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The impact of capital structure on firm performance: Evidence from British high-tech firms

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Abstract

This study investigates the impact of capital structure on firm performance of British high-tech firms. Capital structure is measured by the following three ratios, total debt ratio, long-term debt ratio and short-term debt ratio, while firm performance is measured by ROE, ROA and Tobin's Q. Most data is collected from the database ORBIS over the sample period of 2015 till 2018, while some other data is collected manually from annual reports of the firms. Based on a sample of 466 British high-tech firms, OLS regression analyses are conducted. Literature has indicated that capital structure can have a positive and negative impact on firm performance. Therefore, this study develops two hypotheses. The results show a negative and significant impact of all measurements of capital structure on ROE, ROA and Tobin's Q. This indicates that increasing debt, regardless of the duration of leverage, lowers firm performance. Robustness tests are conducted in order to increase the validity and reliability of the main findings. With the use of lagged variables and a subsample, the negative impact of capital structure on firm performance is confirmed. Future research is needed to assess the generalizability of these findings.

Keywords: Capital structure, leverage, firm performance, high-tech firms, UK.

Table of contents

1. Introduction 5
1.1 Background information 5
1.2 Research objective and contribution 6
1.3 Outline of the study 7
2. Theories and empirical research 8
2.1 Theories on capital structure 8
2.1.1 Irrelevance theory 8
2.1.2 Trade-off theory 9
2.1.3 Pecking-order theory 10
2.1.4 Agency theory 11
2.1.5 Signaling theory 12
2.1.6 Free cash flow theory 12
2.1.7 Conclusion 12
2.2 Empirical review 13
2.2.1 Empirical studies about capital structure theories 13
2.2.2 Capital structure and firm performance 16