with a substantial proportion of intangible assets to tangible assets have to bargain with when obtaining loans. There is no doubt about the importance of innovation on economic growth, but the fact that most Western countries subsidize research and development (R&D) investments substantiates the idea that firms do not invest enough in R&D and innovation. We will investigate whether firms with higher R&D expenditures obtain less external funding, which might reduce the possibility to pursue innovative investments. Thus, we will analyse determinants for leverage and focus on the relationships between leverage, intangible assets and R&D intensity.

We analyse this relationship using a sample of 808 firms from the information technology (IT) services industry from 2006 to 2018. Sorting industries after leverage, the IT services industry is in the low-end. On the other hand, companies which operate in the IT services industry are ranked high with respect to R&D expenses and intangible assets. This makes the IT services industry an ideal industry to analyse if we are to develop a greater understanding of the aforementioned relationships. Using comprehensive statistical analyses with data sourced from global databases, we will discuss connections between company-specific and macroeconomic factors on capital structure.

The IT industry has seen substantial change since the 1960s and 70s, when it was limited to the banking sector, mathematical engineers and computer scientists. Now IT is the backbone of most modern companies, and if the IT system is not up to date, the organization's efficiency is weakened. The industry and the competition have grown massively over the last three decades. In an environment with tight margins, choosing the correct capital structure could be crucial to success. IT services depend on making investments in R&D to capture market share (Harvin et al., 2014). These investments could be made by acquiring debt, but having too much debt can reduce a company's flexibility to make value-creating investments, thereby lowering future profit.

Financing is the process of providing funds for business activities, investing and making purchases by acquiring capital from different sources. The irrelevance theorem of Modigliani and Miller (1958) states that, in a tax-free world, the choice between debt and equity does not matter. In the real world, however, it is more complex, and there is an incentive to optimize the capital structure to maximize the value of a company, because of imperfections in the market.

Innovation from R&D investments has become increasingly important to meet what seems like a never-ending demand for new technological products and services. Furthermore, as more firms become technology-minded, intangible assets constitute growing parts of their total assets. In this thesis, we aim to explain what effect R&D intensity and intangible assets have on leverage. To do this, we have developed the following research question:

Can R&D intensity and intangible assets help explain capital structure for IT services firms?

The main focus of this study is to answer the question mentioned above and thereby understand the choices regarding capital structure and the factors that determine them. In a broad sense, we contribute to research by linking R&D intensity and intangible assets to capital structure choices. As R&D expenditures and intangible assets are factors with increased importance for firms in modern times, and, by analysing these factors in our thesis, we add new insight into their effect regarding capital structure. To analyse the effect of intangible assets and R&D intensity on capital structure, we adopt a panel data regression, including known determinants of capital structure as control variables, as well as macroeconomic factors. The effect is firstly measured on leverage ratio before we implement a two-stage least squares (2SLS) estimation by introducing an instrumental variable for R&D intensity, to establish a causal effect on changes in debt and equity.

The results show that IT services follow other industries regarding the effect of the standard determinants on leverage. Furthermore, we observe a countercyclical debt ratio among IT services firms, with increased leverage during rescissions. We find a positive relationship from intangible assets on leverage, indicating that creditors accept such assets as collateral. Firms with high R&D intensity issue more equity and less debt, which lowers their overall leverage ratio. However, we find that most of the variation in leverage is captured by an unobserved time-invariant component, which reduces the significance of the abovementioned effects.

We begin by presenting the characteristics of the IT services industry and how the industry finances their investments. We do so to give the reader the necessary foundation about the industry before the analysis. Thereafter, we present relevant theory about capital structure. The theory helps in the creation of variables and hypothesis development. Next, we present our data and method with assumptions for the regressions, where we specify the collection and treatment of the data. We analyse the data and the results with regards to theory and previous empirical research. After the analysis, we summarize, conclude and answer the research question. Lastly, we highlight weaknesses for the thesis as well as suggestions for further research. We add useful attachments and information that was not included in the text in the appendix.

2. IT Services Industry Characteristics and Financing

IT services refers to the application of business and technical expertise to enable organizations in the creation, management, and optimization of or access to information and business processes (Gartner, 2019). The global IT services market size is proliferating and expected to reach USD 1.07 trillion by 2025, with a CAGR[1] of 8.4% (Grandviewresearch, 2019). The global market share for IT services is largest in North America, Europe, and Asia Pacific.

The growth of the IT services industry has been extraordinarily in the Asia Pacific region, where labour unit costs have been substantially lower than other regions. Harvin et al. (2014) states that the annual base salary of a senior Indian professional is estimated to be eight times lower than in the United Kingdom or France, nine times lower than in the United States, and as much as ten times lower than in Germany. In the United States (US), the tech industry employs more people than many of the biggest industries, including construction, finance, insurance, and vehicle equipment manufacturing. The IT services industry has shown substantial growth in employment and accounted for more than two million jobs in the US in 2015 (Forrest, 2016). As the market grows, so does the competition. In a report published by Harvin et al. (2014), they claim that IT services companies can no longer rely on their usual tactics to retain market share. Being at the forefront with big data, social media, internet of things[2], increased mobility, and cost reduction will be crucial factors to retain market share.

[1] Compound annual growth rate.
[2] Internet of things is ICT systems where a large number of physical entities communicate with each other and with the internet.

In a report published by the Organization for Economic Cooperation and Development (OECD) (2019), programming and information (IT services) are listed second by sectors on intangible intensity[3], only behind the pharmaceutical industry. IT services companies tend to have high intangible intensity because they possess a substantial amount of computer software and patents, among other intangible assets. Consequently, the industry has a relatively low tangible intensity[4]. Having a low amount of tangible assets can make the process of applying for loans difficult, since these assets are commonly used as collateral.

Technology companies are known to hold much cash, and the tech sector holds more than 50% of total corporate cash reserves in the U. S (Richardson, 2019). Having a low level of debt and much cash on hand gives flexibility in a quickly changing market, where sudden investments needs to be done. Furthermore, having high levels of cash makes it affordable to increase debt levels to spend on capital expenditures or R&D.

The IT services industry tends to invest in projects with severe levels of uncertainty (Canarella & Miller, 2019). Thus, insiders of an IT services firm know more about the possibility of the firm's success than outsiders. R&D projects can for instance involve trade secrets and/ or special solutions that only the company possess as their competitive advantage. Thus, the managers minimize the amount of information shared publicly. It is indicating that the industry, therefore, may face substantial financial constraints, which results in problems with adverse selection in IT services debt markets (Canarella & Miller, 2019). IT services firms require large amounts of capital to fund R&D activity. However, the firms may have trouble accessing the debt markets because their investments, in general, are associated with high risk, and their investments cannot serve as adequate collateral. As mentioned, the industry has become especially important for growth in the economy, providing innovation and supplying numerous jobs, but acquiring funding for IT service firms remains troublesome.

3. Literature review and hypothesis development

In the following chapter, we present the evolution of capital structure theories and elaborate on agency cost and asymmetric information. Thereafter, we present determinants of capital

[3] Intangible assets to total assets.
[4] Tangible assets to total assets.

structure, based on previous empirical research, and introduce macroeconomic factors. Lastly, we develop our hypothesis regarding the effect of intangible assets and R&D intensity on capital structure.

3.1 Literature Review

The first to spark interest in the study of capital structure choices were Modigliani and Miller (1958). With simplified assumptions about real-life market conditions, they proved that a firm's value is independent of its capital structure. Some years later, in 1963, they relaxed their assumptions of a tax-free world and argued that with tax-deductibility of interest payments, the value of a firm would increase with increased debt. However, with their logic, the question of why not all firms were fully leveraged arose. A reconciliation between the assumptions of Modigliani and Miller and observed firm behaviour was reached with the research of Baxter (1967) and his explanation of bankruptcy cost creating an optimal capital structure. Financial distress costs are one such example. If a firm fails to meet its debt obligations, it does not merely liquidate its assets for its creditors. According to Warner (1977), and Andrade and Kaplan (1998), a firm going through bankruptcy can cause the firm to lose somewhere between 1% and 20% of its value. The size of the loss will depend on the types of assets the firm possesses (Long & Malitz, 1985).

The next piece of the puzzle then became to determine the exact optimal structure. Kraus and Litzenberger's (1973) trade-off theory found that weighing the benefit and cost of debt, a firm can choose a capital structure that maximizes its enterprise value. The benefit of the debt stems from tax deductibility, which is generated from interest expense, while the cost arises from the increased probability of default. The marginal benefit of increased leverage will be diminishing when the leverage ratio increases, in the same way, the marginal cost will be increasing. A company will, therefore, have to make a trade-off when choosing how much debt it will take on. The optimal level of debt, according to the theory, will be where the marginal benefit of debt equals the marginal cost.

Myers and Majluf (1984)[5] developed a model which did not try to explain an optimal capital structure, but rather how firms follow a certain preference in their choice of financing. They

[5] Donaldson (1961) was the first to introduce the pecking order theory, in a survey study among American firm

conclude that there are fewer costs and risks associated with financing through internally generated funds than externally as a consequence of asymmetrical information. A company's board has a higher degree of information compared to external investors regarding the prospects of the firm. This can create uncertainty, which is reflected in the higher return demanded by external investors — the more uncertainty, the higher the return demanded. If internally generated funds are not sufficient to cover the firm's need for finance, the firm will prefer to issue the least risky security (debt) and issue the most risky security (equity) only as a last resort.

In comparison with the pecking order theory, which provides a clear prioritization of how firms choose their capital structure, the market timing theory is more dynamic in its reasoning. The theory states that firms prefer external equity when the cost of equity is low and prefer debt otherwise (Baker & Wurgler, 2002). It is the managers' view on the relative cost of equity that works as the deciding factor. When the managers view the stock prices as overvalued, they will, according to the market timing theory, issue equity. When they view the shares as undervalued, they will repurchase equity. However, a manager's view is subject to biases. According to investment banks, the most crucial factor to advise their clients on whether to finance between debt or equity is whether their clients' share prices are at a 52-week high (Ater, 2017). Even though extensively researched, an optimal level of debt or universal theory has not yet been claimed, and according to Myers (2001), there is no reason to expect one either. In the next sections, we present agency costs and asymmetric information theories which in addition to the theories discussed above, helps explain choices of capital structure.

3.1.1 Agency Costs

The common textbook example regarding agency costs is the principal-agent problem. The problem occurs when an entity called the agent, can make decisions on behalf of another entity called the principal. The dilemma exists when agents acts in a way which are contrary to the best interests of the principal. One example of agency costs that can arise when there are conflicts of interest between stakeholders, is between equity holders and debt holders. Management may own shares in the company, and they may have incentives to increase the value of equity, despite what is desirable from creditors, who wants the firm to conduct safe investments which generates interest payments. When the risk of financial distress is high, such a conflict is most likely to occur. Agency costs is therefore an additional cost when increasing the debt levels of a company, which will affect the optimal capital structure (Berk & DeMarzo, 2017). IT services firms have very specialized physical and human capital, which is associated with increased financial distress (Berk & DeMarzo, 2014), thus conflicts between stakeholders is likely to be more prominent than in most other industries.

There are also agency costs associated with debt overhang. The phenomena occur when a company has a debt burden so substantial that it cannot take on additional debt to finance future projects. In some cases, the debt burden can be so enormous that the company may have to drop positive-NPV[6] projects even when they are risk-free. There is debt overhang when shareholders choose not to invest in positive-NPV projects as the earnings from these projects only would go to debt holders.

Asset substitution problem is one type of agency costs. The problem occurs when a firm's management deceives debt issuers by replacing safe assets (or projects) with risky assets (or projects) after a credit analysis has been carried out. For example, an IT services firm could sell a project as a low risk to creditors to get favourable debt rates. Then, after receiving the loan fund, the firm uses the funds for risky endeavours, and as such, transferring the unforeseen risk to creditors[7]. If the project is a success, it primarily benefits the equity holders, since the creditors will receive their fixed return based on the low-risk rate. In case the project is a failure, the creditors are the ones to take a loss. This gives a wealth transfer from existing debtholders to shareholders (Bah & Dumontier, 2001).

Naturally, the creditors are aware of the problems related to agency costs, and to protect themselves from it, they either required a premium, issue credit with short maturity or use debt covenants. A longer debt maturity gives equity holders more opportunities to profit at the expense of debt holders. Thus, agency costs are smallest for short term debt (Berk & DeMarzo, 2014). Debt covenants are restrictions on the actions the firm can take. Covenants may limit the company's ability to pay dividends or restrict some types of investments that the company can take.

[6] Net present value.
[7] Also known as moral hazard.

3.1.2 Asymmetric Information

George Akerlof (1970) is one of the most important contributors to the problem of asymmetric information. He presented the "the lemon's problem", which occurs if a buyer cannot observe the fair value of a good, and as a result is only willing to pay the average expected price. Therefore, only low-quality goods will be sold; this is referred to as adverse selection.

Asymmetric information is also relevant when analysing capital structure. Asymmetric information often arises between managers and investors. Managers possess information about their own company, e.g., future strategic and financial prospects, that external investors and creditors cannot access. Especially for innovative firms, such as IT services firms, asymmetric information tends to be higher (Bah & Dumontier, 2001). For these firms, the value of their projects depends on confidentiality. Due to rivalry, innovative firms hesitate to share characteristics of the projects that could make them attractive to external investors/creditors, in fear of disclosing vital innovation-related knowledge. Since the information asymmetry remains high in fear of transferring technological knowledge to competitors, innovative firms are discouraged to issue new shares. These firm are, as a result, expected to prefer internal financing (Bah & Dumontier, 2001).

Issuing new shares when management know they are undervalued is costly for the original shareholders (Berk & DeMarzo, 2017). Thus, managers who perceive the firm's equity to be undervalued will prefer to fund new investments using debt or retained earnings. Consequently, when a firm issues equity, it signals to the investors that its equity might be overvalued. The outside investors are therefore not willing to pay the pre-announced price, leading to a fall in stock prices. According to Berk and DeMarzo (2017), several studies have confirmed this result, finding a 3% drop in stock price on average for US firms on the announcement of an equity issue. It is clear from empirical studies that relatively more equity is issued in capital markets where asymmetric information is prominent (Berk & DeMarzo, 2017).

Asymmetric information plays a vital role regarding signalling. This can create a problem for companies with a high degree of asymmetric information between insiders and outsiders. If these firms where to sell equity to outside investors, the firm's owners may signal that the future is not as promising as expected, otherwise they would have chosen debt to retain their percentage claim of the firms' revenue. Thus, signalling leads to new shares being undervalued and a preference for debt financing (Berk & DeMarzo, 2017).

3.2 Determinants of Capital Structure

3.2.1 Standard Factors

Tangible assets

Tangible assets are physical assets that can be transacted for some monetary value though the liquidity of different markets will vary. It is easier for outsiders to value tangible assets than intangible assets - which lowers expected distress costs. Tangible assets are simple to collateralize, and thus they reduce the agency costs of debt. Creditors should therefore be more willing to lend to companies with a high proportion of tangible assets, and better loan terms will be provided (Rajan & Zingales, 1995). The lower degree of asymmetric information due to the simplicity of valuing the assets for outsiders, gives a positive relationship between tangible assets and leverage ratio according to the trade-off theory (Kraus & Litzenberger, 1973). Most studies find that higher tangibility indicates a lower risk for the lenders as well as reduced direct costs of bankruptcy. As a result, firms with higher tangibility exhibits higher leverage ratios.

Size

According to Frank and Goyal (2009), larger firms as measured by book assets are more diverse and will have lower default risk. According to the trade-off theory, a positive relationship between size and leverage is thus expected. In addition to Frank and Goyal (2009), Antoniou et al. (2008), and Sheikh and Wang (2011) also find the same positive relationship between firm size and leverage.

On the other side, size may also be a proxy for the information outside investors have, which according to the pecking order theory, should increase the firm's preference for equity relative to debt (Rajan & Zingales, 1995). Larger companies have more information available to external parties than smaller companies. Thus, larger companies will have lower asymmetric information associated with SEO[8], and it will reduce the likelihood of mispricing of stocks.

[8] Secondary equity offering.

Titman and Wessels (1988), Hall et al. (2004) and Chakraborty (2010) find a negative relationship between size and leverage. However, the general understanding is in line with the trade-off theory, where larger firms tend to have more debt, and we believe that IT services firms will be affected in the same way.

Profitability

Profitable companies have lower expected costs related to financial distress and find interest tax shields more valuable. Furthermore, positive cash flows increase a company's ability to meet its debt obligations (Frank & Goyal, 2009). As a result, the trade-off theory predicts a positive relationship between profitability and leverage. Al-Ajmi et al. (2009) and Kaur and Rao (2009) find this relationship in their studies.

It is the pecking order theory that has the most support from empirical studies regarding profitability. As previously mentioned, the pecking order theory states that firms prefer internal funds over external funds and profitable firms will use their retained earnings when in need of funds, thus becoming less levered over time (Frank & Goyal, 2009).

Market-to-book ratio

Market-to-book ratio is the most widely used proxy for growth opportunities. From the pecking order theory, the relationship between growth opportunities and leverage is positive. High growth firms have a greater need for funds, and as a result, are expected to borrow more (Frank & Goyal, 2009).

The trade-off theory predicts that growth opportunities reduces leverage as firms with high market-to-book ratios have higher costs of financial distress (Frank & Goyal, 2009). Another reason for the market-to-book ratio to have a negative relationship with leverage stems from the market timing theory. Rajan and Zingales (1995) find that firms tend to issue stock when their stock price is high relative to earnings or book value, and firms with high growth opportunities will prefer to issue equity over acquiring new debt.

The agency costs related to debt overhang is highest for firms that have high future growth opportunities and require significant investments (Berk & DeMarzo, 2017). Empirical research by Kaur and Rao (2009) and Nunkoo and Boateng (2010) find a negative relationship between growth opportunities and leverage.

Dividend payout

The trade-off theory predicts that firms paying dividends should hold more debt if they are viewed as less risky (Frank & Goyal, 2005). This positive relationship between dividend payout and leverage has, however, little support from empirical studies, and Frank and Goyal (2009) find a negative effect between the factors in a later study.

The pecking order theory also have ambiguous results in what way dividend payout affects capital structure. Given that debt is preferable over equity, the financing hierarchy predicts a positive relationship. However, paying dividends indicates that a firm is subject to market surveillance and will have lower degree of asymmetric information. This leads to an inverse relationship between dividend payout and leverage, as there instead are more frequent equity issuances (Drobetz et al., 2013). The empirical study by Frank and Goyal (2009) shows that companies paying dividends tend to have lower leverage ratios, thus supporting a negative relationship between dividend payout and leverage.

3.2.2 Macroeconomic Factors

Stock market return (MSCI)

An increasing return in the stock market implies a higher probability of an overvaluation of the stock price, which creates an incentive for the firm to issue equity as it has become relatively cheap. The market timing theory, therefore, implies a negative relationship between stock prices and leverage (Baker & Wurgler, 2002). This is accordance with Stulz (1996), and her research on risk management. The pecking order theory also predicts a negative relationship. Increasing stock performance can be associated with a higher stable cash flow, which in turn will lead to increased retained earnings. Higher free cash flow implies a reduced need for external capital and lower leverage. The trade-off theory stands opposite to this with its focus on agency costs. A greater return with corresponding higher cash flow will give equity holders an incentive to increase the debt as leverage reduces management control over the cash flow (Jensen, 1986). Increased stock prices will lead to a lower market-value-based leverage ratio. If the firm follows a target level leverage ratio, it will have to take on debt to maintain it (Frank & Goyal, 2009).

Inflation

The literature regarding the effect of inflation is coherent and predicts a positive relationship to leverage (Hocman & Palmon, 1985). According to the market timing theory, in periods when inflation is relatively high in comparison to market interest rates, it is preferable to issue debt. The trade-off theory also exhibits a positive relationship between inflation and leverage due to the increased value of the tax-shield (Frank & Goyal, 2009). This is because of the reduced real interest rate when inflation rises.

Recession

The overall state of the economy is likely to affect firm capital structure in several ways. The trade-off theory predicts a decrease in leverage ratio during recessions as firm often exhibits lower profits. With lower profits, firms need less interest deduction to offset the firm's pre-tax income, which leads to a lower optimal leverage ratio (Van Empel, 2012).

According to the pecking order theory, the relationship is opposite. With lower profits, firms will have less internal funds to finance their operations and must tend to debt financing. Furthermore, the pecking order theory claims that share prices are generally low and undervalued because of fear in the market during a recession. This leads managers to prefer debt over equity. However, Lemmon et al. (2008) finds that capital structure tends to remain stable during recession, and the effects might first be visible after some time.

Yield spread

The difference between short and long-term rates is known to work as a leading indicator of the economic outlook. A low spread indicates pessimism in the market and a higher possibility of recession, while a high yield spread will predict the opposite (Dahlquist & Harvey, 2001). As the yield spread can function as an indicator for recession, we expect the same relationship between yields spread and leverage as with recession and leverage. An increase in the yield spread indicates better future economic prospects which should wield less debt for IT services companies.

3.2.3 R&D Intensity Effect on Capital Structure

Because R&D investments are hard to assess and monitor, they give managers increased possibilities to deceive lenders by pursuing riskier investments after they have received the funds. Thus, the asset substitution problem suggests that R&D-intensive firms should receive higher interest rates and, as a result, prefer equity over debt when in need of funds. According to Berk and DeMarzo (2014), firms with high R&D expenditures and future growth opportunities invest in very specialized physical and human capital. Such capital is associated with high costs as a result of financial distress. Thus, the trade-off theory predicts an inverse relationship between R&D expenditures and leverage.

On the contrary, Myers and Majluf's (1984) pecking order theory suggests that more innovative firms are more reliant on external sources when financing and favour debt over new equity. Debt is preferred because innovative firms have high degree of asymmetric information between insiders and outsiders due to the uncertainty and discretion in their projects. Therefore, if these innovative firms were to finance themselves by issuing equity, it may signal a poor future, otherwise the managers would have chosen debt to keep their percentage claim of the firms' revenue. Thus, issues related to signalling should make managers prefer debt financing.

Firm-specific assets are assets which are more valuable relative to their use within a particular firm than they are in another firm (Balakrishnan & Fox, 1993). A firm with specific assets make liquidation a challenge in the case of bankruptcy. Common assets are associated with lower uncertainty, as they are re-deployable; their value is the same for any other independent agent (Bah & Dumontier, 2001). Specific assets, however, come with higher uncertainty and reduced value when liquidating a firm. Creditors are aware of the assets a firm holds; thus, they demand a higher risk premium from firms with more specific assets. An R&D investment should, by nature, result in specific assets, and, as discussed, these assets increase the transaction costs on debt financing. Therefore R&D-intensive firms should favour equity financing over debt financing.

However, Lee and Lee (2019) find that biotechnology companies are more likely to finance their R&D investments with debt. The characteristics of the biotechnology industry are similar in many respects to those of the IT services industry – especially regarding the high R&D expenditures. Like biotechnology firms, IT services firms are to some extent dependent on their ability to develop new products (e.g., IT solutions) with which to secure future commercial success. As for the need to fund R&D investments, IT services firms should acquire debt though there is a risk premium.

Overall, how does R&D intensity effect leverage? Capital structure theories pull in opposite directions. One the one hand, the trade-off theory predicts a negative relationship between R&D intensity and debt. This relationship stems from the fact that innovative firms investing heavily in specialized physical and human capital, which is associated with increased financial distress. On the other hand, the pecking order theory predicts a positive relation between R&D and leverage due to signalling leading to an undervaluation of new shares. Previous empirical work is also divided. Bah and Dumontier (2001) provide evidence that R&D investments lead to specific assets which in turn receive higher risk premiums from creditors, thereby resulting in a preference for equity over debt. However, Lee and Lee (2019) report a positive relation between R&D intensity and leverage in their study of biotechnology companies, which exhibits characteristics similar to those of the IT services industry. Though the theories and literature are divided, we believe that the IT services industry will follow the biotechnology industry due to their similarities. Thus, the first hypothesis is formulated in the following way:

Hypothesis 1 (H1): R&D intensity has a positive effect on debt for IT services firms.

3.2.4 Intangible Assets Effect on Capital Structure

An intangible asset is an identifiable, non-monetary asset without physical substance. One can identify such an asset when it is separable, or when it comes from contracts or other legal rights (IFRS, 2019). The figures we find in companies' financial statements are measurable, with some exceptions (e.g., acquisition goodwill), and, to some extent, they should function as collateral in the same way tangible assets do. Patents, computer software, and domains are among the intangible assets that can be identified and sold. Nevertheless, these intangible assets are, in most instances, more difficult to value than tangible assets such as property, plant, and equipment.

Intangible assets can support debt through their ability to create cash flow. Many customers choose Coca-Cola as their preferred soft drink even if they could not tell the difference from a cheaper brand of cola in a blind test. Coca-Cola's brand thus helps generate cash flow (Lim et al., 2019). When lending, creditors are highly interested in the borrower's ability to generate cash flow, which indicates that intangible assets can help support debt.

However, Myers (2001) claims that high business risk increases the chances of financial distress and that intangible assets are more likely to lose value under financial distress. As mentioned in the previous section, the possession of specific assets might make liquidation difficult in case of bankruptcy. To re-deploy intangible assets can be challenging, and agency problems can limit the use of intangible assets by anyone other than the original owners (Rampini & Viswanathan, 2013). Thus, according to the trade-off theory, a company with relatively more intangible assets will take on less debt. In the same vein, Lim et al. (2019) argue that intangible assets can be unimportant when a firm already has sufficient levels of tangible assets with which to support their desired debt. Lim et al. (2019) also argue that lenders traditionally view intangible assets as riskier than tangible assets, thus making equity financing more appropriate.

Intangible assets count for an increasing proportion of the total value of firms. Furthermore, we believe that intangible assets have a positive effect on leverage, as any valuable assets should contribute at least somewhat to increasing a firm's debt capacity. However, this effect can be small or even insignificant. Thus, our second hypothesis is formulated in the following way:

Hypothesis 2 (H2): Intangible assets supports debt for IT services firms.

4. Data and Methodology

In this chapter, we elaborate on the methodology and data used in our study. First, we describe our work on collecting the final data sample. Then we define our variables and provide descriptive statistics. Lastly, we describe the methodology used.

4.1 Data Sources and Sample Selection

We acquired the financial statements of listed IT services companies in the period 2006-2018 from the Compustat Global database. Only companies that have been listed on stock exchange during the period of interest are added to our final sample. To get a refined and appropriate selection of companies, we have filtered by the Standard Industrial Classification (SIC) codes

7371[9], 7372[10], 7373[11] and 7374[12] (SEC, 2019). As the companies are located in different countries and file their reports in different currencies, all data is converted to American dollars to be comparable[13]. We are aware of the inaccuracies that can arise from the fact that companies from different countries report their financial statements with varying rules of accounting. By gathering all data from one database, we mitigate some of these inaccuracies.

We remove firm-years where the total value of assets is below USD 1 million. This is in line with the work of Drobetz et al. (2013) on capital structure. Furthermore, companies with two or less coherent firm-years are removed. When obtaining R&D expenses from Compustat, we observe a significant number of firms who do not report R&D expenses. By manually checking a sample of firms with missing R&D expenses with their respective annual reports, we found that the companies did indeed report zero R&D or didn't report any R&D at all. Therefore, we record missing R&D expenses to zero, following Frank and Goyal (2009). As we later introduce a R&D tax subsidy variable which represents each country's implied tax subsidy in a given year, we limit our sample to countries where this information can be obtained. Some countries are therefore omitted, even though they represent a moderate share of the listed IT services firms, such as India. However, by running the regressions without omitting any countries, we get similar results. Indicating that our results are unlikely to be affected by this selection. To make sure extreme values and outliers do not influence this study, we winsorize[14] all control and dependent variables in both tails at a 1% level. The final sample consists of 808 firms from 26 countries, equal to 7127 firm-years, due to missing observations of some firms in specific years. In some models, the sample size will be more limited due to missing values in certain variables. The macroeconomic factors are retrieved from different sources[15].

4.2 Defining Variables

The choice of variables is based on the discussions of determinants of capital structure in Chapter 3. In this section, we provide a technical description of how the various variables are

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[9] 7371 = Computer programming services.
[10] 7372 = Prepackaged software.
[11] 7373 = Computer integrated systems design.
[12] 7374 = Computer processing & data preparation.
[13] The exchange rates were obtained from Datastream. We used a yearly average of the exchange rates to convert to US dollars.
[14] Winsorizing is the procedure of limiting extreme values in the data. By winsorizing at upper (lower) 1%, values above (below) this threshold will be replaced by the cut off value. Dummy variables are not winsorized.
[15] See appendix Table A2 for all sources for different variables.

constructed. We use the terms from Compustat so that the reader can recognize the entries from the annual accounts. Table A1 in the appendix shows the structure of the included variables.

4.2.1 Dependent Variables

When defining leverage, most studies tend to use some sort of leverage ratio. Frank and Goyal (2009) and Titman and Wessels (1988) used a sum of short- and long- term debt divided by total assets. However, there is a split opinion of whether one should use book or market values for assets. Barclay et al. (2006) claim that market leverage is forward-looking, while book leverage is backward-looking. Myers (1977) point out that the focus should be on book leverage since it reflects the company's assets right now. He elaborates that book values are not necessarily more accurate than stock market values, but simply that they refer to assets already in place. Frank and Goyal (2009), however, argue that when measuring leverage in a specific industry, a market-based leverage ratio is preferable, but further states that the market value of the debt may be volatile and difficult to quantify.

To broaden the scope of our thesis we will include both book and market leverage ratios as measurements for leverage. Naturally, the results between the two methods will deviate from one another to some extent. A few scholars interpret cash on hand as negative debt and thus subtract cash from the measurement of debt. Since IT services firms in general hold little debt and a substantial amount of cash, we follow Drobetz et al. (2013) and Frank and Goyal (2009), and measure leverage without taking cash into account to get comparable results. Our dependent variables will hereafter be referred to as *Book leverage* and *Market leverage*. The two variables are defined as follows:

$$\text{Book leverage} = \frac{\text{Long term debt} + \text{Debt in current liabilities}}{\text{Total assets}} \tag{1}$$

$$\text{Market leverage} = \frac{\text{Long term debt} + \text{Debt in current liabilities}}{\text{Total assets - Common equity} + \text{Market value of equity}} \tag{2}$$

As the measurements above cannot with certainty capture whether the effect on leverage ratio is due to a relative change in either debt or equity, we add two dependent variables that looks specifically on the issuances of debt or equity. We construct one dependent variable for change in total debt[16], and one dependent variable for change in equity. For equity, we measure the change by the change in number of shares outstanding[17]. The variables are created such that the value reported in period t equals the change between period t and t+1.

$$\Delta \text{Debt} = \Delta(\text{Long Term debt} + \text{Debt in current liabilities}) \qquad (3)$$

$$\Delta \text{Equity} = \Delta(\text{Common shares}) \qquad (4)$$

4.2.2 Standard Factors

Tangible assets (*Tangibility*)

We calculate tangibility as a fraction of property, plant, and equipment over total assets, following Frank and Goyal (2009) and Drobetz et al. (2013).

$$\text{Tangibility} = \frac{\text{Property, plant and equipment}}{\text{Total assets}} \qquad (5)$$

Market-to-book (*M/B*)

Market-to-book is a commonly used measurement for growth opportunity and is present in numerous empirical papers (Lim et al., 2019; Frank & Goyal, 2009; Drobetz et al., 2013).

$$\text{M/B} = \frac{\text{Total assets - Ordinary equity + Market value of equity}}{\text{Total assets}} \qquad (6)$$

Profitability (*Profit*)

We design the variable for a company's profitability as the ratio between operating profit before depreciation and total assets.

$$\text{Profit} = \frac{\text{Operating income before depreciation}}{\text{Total assets}} \qquad (7)$$

Size (*LNSize*)

When determining a company's size, we use the natural logarithm of the book value of total assets. An alternative measure for size is the natural logarithm of sales. The two types are quite

[16] Total debt is a sum of Compustat items: Long term debt + Debt in current liabilities.
[17] Adjusted for stock splits and reverse stock splits.

similar, and within our sample, strongly correlate[18]. We follow Frank and Goyal (2009) and Bah and Dumotier (2001), among others, and use the natural logarithm of assets as a proxy for size.

$$\text{LNSize} = \text{Ln}(\text{Total assets}) \quad (8)$$

Dividend payout ratio (*Dividend*)

We calculate the dividend payout ratio as a fraction of total dividends paid in a given year over the net income in the same year. Even though Frank and Goyal (2009) showed in a working paper that a dividend dummy variable works empirically, we construct the actual dividend payout ratio to avoid loss of information. The variable is constructed as follows:

$$\text{Dividend} = \frac{\text{Dividends}}{\text{Net income}} \quad (9)$$

4.2.3 R&D and Intangibility

R&D intensity (*R&DInt*) and R&D dummy (*R&DFirm*)

Following Bah and Dumotier (2001), we measure R&D intensity as a fraction of R&D expenditures to sales, as presented in equation *(10)*. We also add a dummy variable to differentiate between companies reporting R&D and those who don't, as shown in equation *(11)*.

$$\text{R\&DInt} = \frac{\text{R\&D expenditures}}{\text{Sales}} \quad (10)$$

$$\text{R\&DFirm} = \begin{matrix} 1 \text{ if R\&D expenditures} > 0\text{, in year t} \\ 0 \text{ if R\&D expenditures} = 0\text{, in year t} \end{matrix} \quad (11)$$

Intangibility (*Intangibility*)

Tangibility and intangibility[19] are prone to being affected by mechanical relations, since the sum of goodwill, intangible and tangible assets, divided by total assets, sums to one. Prior

[18] In our data sample Ln(Size) and Ln(Sales) have a correlation coefficient of p=0.83

[19] Ratio of intangible assets to total assets.

studies usually find a positive relationship between tangibility and leverage ratio, indicating a negative relationship between intangibility and leverage ratio (Lim et al., 2019). To avoid perfect negative multicollinearity between tangibility and intangibility, we use property, plant and equipment as a proxy for tangible assets, and subtract goodwill from intangible assets. In this manner, we allow both tangibility and intangibility to have the same sign in a regression.

$$\text{Intangibility} = \frac{\text{Intangible assets - Goodwill}}{\text{Total assets}} \qquad (12)$$

4.2.4 Macroeconomic Factors

Stock market return, inflation, recession and yield spread

We add macroeconomic factors to our model to account for global effects. We use the MSCI[20] World Index to observe the return of the stock market[21]. By using the stock market return, we aim to capture the effect of economic expansions and recessions. We collect data on inflation from OECD[22], and yield spread from Federal Reserve[23]. Data on recessions are from the National Bureau of Economic Research (NBER, 2019), and we follow their definition of a recession. The three abovementioned variables are all presented in percentages. A given year is assigned the value one if at least six months of that year is defined as recession, and in our period of interest, only 2008 and 2009 are defined as recession-years.

4.3 Regression Method and Specification

In order to answer our hypothesis, we perform a panel data regression. As our sample consists of 12 years and 808 companies, we follow Petersen's (2009) recommendation to cluster standard errors by the more frequent cluster. Therefore, to control for serial correlation within firm-data, we use clustered standard errors at firm-level, but include year fixed effects. When using clustered standard errors, we also control for heteroskedasticity in the regression output (Petersen, 2009).

The base regressions specification used in this study is:

[20] Morgan Stanley Capital International.
[21] Data retrieved from: https://www.msci.com/documents/10199/178e6643-6ae6-47b9-82be-e1fc565ededb
[22] Data retrieved from: https://data.oecd.org/price/inflation-cpi.htm
[23] Data retrieved from: https://fred.stlouisfed.org/series/T10Y3M

$$Y_{i,t} = \alpha + \beta X_{i,t} + \varepsilon_{i,t}, \tag{13}$$

$$Y_{i,t} = \alpha + \beta X_{i,t} + c_f + \theta_t + \varepsilon_{i,t}, \tag{14}$$

where $Y_{i,t}$ denotes the dependent variable for firm i at time t, and α is the intercept. $\beta X_{i,t}$ represents the regression coefficients for the different independent variables. Lastly, $\varepsilon_{i,t}$ captures the effects of factors that are not included as explanatory variables. The model presented in equation *(14)* includes three sub-specifications, which involve either calendar year fixed effects (θ_t), firm fixed effects (c_f), or both. We do so following Drobetz et al. (2013) to account for unobserved heterogeneity across time and at the firm level.

As changes in leverage ratio can emerge from changes in debt and/or equity, we try to establish a causal relationship between these variables and R&D intensity by utilizing a 2SLS model with Δ*Debt* and Δ*Equity* as dependent variables. We do so by estimating β from equation *(13)* and *(14)* using an exogenous source of variation in R&D expenditures.

4.4 Descriptive statistics

Table 1 provides a summary of the descriptive statistics for the variables used in this thesis. As mentioned earlier, all the variables, except dummies, are winsorized at the upper and lower one percentile to reduce the effect of outliers and extreme observations. To put our data into perspective, we will compare them to those of Frank and Goyal (2009) and Bessler et al. (2013) and their work on capital structure. In Graph 1, we also provide the average leverage ratio by year for IT services firms compared to the average of companies in G7 countries. In appendix A3, a list of included countries and their respective share of observations is included.

Table 1
Descriptive Statistics

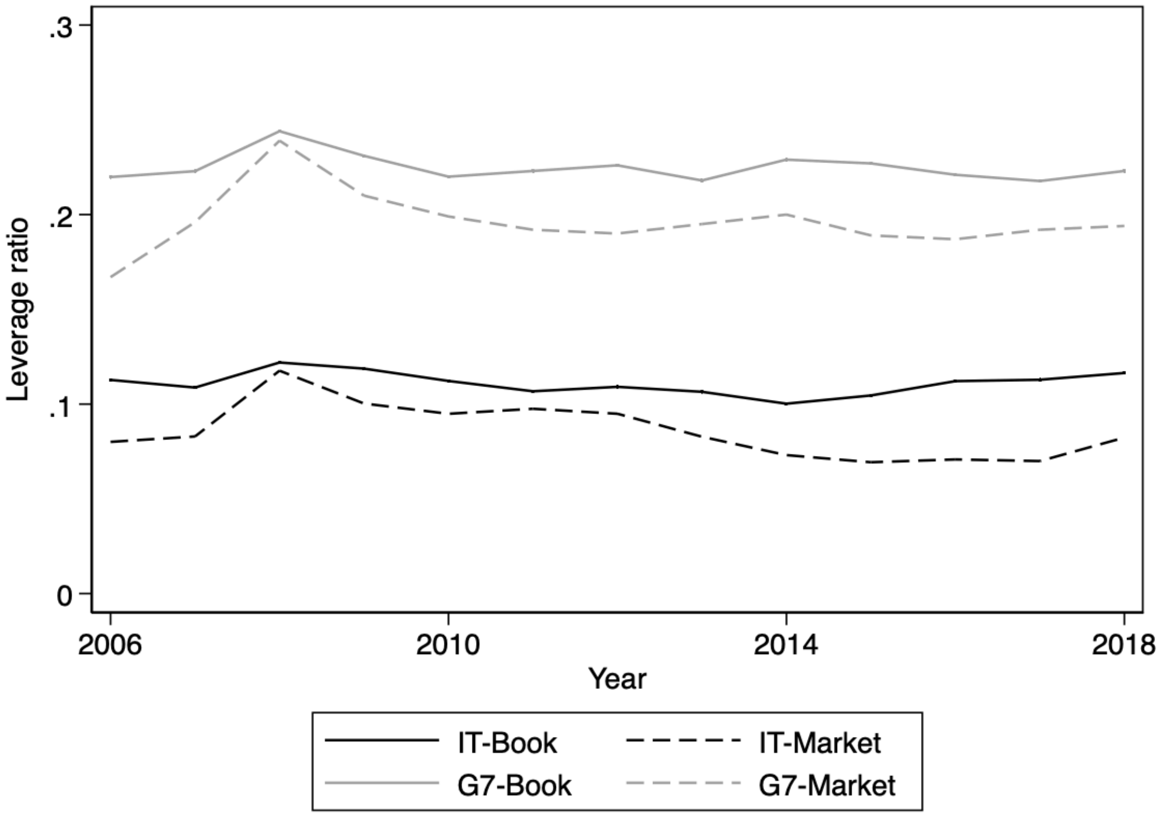
	N	Mean	Median	Std. Dev.	min	Percentiles p25	Percentiles p75	max
Dependent variables								
Book leverage	7127	.115	.051	.149	0	0	.187	.671
Market leverage	6413	.087	.027	.123	0	0	.134	.548
ΔDebt	6307	.019	0	.091	-1	-.058	.029	2.095
ΔEquity	5800	.023	0	.043	-.234	0	.045	.821
Company specific variables								
R&DInt	7127	.073	.023	.102	0	0	.116	.447
R&DFirm	7127	.717	1	.451	0	0	1	1
Intangibility	7127	.073	.03	.097	0	.008	.099	.417
Tangibility	7127	.082	.037	.105	.003	.018	.097	.472
M/B	6413	1.85	1.436	1.088	.768	1.004	2.388	4.153
Profit	7127	.087	.091	.111	-.272	.043	.145	.337
LNSize	7127	4.549	4.322	1.436	2.441	3.468	5.346	8.272
Dividend	7127	.169	0	.372	-.623	0	.262	2.323
Macroeconomic variables								
Inflation	7127	.02	.022	.009	.004	.016	.026	.036
MSCI	7127	.078	.096	.179	-.403	-.003	.206	.308
Spread	7127	.018	.019	.011	-.003	.01	.021	.038
Recession	7127	.151	0	.358	0	0	0	1

As Graph 1 on the following page depicts, the IT services industry exhibits a lower leverage ratio compared to the average of companies in G7 countries. By examining Table 1, IT services firms have an average market (book) leverage of 8.7% (11.5%). Frank and Goyal's (2009) study on capital structure of publicly traded American firms from 1950 to 2003 find this to be 28% (29%). Bessler et al. (2013) observe the book leverage ratio to be 24.4% for 20 developed countries between 1980 and 2011.

Market value of equity is forward-looking, in the aspect that it takes the future growth opportunity into account (Berk & DeMarzo, 2014). For firms with positive prospects, investors will value its equity beyond the book value. For the IT services industry, investors seem to expect future growth, and as a result, the market equity will be higher than book equity. Thus, the industry market leverage will, on average, be lower than book leverage. However, in 2008, the gap between *Book leverage* and *Market leverage* almost closes. Implying that for the average IT services firm, the equity capital was close to being valued by investors below its book value. Not an unusual trait following the financial crisis as the investors had a deteriorating view on the market.

Graph 1
Average Leverage Ratio by Year

The graph presents yearly average leverage ratios for the IT services industry and for companies in G7 countries. The IT services sample consists of 808 firms, while the G7 sample contains 5975 firms. All data are collected from the Compustat Global database.



On average, both *Book leverage* and *Market leverage* are considerably lower for IT services firms than for the average industrial company from the US or the G7. 28% of our observations show zero total debt. It is perhaps not surprising that we observe such a high number for the IT services industry. Strebulaev and Yang (2013) find that 14% of nonfinancial US-firms have zero leverage, and as IT services firms have little debt in general, we would expect this number to be higher for our industry.

As expected, the low leverage ratio for IT services firms is accompanied by a low tangibility. The average tangibility-measure is at 8.2% for IT services firms while the average for 20 developed countries is at 29.5% (Bessler et al., 2013). Consequently, the industry will have a relative high degree of intangible assets before controlling for goodwill. IT services rank second (only behind pharmaceuticals) across all industries when measuring intangible assets to total assets (Demmou et al., 2019). When focusing on the identifiable intangible assets on the balance sheet, and by subtracting goodwill, we find that they constitute about 7.3% of total assets. *R&DInt* is, on average, twice as high as Besler's et al. (2013) findings, and approximately 72% of the total observations show R&D expenses.

For most of the variables, the mean is above the median, which indicates that the variables are right-skewed. *Market leverage* has fewer observations than *Book leverage* due to missing values of stock prices for certain years. *M/B* is also a variable created from the market value of equity, and therefore shows the same number of observations as *Market leverage*. For the remaining unabbreviated variables, we find them to be consistent we previous literature.

Correlation

To determine if multicollinearity is an issue in our dataset, we perform a Pearson correlation test and present the results in Table 2 below. Most coefficients are relatively small and does not indicate much correlation between the variables. However, some observations are worth further exploration. *Book leverage* and *Market leverage* shows the highest correlation and is in line with what we expected between our dependent variables. *M/B* and *Market leverage* have a negative coefficient of -0.367. We are not surprised with this moderate correlation due to the negative mechanical relationship that exists between the variables. *R&DInt* and *R&DFirm* also exhibits a moderate correlation due to the construction of the R&D dummy. Companies with a large share of tangibility and intangibility tend to have higher leverage ratios, while high levels of *M/B*, *R&DInt*, and *R&DFirm* trend in the opposite direction. To *ΔDebt* and *ΔEquity* the R&D variables show a negative and positive sign, respectively. This is somewhat contrary to that we would expect as *hypothesis 1* predicts a positive relationship between R&D intensity and debt. However, further analysis is necessary before accepting or rejecting the hypothesis. For *Intangibility*, the coefficients are positive and in line with our expectations.

All of the independent variables show similar correlation sign to *Book leverage* and *Market leverage*[24]. The correlation matrix does not lead us to suspect a problem with multicollinearity in our data. To support the conclusion of the Pearson correlation test, we have conducted VIF-tests[25]. These tests did not provide any reason to suspect multicollinearity.

[24] With an exception being *Spread.*
[25] Variance Inflation Factors (VIF) test. All values are below 5.

Table 2
Pearson Correlation Matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
(1) Book leverage	1.000															
(2) Market leverage	0.874	1.000														
(3) ΔDebt	-0.045	-0.052	1.000													
(4) ΔEquity	0.039	0.007	-0.007	1.000												
(5) R&DInt	-0.108	-0.161	-0.015	0.030	1.000											
(6) R&DFirm	-0.114	-0.129	-0.007	0.083	0.449	1.000										
(7) Intangibility	0.079	0.052	0.042	0.038	0.161	0.081	1.000									
(8) Tangibility	0.194	0.223	0.006	0.022	-0.117	-0.058	-0.177	1.000								
(9) M/B	-0.144	-0.367	0.061	0.118	0.208	0.090	0.038	-0.085	1.000							
(10) Profit	-0.141	-0.160	0.023	-0.091	-0.190	0.009	0.017	0.009	0.198	1.000						
(11) LNSize	0.139	0.076	0.066	-0.083	-0.066	0.111	-0.035	0.059	0.023	0.152	1.000					
(12) Dividend	-0.111	-0.120	0.001	-0.071	-0.041	0.095	-0.031	0.018	0.021	0.190	0.132	1.000				
(13) MSCI	-0.017	-0.063	0.017	0.024	-0.016	0.001	-0.005	0.000	0.101	0.020	-0.005	0.012	1.000			
(14) Inflation	0.022	0.065	-0.040	-0.014	-0.021	-0.052	-0.006	0.007	-0.108	-0.009	-0.001	-0.026	-0.566	1.000		
(15) Spread	-0.007	0.040	-0.019	-0.005	-0.014	-0.004	0.001	0.023	-0.118	0.020	-0.032	0.011	0.136	-0.547	1.000	
(16) Recession	0.030	0.101	-0.042	-0.060	-0.037	-0.066	-0.005	0.020	-0.190	-0.029	-0.026	-0.008	-0.314	0.031	0.429	1.000

5. Results and Discussion

In the following sections, we present and interpret the results of our models. We interpret the variables with respect to capital structure theory, previous empirical findings, and our hypotheses. Initially, we ran regressions with *Book leverage* and *Market leverage* as dependent variables. We also tested for a causal effect between R&D intensity and leverage through an instrumental variable approach by using a 2SLS estimation.

5.1 Determinants of Leverage Ratio

The first column in Table 3 is an OLS model. In columns (2) and (3), we add firm and year-fixed effects separately. This makes it possible to distinguish between both time-varying and time-constant effects and firm-varying and firm-constant effects. In Column (4), we add both fixed effects. Lastly, Column (5) includes macroeconomic factors but excludes year-fixed effects, as time effects are likely to capture some of the impact of the macroeconomic factors.

Table 3
Panel Data Regression to Estimate Determinants of Capital Structure

The table shows the results of the leverage regressions using a sample of 808 listed IT services firms during the period from 2006 to 2018. Standard errors clustered at firm level are given in parenthesis. Firm FE and Year FE indicate whether firm and calendar year fixed effects are included in the specification. The symbols *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)
Dep. Var: Book leverage					
R&DInt	-0.149***	-0.007	-0.150***	-0.006	-0.008
	(0.039)	(0.050)	(0.040)	(0.049)	(0.049)
R&DFirm	-0.023**	-0.004	-0.023**	-0.000	-0.002
	(0.010)	(0.008)	(0.010)	(0.007)	(0.008)
Intangibility	0.207***	0.018	0.207***	0.024	0.022
	(0.042)	(0.043)	(0.042)	(0.044)	(0.043)
Tangibility	0.271***	0.344***	0.274***	0.336***	0.339***
	(0.060)	(0.069)	(0.060)	(0.068)	(0.068)
M/B	-0.011***	-0.001	-0.011***	0.001	0.000
	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)
Profit	-0.192***	-0.219***	-0.189***	-0.223***	-0.221***
	(0.034)	(0.036)	(0.035)	(0.036)	(0.036)
LNSize	0.016***	0.031***	0.016***	0.034***	0.032***
	(0.003)	(0.009)	(0.003)	(0.010)	(0.009)

Dividend	-0.038***	-0.005	-0.038***	-0.004	-0.005
	(0.006)	(0.003)	(0.006)	(0.003)	(0.003)
MSCI					0.010
					(0.008)
Inflation					0.322
					(0.238)
Spread					-0.451**
					(0.198)
Recession					0.015***
					(0.005)
Year FE	No	No	Yes	Yes	No
Firm FE	No	Yes	No	Yes	Yes
N	6413	6413	6413	6413	6413
adj. R^2	0.131	0.684	0.131	0.686	0.686

	(1)	(2)	(3)	(4)	(5)
Dep. Var: Market leverage					
R&DInt	-0.101***	-0.030	-0.105***	-0.026	-0.031
	(0.028)	(0.031)	(0.029)	(0.031)	(0.031)
R&DFirm	-0.017**	-0.002	-0.017**	0.003	0.001
	(0.008)	(0.006)	(0.008)	(0.006)	(0.006)
Intangibility	0.143***	0.007	0.143***	0.013	0.009
	(0.031)	(0.032)	(0.031)	(0.032)	(0.032)
Tangibility	0.223***	0.205***	0.224***	0.192***	0.197***
	(0.048)	(0.043)	(0.048)	(0.042)	(0.042)
M/B	-0.035***	-0.026***	-0.034***	-0.021***	-0.022***
	(0.002)	(0.003)	(0.002)	(0.003)	(0.003)
Profit	-0.115***	-0.141***	-0.116***	-0.151***	-0.146***
	(0.022)	(0.026)	(0.023)	(0.026)	(0.026)
LNSize	0.009***	0.028***	0.009***	0.035***	0.030***
	(0.002)	(0.005)	(0.002)	(0.007)	(0.005)
Dividend	-0.031***	-0.006*	-0.031***	-0.005*	-0.005*
	(0.005)	(0.003)	(0.005)	(0.003)	(0.003)
MSCI					0.003
					(0.006)
Inflation					0.696***
					(0.204)
Spread					0.110
					(0.165)
Recession					0.016***
					(0.005)
Year FE	No	No	Yes	Yes	No
Firm FE	No	Yes	No	Yes	Yes
N	6413	6413	6413	6413	6413
adj. R^2	0.228	0.720	0.228	0.726	0.724

The effect of standard variables

Tangibility and *LNSize* have a positive impact on *Book leverage* and *Market leverage*. The effect is significant at the 1% level. The significance level of the coefficients is similar in all columns, thereby supporting the common belief that tangible assets works as collateral and that larger firms tend to have higher leverage ratios (Bessler et al., 2013; Antoniou et al., 2008; Sheikh & Wang, 2011). In Column (4), we observe that a percentage point increase in *Tangibility* results in a 0.336 (0.192) percentage point increase for *Book leverage* (*Market leverage*), all else being equal. Though there is no clear definition of what to classify as "economically significant", we would argue that the coefficients' seem quite large and that they indicate economic significance.

Profit has a negative impact on leverage ratio. The coefficient is significant at the 1% level for all columns, regardless of the dependent variable. High profitability leads to increased FCF[26], which in turn will lead to more internally generated funds and reduce the need for external financing (Park & Pincus, 1997). This finding is consistent with the pecking order theory. Therefore, our results indicate that profitable IT services firms can use retained earnings to fund their projects instead of issuing debt.

Dividend has a negative sign in all columns. Using *Market leverage* as our dependent variable, the negative coefficients from *Dividend* are significant at the 1% level in columns (1) and (3), and they are significant at the 10% level in the remaining columns. All else being equal, a one percentage point increase in the dividend ratio results in a 0.038 (0.031) percentage point decrease in *Book leverage* (*Market leverage*) in Column (3). The effect of the dividend payout seems reasonable form an economic point of view, as dividend-paying firms have enough retained earnings to pay dividend and finance their projects from internal funds. If these firms had insufficient internally generated funds, they might hold back dividend payments. Our findings follow empirical research (Rajan & Zingales, 1995; Frank & Goyal, 2009; Drobetz et al., 2013), and we find that IT services firms that pay dividends tend to have lower leverage ratios.

The *M/B* coefficients are negative across all columns and significant at the 1% level for *Market leverage*. This could be related to IT services firms with high growth opportunities having higher financial distress which therefore leads them to obtain unfavourable rates from creditors (Wilner, 2000). Consequently, they turn to equity financing, in accord with the trade-off theory. For *Book leverage* the significance disappears when firm-fixed effects are included. The difference in significance between *Book leverage* and *Market leverage* probably stems from the negative mechanical relationship between *Market leverage* and *M/B*. Frank and Goyal (2009) report similar results and claim that growth opportunity loses its reliable impact when book leverage is studied.

---

[26] Free cash flow.

We observe a higher explanatory power for *Market leverage* than for *Book leverage*, which is in agreement with prior studies (Drobetz et al., 2013; Lemmon et al., 2008). More importantly, we find that adding firm-fixed effects to the OLS considerably increases adjusted R-squares. In columns (1) and (2), we see an increase in adjusted R-squares from 13.1% to 68.4% when *Book leverage* is used as the dependent variable. This supports the conclusion that the capital structure of IT services firms is to a large extent explained by an unobserved time-invariant component.

A. The Effect of R&D Intensity on Leverage Ratio

The *R&DFirm* dummy shows a significantly negative coefficient at the 5% level in columns (1) and (3) for both *Book leverage* and *Market leverage*. The negative coefficients in these models imply that firms which have R&D expenditures tend to have a lower leverage ratio than firms which report zero R&D expenditures. By controlling for firm-fixed effects, the difference between the firms disappears. Furthermore, the magnitude of the coefficients is relatively low and does not lead us to believe that simply having R&D expenditures alone will have an economically significant effect on leverage.

All of the estimated signs of the *R&DInt* coefficients are negative for both measurements of leverage. The coefficients are significant at the 1% level in columns (1) and (3) but lose their significance when firm-fixed effects are included. Several explanations can account for the negative effect on leverage. First, IT services firms with high R&D investments may have trouble accessing debt markets, as these investments are perceived as risky and do not serve as good collateral (Canarella & Miller, 2019). Because of the asset substitution problem, companies with high R&D investments exhibit high agency costs of debt, as it is easier for management to pursue a riskier investment once a firm has received the funds. Also, investing in R&D tends to result in specific assets which cannot be sold easily. Firm-specific assets therefore make liquidation in case of bankruptcy challenging. This uncertainty for specific assets and the value they return when liquidating a firm makes creditors demand a higher risk premium (Balakrishnan & Fox, 1993).

In total, R&D expenditures seem to have a negative effect on leverage; however, the effect is insignificant when firm-fixed effects are controlled for. This seems to invalidate *hypothesis 1.* This negative effect does not necessarily imply a negative effect between R&D intensity and debt. The negative effect on leverage may stem from a positive change in debt and equity, but a relatively larger change in equity. Thus, in Section 5.2, we adopt changes in debt and equity as dependent variables to be able to fully reject or accept *hypothesis 1.*

B. The Effect of Intangible Assets on Leverage Ratio

We observe a positive relationship between *Intangibility* in all columns for both dependent variables. In columns (1) and (3), the coefficients are significant at the 1% level. When firm-fixed effects are accounted for, the signs remain positive, but insignificant. This positive effect might indicate that identifiable intangible assets can create cash flows for IT services firms. Creditors favour firms with steady cash flows, and will provide lower interest rates, even though the assets are not collateralizable. This should increase the firm's debt and result in a higher leverage ratio (Lim et al., 2019).

When we compare the effects of intangible and tangible assets on book leverage, the point estimates for *Intangibility* are consistently smaller. Nevertheless, the magnitude is still quite sizeable. For *Book leverage* in Column (3), the coefficient for *Tangibility* is significant at 0.274, while that for *Intangibility* is significant at 0.207. The smaller point estimate for *Intangibility* versus *Tangibility* indicates that an increase in tangible assets has a larger impact on leverage ratio than an equally large increase in intangible assets. However, Lim et al. (2019) state that point estimates should be compared with caution, as tangible-asset measures are more precise than intangible-assets measures. According to their study, identifiable intangible assets support debt financing as much as tangible assets do. Our results do not support this finding. This might be because common tangible assets (e.g., property, plant, and equipment) are easier to re-deploy than intangible assets for IT services firms.

Macroeconomic factors

In the fifth column, we include macroeconomic factors into our regression, which only marginally helps in increasing the explanatory power from Column (2). Increased stock market returns, as measured by *MSCI,* have a minimal point estimate and do not show any significance in explaining either *Book leverage* or *Market leverage.*

Inflation exhibits a positive relationship with both leverage measures, which is in line with the pecking order theory, according to which increased inflation leads to the increased value of the tax-shield and consequently to more debt. The inflation coefficient is significant at the 1% level for *Market leverage* but insignificant when *Book leverage* is the dependent variable. The coefficient for *Inflation* can be interpreted as a one percentage point increase in inflation, which yields a 0.696 percentage point increase in *Market leverage*, all else being equal. This seems to be a relatively large effect, and its magnitude is not well explained with economic intuition. Nevertheless, a positive inflation coefficient is consistent with Frank and Goyal's (2009) finding that companies tend to have higher leverage ratios when inflation is high. According to Taggart (1985), the real value of interest tax deduction on leverage is larger when inflation is expected to be high. This results in a positive predicted relationship according to the trade-off theory.

The effect of yield spread is divided. When *Market leverage* is the dependent variable, the *Spread* coefficient is positive but insignificant, but when we consider *Book leverage,* we observe a negative and significant coefficient at the 5% level. A low yield spread may signal recession in subsequent periods; hence, the significantly negative relation between *Spread* and *Book leverage* indicates a countercyclical leverage ratio.

From the regression output, we see that *Recession* is positively related to leverage ratio in the IT services industry. This positive relation, similar to *Spread*, indicates that the industry's leverage ratio is countercyclical; therefore, more debt (or less equity) is used during periods of recession. By focusing on *Market leverage* as the dependent variable, we notice that the *Recession* coefficient indicates that, in periods of recession, the leverage ratio is around 1.2% higher than in periods without recession, all else being equal. The positive coefficients are significant at the 1% level for both measurements of leverage.

5.2 Determining Causal Effect through 2SLS Estimation

To determine whether the effect on leverage ratio stems from changes in equity or debt, we adopt a new model using *ΔDebt* and *ΔEquity* as our independent variables. To control for omitted variable bias, we utilize an instrumental variable approach, using 2SLS estimation to establish a causal relationship between R&D intensity and the changes in debt and equity. We do so by using implied R&D tax subsidy rates as an instrument for R&D intensity. This works as a natural experiment and originates from Wilson's (2009) work, which used state R&D tax credit in the US to find that R&D tax credit effectively increases R&D investments within the state.

To gather data on implied R&D tax subsidy rates, we used data published by the OECD[27]. When we look at the incentives different countries use to promote R&D, many factors come into consideration. A few countries in our sample do not offer tax credit but instead offer incentives such as reduced tax rates or accelerated depreciation on R&D assets, among others. It is difficult to compare such tax relief across countries, as fiscal legislation is complex (Warda, 2001). Therefore, it is incorrect to claim that countries that do not offer R&D tax credit do not incentivize firms to invest more in R&D. Of interest is the sum of incentives a country provides. Consequently, we extend Wilson's (2009) idea to focus on R&D tax credit alone and include other R&D incentives as well. To do so, we utilize the B-index.

The B-index is a measurement of the before-tax income a "representative" firm needs to break even on USD 1 of R&D expenditures (Warda, 2001). In general, the index is presented as an implied subsidy rate, by taking one minus the B-index. More generous provisions give a lower break-even point and thus a higher subsidy. The OECD (2013) defines the B-index as follows:

$$\text{B-index} = \frac{1 - A}{1 - \mathcal{T}}, \qquad (15)$$

where $\mathcal{T}$ is the corporate tax rate, and A is the combined net present value of credits and allowances which apply to R&D outlays. The more favourable a country's tax treatment of R&D expenditures, the lower its B-index. Thus, in a country with full write-off of R&D expenditures and zero R&D tax incentives schemes, A will be equal to $\mathcal{T}$, and the B-index will be one. When the B-index is one, the implied tax subsidy rates on R&D expenditures will be zero. We use the real R&D implied tax subsidy rate in our model, and we name the variable *R&DSub*.

For R&D tax subsidy rates to function as an instrument, it should be correlated with the independent variable, and the covariance between the instrument and the error term should be equal to zero. The first condition can be verified through regression, which is why we include the first-stage regression in Table 5. The second condition is more difficult to prove, and we

[27] Data retrieved from: https://stats.oecd.org/Index.aspx?DataSetCode=RDTAX under the following tab: Implied tax subsidy rates on R&D expenditures.

can only argue that, on the basis of economic intuition, there is nothing to imply that our instrument is correlated with the dependent variables. However, *R&DInt* is moderately correlated with the *R&DFirm,* and including this variable in the 2SLS could cause biased results. We have therefore omitted *R&DFirm* from the models.

To give a better understanding of the correlation between the instrumental variable and the independent and dependent variables, a Pearson correlation table is presented in Table 4. The correlation of *R&DSub* and *R&DInt* is merely at 0.193, which is somewhat lower than what we would expect. For firms having zero or negative implied tax subsidy, the average *R&DInt* is less than 7%, but for those receiving tax subsidy, the number is close to 8%. For *R&DFirm*, observations with at least some R&D expenditures rises from approximately 70% to 72%. *R&DSub* show almost no correlation with the dependent variables.

Table 4
Pairwise Correlation Coefficients of the Instrument with the Independent and Dependent Variables

	R&DSub
Independent variable:	
R&DInt	0.193
Dependent variables:	
ΔDebt	-0.032
ΔEquity	0.024

Panel A in Table 5 provides the results from the OLS, while Panel B provides the results from the 2SLS instrumental variable regression. The panels are repeated twice, as the models are completed with and without fixed effects. All control variables are included in each of the regressions, but they are not explicitly shown. We begin by discussing the results regarding *R&DInt.*

Table 5

2SLS Estimation of the Effect of R&D Intensity on Changes in Debt and Equity

The table shows the two-stage least squares (2SLS) coefficients for the effect of R&D intensity on changes in debt and equity. The total sample consists of 7127 firm-year observations and 808 firms in the period of 2006-2018. Panel A present the standard OLS regressions while Panel B display the 2SLS. For Panel B, column (3) and (8) show the first-stage regression while (4), (5), (9) and (10) show the second-stage. Standard errors clustered at firm level are given in parenthesis. Firm FE and Year FE effects indicate whether calendar year and firm fixed effects are included in the specification. Control variables from the leverage ratio regression in Table 3 are included in all models. The symbols *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	Panel A: Panel data regression		Panel B: IV – 2SLS			Panel A: Panel data regression		Panel B: IV – 2SLS		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dep. Var:	ΔDebt	ΔEquity	R&DInt	ΔDebt	ΔEquity	ΔDebt	ΔEquity	R&DInt	ΔDebt	ΔEquity
Regression stage			First stage	Second stage	Second stage			First stage	Second stage	Second stage
R&DInt	-0.066**	0.157**				-0.012	0.100			
	(0.027)	(0.073)				(0.037)	(0.081)			
$\widehat{R\&DInt}$				-0.170***	0.295***				-0.024	0.156
				(0.051)	(0.089)				(0.053)	(0.130)
R&DSub			0.069**					0.041*		
			(0.029)					(0.022)		
Intangibility	0.168***	0.123**	0.155***	0.254***	0.211***	0.109	0.047	0.025	0.132	0.056
	(0.052)	(0.061)	(0.031)	(0.085)	(0.068)	(0.088)	(0.056)	(0.037)	(0.103)	(0.072)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes
Firm FE	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes
N	5624	5524	6413	5624	5524	5624	5524	6413	5624	5524
adj. R^2	0.041	0.055		0.023	0.029	0.217	0.286		0.189	0.223

A. The Effect of R&D Intensity on Changes in Debt and Equity (H1)

In Panel A, *R&DInt* is negative and significant for *ΔDebt* and positive and significant for *ΔEquity*. The magnitude is largest for *ΔEquity*, where a one percentage point increase in *R&DInt* leads to an average of 0.157 percentage point increase in the amount of issued equity, all else being equal. This seems to be relatively large and economically significant effect, given that we found the coefficient on *Tangibility* on the effect on leverage ratio from Column (4) in Table 3 to be 0.336 (0.192). By using implied R&D tax subsidy rates as an instrument for R&D intensity, we find that the panel data regression underestimates the effect of *R&DInt* on *ΔDebt* and *ΔEquity*. Also, the coefficients of the predicted values of *R&DInt* retain their significance when 2SLS estimation is used before controlling for fixed effects. In the first-stage regressions, the instrument is positively significant to *R&DInt*; however, only at the 10% level when controlling for fixed effects.

As R&D activities have been found to produce greater informational asymmetries than tangible assets, resulting in lower levels of debt (Aghion, et al. 2004), firms should generally rely on equity financing rather than on debt financing to fund R&D. Our negative coefficients on debt and positive coefficients on equity supports this. However, it is contrary to what we predicted in *hypothesis 1*. The reason for this may be that equity investors are eager to support IT services firms with high R&D investments, as R&D has been shown to produce substantial growth opportunities. This is consistent with the agency theory, according to which firms with growth options wield less leverage due to asset substitution problems (Lee & Lee, 2019). It may also be argued that IT services firms, which have a relatively large share of R&D expenditures, are likely to produce a significant amount of specific assets which creditors are sceptical to accept as collateral (Bah & Dumontier, 2001). Consequently, it seems that IT services firms with higher R&D intensity issue more equity and less debt, which decreases their overall leverage ratio.

When fixed effects are included, none of the coefficients remain significant and their economic significance is reduced; however, their directions remain consistent. This leads us to believe that there is a lack of causality between R&D intensity and the effect on capital structure for IT services firms, and that the significant effects from OLS are due to correlation and not to causation.

An explanation for the insignificant relationship may be that firms are less liable when financing projects with external funds. Consequently, they are willing to take on greater risk at the expense of external investors, thereby creating a problem of moral hazard. The problem might be greater for firms with high R&D investments, as R&D is difficult to collateralize. As a result, R&D intensity imposes little effect on debt and equity issuance and the overall capital structure.

B. The Effect of Intangible Assets on Changes in Debt and Equity (H2)

For *Intangibility*, the coefficients are significant and positive for both *ΔDebt* and *ΔEquity* before controlling for fixed effects. The magnitude of the coefficients is greater for *ΔDebt* and smaller for *ΔEquity,* compared to the *R&DInt* coefficients. From Panel A, a one percentage point increase in *Intangibility* will increase the average change in debt by 0.168 percentage points, if all else is held constant. As was argued with the *R&DInt* coefficients, this magnitude seems more than sizeable enough to indicate economic significance. Comparing these results with the leverage ratio regression in Table 3, we find our results to be coherent regarding the effect on leverage. Intangible assets positively affect both debt and equity, but its effect on debt must be dominating as the overall effect on the leverage ratio is positive. The dominating effect of debt is supported by the magnitude of the coefficients, as they are larger for *ΔDebt* than *ΔEquity.*

The positive relationship between intangible assets and change in debt is likely to arise, as our intangible assets are identifiable, may be collateralizable and may therefore support debt as tangible assets do (Lim et al., 2019). It can also be explained with reference to the low level of tangibility, as firms with sufficient tangible assets will support all the debt they require, thus making it unnecessary for intangible assets to back debt. Furthermore, from the perspective of the pecking order theory, firms with few tangible assets, such as IT services firms, are more sensitive to information asymmetries. These firms will thus issue debt rather than equity when they are in need of external funds (Harris & Raviv, 1991). As more intangible assets seem to indicate that IT services firms issue both more debt and equity, but in a greater magnitude for debt, our results from the OLS without fixed effects are consistent with the pecking order theory.

However, when accounting for fixed effects, we experience the same loss of significance and magnitude for the *Intangibility* coefficients as with the *R&DInt* coefficients. Though we do not use an instrument for intangible assets, the results provide no indications that intangibility affects either the issuance of debt or equity on a within-firm level. We find it peculiar that none of the examined variables seem to show a significant relationship with either leverage ratio or changes in equity and/or debt when controlling for fixed effects. This is especially true of intangibility, as we hypothesized that it has at least some impact on the capital structure of IT services firms.

5.3 Robustness

We test the robustness of our results in three different ways. First, we repeat our regression analysis in Table 3 by using different definitions of leverage, following Rajan and Zingales (1995). Thereafter, we estimate the leverage ratio regressions using lagged values of the independent variables. Lastly, we examine our findings for biases that might arise from differences in the institutional regimes.

Column (4) in Table 3 has been revised with alternative measures of leverage to determine whether our previous results depend on how leverage is defined. We choose the model in Column (4) as it accounts for firm and year-fixed effects, thus reducing the omitted variable bias. The different measurements for leverage are presented in Table A1, and the results from the regressions in Table A4. The regressions support the conclusion that tangibility, size, and profitability are the most reliant drivers of corporate leverage in the IT services industry. For the remaining variables, the coefficients show the same signs as in Table 3; however, the significance levels do vary in some instances.

The leverage ratio regressions in which the explanatory variables are lagged by one period are presented in Table A5. To some extent, we mitigate the concern for reverse causality and simultaneity bias by lagging the independent variables. The results for the OLS models and fixed effect models remain unchanged with the different specification.

Lastly, following Drobetz et al. (2013), we examine our regression output for biases that might exist due to differences in institutional regimes between countries. Accessibility to external finance is determined by a country's legal origin (LaPorta et al., 1998). It is commonly accepted that capital markets in countries with common law supply superior opportunities to manage their capital structure (Halling et al., 2012; Drobetz et al., 2013). According to Fan et al. (2012), the legal regime explains a substantial part of the cross-sectional variance in corporate leverage, where systems, with common law being associated with lower leverage ratios than countries with civil law systems. To test the robustness of our firm-specific determinants of leverage across countries, we add cross-product terms between our variables and a dummy variable indicating law regime. The results are documented in Table A6.

Overall, the coefficients on the non-cross terms remain mainly unchanged. There is, however, some evidence for an increased influence of dividend payout ratio and profitability on leverage in countries with common law systems. Besides these two variables, the cross-product terms are largely insignificant. We conclude that our dependent variables are mainly independent of institutional characteristics, which indicates that IT services firms are mostly independent of country-level influences. To summarize, our results are robust across the three different robustness tests.

6. Conclusion

6.1 Summary and Conclusion

The aim of this study has been to analyse which factors affect the capital structure of globally listed IT services firms with a focus on the effect of R&D intensity and intangible assets. Therefore, this study's research question is as follows:

Can R&D intensity and intangible assets help explain capital structure for IT services firms?

To answer this question, we first provided a literature review on capital structure, and utilized this to develop our hypotheses and variables. Next, we ran regressions with these variables on leverage ratio and changes in debt and equity.

The intuition behind *hypothesis 1* is that innovative firms with high R&D intensity have a higher degree of asymmetric information between insiders and outsiders. Thus, signalling can lead to the undervaluation of new shares, thereby making equity issuances less preferable than debt issuances. Secondly, the relationship between R&D intensity and leverage is positive for biotechnology firms which have industry traits similar to those of IT services.
Since intangible assets can help generate cash flow, and because any valuable asset should at least contribute somewhat to increase a firm's debt capacity, we expect intangible assets to have a positive effect on debt. This is the main reasoning behind *hypothesis 2*.

To answer the research question and hypothesis, we have developed measurements for debt- and market leverage ratios and measurements for debt and equity issuance. Also, we have included implied R&D tax subsidy as an instrumental variable in an attempt to establish a causal relationship between R&D intensity and the issuance of debt and equity. Before we investigate whether the effects on capital structure are driven from changes in equity or debt, we first run regressions on leverage ratios to establish which determinants affect capital structure.

From the empirical sections of this thesis, we derive the following conclusions. Standard determinants of capital structure show traits similar to those of previous empirical work. Judging from the macroeconomic factors alone, recession seems to be a reliant determinant of the overall leverage ratio of IT services firms. However, the inclusion of the macroeconomic variables does not explain much of the variance in leverage ratio. Regarding *hypothesis 1*, we find that, before the inclusion of firm-fixed effects, a significantly negative relationship exists between R&D intensity and leverage. However, the negative effect becomes insignificant when firm-fixed effects are included. By accounting for firm-fixed effects, the explanatory power of the models increases considerably. This makes many of the variables, such as *R&DInt*, lose their significant effect, implying that the capital structure of IT services firms to a large extent is driven by an unobserved time-invariant component. Because we are not able to establish a causal relationship between R&D intensity and debt for IT services firms, we reject *hypothesis 1*. In fact, R&D intensity seem to have a negative relationship with both leverage ratio and debt. We confirm that IT services firms do not have the same positive relationship between R&D intensity and leverage as biotechnology firms. Across all models in the leverage ratio regression, we observe a positive relationship between intangible assets and leverage. The magnitude of the coefficients is somewhat smaller than those of tangible assets, thereby indicating that intangible assets do not support debt as much as tangible assets for IT services firms. Nevertheless, we reject *hypothesis 2*, as the observed positive effect of tangible assets on leverage is not significant to the inclusion of firm-fixed effects. In conclusion, intangible assets and R&D intensity are not reliable determinants of capital structure for IT services firms.

6.2 Limitations

This study has three key limitation, the first of which is related to the data collection and its reliability. Gathering the data was a time-demanding process, and the amount of data was too large for us to manually assure its accuracy. However, we retrieved the data from acknowledged sources in an attempt to minimize inaccuracies. Furthermore, for a very small section of our sample, we manually checked companies' financial reports, and we observed that most of the data aligned. Nevertheless, we found that numbers from a company's financial statement diverged from the collected data in a few instances. Though we cannot document the magnitude of these inaccuracies, they may have affected our data to some extent.

Secondly, there is a limitation related to the classification of firms. Firms were included based on SIC codes associated with the IT services industry. Thus, errors in our data may have arisen if a firm changed its main business between 2006 and 2018. In addition, we found companies that were defined within the SIC codes but whose main business activity clearly deviated from IT services. For example, firms operating within mining and shipping were present in our sample. Consequently, there is a possibility that our dataset contains some firms which are clearly not within the IT services sector. It is also possible that our dataset is missing firms that actually operate within the IT services sector.

Lastly, as mentioned in Chapter 4, different accounting standards exists across countries. These differences are not considered in this study. By gathering all the financial numbers from one database, we mitigate some inaccuracies that might arise. Due to the different accounting standards implemented in different countries, it is not unlikely that our results are affected to some extent.

6.3 Further Research

Keeping our limitations in mind, we note that a natural starting point for further research would be an improvement of the inaccuracies mentioned above. Furthermore, our data consists solely of listed firms which are predominantly large and mature. To obtain a deeper understanding of the capital structure of companies and the effect of R&D intensity and intangibility, adding non-listed firms to the sample would contribute with valuable information. It would be reasonable to assume that these firms are affected in a different manner, and an analysis of such companies would provide additional insight into the topic.

Because this study has used data from 26 countries, an interesting approach would be to go deeper into cross-country differences. In our study, we distinguished between countries with common or civil law as a robustness test. However, cultural and institutional differences are likely to affect a firm's capital structure beyond what is explained by a country's legal system. Therefore, it would be interesting to determine how these dissimilarities influence the effects of the variables on the overall capital structure.

Another approach for further research would be to incorporate aspects of behavioural corporate finance. Managerial traits and discretionary judgment are likely to have some impact on a firm's R&D expenditures. Are there differences between female and male managers willingness to invest in R&D? And what if the managers are innovators themselves (e.g., Elon Musk)? By capturing these traits, it would be interesting to investigate to what extent such managerial characteristics effect R&D intensity and capital structure. The possibilities for further research on this topic are many. We hope this study contributes to and encourages further research in the field of capital structure.

7. References

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8. Appendix

Table A1
Variable Construction

Variable	Variable Construction
Company-specific variables	
Book leverage	(Long term debt + Debt in current liabilities)/(Total assets)
Market leverage	(Long term debt + Debt in current liabilities)/(Total assets - Ordinary equity + Market value of equity)
ΔDebt	(Long term debt$_{t+1}$ + Debt in current liabilities$_{t+1}$)/(Long term debt$_t$ + Debt in current liabilities$_t$) – 1
ΔEquity	(Common shares$_{t+1}$)/(Common shares$_t$) – 1 (adj. for stock split using Compustat variable SPLIT)
Tangibility	Tangible assets/Total assets
Intangibility	(Intangible assets – Goodwill)/Total assets
Profit	Operating income before depreciation/Total assets
M/B	(Total assets - Ordinary equity + Market value of equity)/Total assets
LNSize	Ln(Total assets)
R&DFirm	1 if R&D expenses is greater than 0, else 0
R&DInt	R&D expenses/Total sales
Dividend	Dividends paid/Net income
Macroeconomic factors	
Recession	1 if recession, else 0
MSCI	Annual stock market return of the MSCI World Index
Spread	10-Year treasury constant maturity minus 3-month treasury constant maturity
Inflation	Annual yearly growth rate in OECD.
Alternative measurements of leverage ratio and Law (robustness)	
Book leverage 2	(Total assets – Ordinary equity)/Total assets
Book leverage 3	(Long term debt + Debt in current liabilities)/(Ordinary equity + Long term debt + Debt in current liabilities)
Market leverage 2	(Total assets – Ordinary equity)/(Total assets – Ordinary equity + Market value of equity)
Market leverage 3	(Long term debt + Debt in current liabilities)/ (Market value of equity + Long term debt + Debt in current liabilities)
Law	1 if country has common law regime, else 0

Table A2
Data Description

Data	Source	Description
Company-specific data		
Total assets	Compustat	Total assets and liabilities of a company at a point in time.
Common shares	Compustat	Number of common/ordinary shares outstanding as of the company's fiscal year-end. For ΔEquity common shares are adjusted for stock splits and reverse stock splits.
Ordinary equity	Compustat	Common stock outstanding, capital surplus, retained earnings, and adjustments for treasury stocks.
Debt in current liabilities	Compustat	This item represents the total amount of short-term notes and the current portion of long-term debt due in 1 year.
Long term debt	Compustat	Debt obligations due more than one year from the company's balance sheet date.
Total short time debt	Compustat	This item represents liabilities due within one year, including the current portion of long-term debt.
Operating income before depreciation	Compustat	Sales revenue less operating expenses.
Tangible assets	Compustat	Property, plant and equipment.
Intangible assets	Compustat	Copyrights, design costs, goodwill, licenses, patents, trademarks and tradename, software, operating rights etc.
Goodwill	Compustat	The excess cost over equity of an acquired company.
Market value of equity	Bloomberg	The market value of equity at the end of the financial year.
Dividend	Bloomberg	Dividend paid that financial year.
Macroeconomic data		
Recession	Datastream	NBER classifies recession as a significant decline in economic activity spread across the economy, lasting more than a few months.
R&D tax credit	OECD	Implied R&D tax subsidy rates for a given country in a specific year.
MSCI World Index	MSCI	The MSCI World Index is a broad global equity index that represents large and mid-cap equity performance across all 23 developed markets countries.
Spread	Federal reserve	10-Year treasury constant maturity minus 3-month treasury constant maturity.
Inflation	OECD	Annual yearly growth rate in OECD.
Exchange rates	Datastream	
Law regime	World Factbook	

Table A3
Company Statistics

Number of companies, percentage of total observations, law system and highest recorded implied R&D tax subsidy rate during the period of 2006 to 2018.

Country	Companies	%	Law system	R&D tax subsidy
Japan	158	18.49%	Civil	17%
USA	122	15.07%	Common	6%
China	98	11.52%	Civil	15%
UK	85	10.18%	Common	11%
South Korea	81	9.79%	Civil	11%
France	72	8.97%	Civil	45%
Sweden	34	4.32%	Civil	5%
Germany	23	3.23%	Civil	-2%
Australia	20	2.88%	Common	12%
Canada	18	2.69%	Common	18%
Norway	13	1.92%	Civil	22%
Finland	11	1.57%	Civil	28%
Poland	9	1.20%	Civil	22%
South Africa	9	1.15%	Common	17%
Italy	9	1.22%	Civil	12%
Switzerland	7	0.98%	Civil	-1%
Israel	7	0.95%	Civil	0%
The Netherlands	7	0.94%	Civil	15%
Denmark	6	0.76%	Civil	0%
Greece	6	0.63%	Civil	11%
Austria	4	0.44%	Civil	17%
Belgium	3	0.44%	Civil	16%
Portugal	2	0.36%	Civil	41%
Ireland	2	0.17%	Common	29%
Russia	1	0.07%	Civil	11%
Spain	1	0.05%	Civil	45%

Table A4
Panel Data Regression Using Alternative Measures on Leverage

The table shows the results of the leverage regressions using a sample of 808 listed IT services firms during the period from 2006 to 2018, with alternative measures of leverage. Definitions of leverage are provided in table A1. Standard errors clustered at firm level are given in parenthesis. Firm FE and Year FE effects indicate whether firm and calendar year fixed effects are included in the specification. The symbols *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)
Dep.Var:	Book (2)	Book (3)	Market (2)	Market (3)
R&DInt	-0.138*	-0.052	-0.090*	-0.063
	(0.072)	(0.076)	(0.048)	(0.047)
R&DFirm	0.018*	0.009	0.016*	0.005
	(0.010)	(0.012)	(0.010)	(0.012)
Intangibility	0.017	0.033	0.043	0.019
	(0.077)	(0.076)	(0.054)	(0.052)
Tangibility	0.302***	0.405***	0.181***	0.218***
	(0.090)	(0.108)	(0.061)	(0.069)
M/B	0.011**	0.002	-0.095***	-0.042***
	(0.005)	(0.005)	(0.005)	(0.006)
Profit	-0.330***	-0.381***	-0.288***	-0.242***
	(0.050)	(0.058)	(0.038)	(0.042)
LNSize	0.017	0.040***	0.037***	0.053***
	(0.013)	(0.015)	(0.009)	(0.010)
Dividend	-0.006	-0.006	-0.010**	-0.009**
	(0.005)	(0.006)	(0.004)	(0.005)
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	yes	Yes
N	6413	6413	6413	6413
adj. R^2	0.743	0.668	0.803	0.686

Table A5
Panel Data Regression Using Lagged Independent Variables

The table shows the results of the leverage regressions using a sample of 808 listed IT services firms during the period from 2006 to 2018, where all independent variables are lagged by one period. Standard errors clustered at firm level are given in parenthesis. Firm FE and Year FE effects indicate whether firm and calendar year fixed effects are included in the specification. The symbols *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)
Dep.Var: Book leverage$_t$				
R&DInt$_{t-1}$	-0.139***	-0.018	-0.136***	-0.013
	(0.041)	(0.048)	(0.042)	(0.048)
R&DFirm$_{t-1}$	-0.023**	-0.002	-0.024**	0.002
	(0.010)	(0.008)	(0.010)	(0.008)
Intangibility$_{t-1}$	0.219***	0.035	0.219***	0.039
	(0.044)	(0.048)	(0.044)	(0.049)
Tangbility$_{t-1}$	0.248***	0.249***	0.252***	0.241***
	(0.061)	(0.072)	(0.061)	(0.071)
M/B$_{t-1}$	-0.010***	0.002	-0.011***	0.002
	(0.004)	(0.003)	(0.004)	(0.004)
Profit$_{t-1}$	-0.167***	-0.134***	-0.161***	-0.134***
	(0.037)	(0.041)	(0.037)	(0.042)
LNSize$_{t-1}$	0.016***	0.026***	0.016***	0.029***
	(0.003)	(0.008)	(0.003)	(0.009)
Dividend$_{t-1}$	-0.035***	-0.001	-0.035***	-0.000
	(0.007)	(0.003)	(0.007)	(0.003)
Year FE	No	No	Yes	Yes
Firm FE	No	Yes	No	Yes
N	5542	5542	5542	5542
adj. R^2	0.115	0.690	0.117	0.693

	(1)	(2)	(3)	(4)
Dep.Var: Market leverage$_t$				
R&DInt$_{t-1}$	-0.106***	-0.030	-0.105***	-0.015
	(0.031)	(0.032)	(0.031)	(0.032)
R&DFirm$_{t-1}$	-0.020**	-0.009	-0.019**	-0.002
	(0.008)	(0.007)	(0.009)	(0.007)
Intangibility$_{t-1}$	0.159***	0.027	0.160***	0.034
	(0.034)	(0.038)	(0.034)	(0.039)
Tangbility$_{t-1}$	0.211***	0.118***	0.214***	0.096**
	(0.050)	(0.043)	(0.050)	(0.041)
M/B$_{t-1}$	-0.030***	-0.011***	-0.031***	-0.008***
	(0.002)	(0.002)	(0.003)	(0.003)
Profit$_{t-1}$	-0.107***	-0.084***	-0.105***	-0.090***
	(0.024)	(0.029)	(0.024)	(0.029)
LNSize$_{t-1}$	0.009***	0.030***	0.009***	0.039***
	(0.003)	(0.006)	(0.003)	(0.007)
Dividend$_{t-1}$	-0.029***	-0.002	-0.028***	0.000
	(0.005)	(0.003)	(0.005)	(0.003)
Year FE	No	No	Yes	Yes
Firm FE	No	Yes	No	Yes
N	5523	5523	5523	5523
adj. R^2	0.186	0.710	0.196	0.727

Table A6
Panel Data Regression Controlling for Law Regime

The table shows the results of the leverage ratio regressions using a sample of 808 listed IT services firms during the period from 2006 to 2018, In addition, the cross-products terms with the explanatory variables and country law regime dummy is included. The variable Law is set equal to one for countries with common law regime and zero otherwise. Standard errors clustered at firm level are given in parenthesis. Firm FE and Year FE effects indicate whether firm and calendar year fixed effects are included in the specification. The symbols *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	Dep.Var: Book leverage				Dep.Var: Market leverage			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
R&DInt	-0.159***	-0.005	-0.160***	-0.004	-0.113***	-0.041	-0.116***	-0.038
	(0.043)	(0.044)	(0.043)	(0.044)	(0.031)	(0.029)	(0.032)	(0.030)
R&DFirm	-0.016	-0.005	-0.016	-0.001	-0.015*	-0.003	-0.014	0.002
	(0.010)	(0.008)	(0.011)	(0.008)	(0.009)	(0.007)	(0.009)	(0.007)
Intangibility	0.257***	0.009	0.257***	0.014	0.164***	-0.005	0.165***	0.002
	(0.055)	(0.050)	(0.055)	(0.051)	(0.040)	(0.039)	(0.040)	(0.039)
Tangibility	0.292***	0.349***	0.294***	0.342***	0.230***	0.210***	0.231***	0.199***
	(0.063)	(0.072)	(0.063)	(0.071)	(0.050)	(0.045)	(0.050)	(0.044)
M/B	-0.011***	-0.004	-0.011***	-0.001	-0.035***	-0.026***	-0.034***	-0.020***
	(0.004)	(0.003)	(0.004)	(0.003)	(0.002)	(0.003)	(0.002)	(0.003)
Profit	-0.246***	-0.241***	-0.243***	-0.244***	-0.156***	-0.156***	-0.156***	-0.164***
	(0.039)	(0.043)	(0.040)	(0.044)	(0.026)	(0.031)	(0.026)	(0.031)
LNSize	0.013***	0.029***	0.013***	0.031***	0.008***	0.029***	0.008***	0.035***
	(0.003)	(0.010)	(0.003)	(0.012)	(0.003)	(0.006)	(0.003)	(0.008)
Dividend	-0.040***	-0.009**	-0.040***	-0.009**	-0.033***	-0.008**	-0.033***	-0.008**
	(0.006)	(0.004)	(0.006)	(0.004)	(0.005)	(0.003)	(0.005)	(0.003)
R&DInt * Law	0.036	-0.001	0.034	-0.002	0.082	0.063	0.080	0.072
	(0.127)	(0.165)	(0.127)	(0.163)	(0.089)	(0.102)	(0.090)	(0.102)
R&DFirm * Law	-0.022	0.007	-0.021	0.008	-0.004	0.011	-0.005	0.009
	(0.028)	(0.017)	(0.028)	(0.017)	(0.022)	(0.013)	(0.023)	(0.013)
Intangibility * Law	-0.186**	0.022	-0.185*	0.018	-0.070	0.028	-0.070	0.021
	(0.094)	(0.092)	(0.095)	(0.094)	(0.071)	(0.071)	(0.071)	(0.073)
Tangibility * Law	-0.289	-0.014	-0.287	-0.042	-0.092	-0.086	-0.096	-0.125
	(0.235)	(0.252)	(0.235)	(0.262)	(0.206)	(0.178)	(0.208)	(0.189)
M/B * Law	-0.019	0.059**	-0.019	0.059**	-0.031*	-0.018	-0.030*	-0.016
	(0.023)	(0.024)	(0.023)	(0.024)	(0.017)	(0.021)	(0.018)	(0.021)
Profit * Law	0.249**	0.080	0.246**	0.071	0.208***	0.091	0.202***	0.072
	(0.105)	(0.073)	(0.106)	(0.074)	(0.076)	(0.064)	(0.076)	(0.065)
LNSize * Law	0.011*	0.011	0.011*	0.014	0.006	-0.005	0.006	-0.003
	(0.007)	(0.016)	(0.007)	(0.016)	(0.005)	(0.011)	(0.005)	(0.011)
Dividend * Law	0.013	0.040**	0.013	0.042**	0.007	0.021*	0.007	0.024*
	(0.029)	(0.016)	(0.029)	(0.017)	(0.020)	(0.012)	(0.020)	(0.013)
Year FE	No	No	Yes	Yes	No	No	Yes	Yes
Firm FE	No	Yes	No	Yes	No	Yes	No	Yes
N	6413	6413	6413	6413	6413	6413	6413	6413
adj. R^2	0.140	0.686	0.140	0.688	0.233	0.721	0.233	0.726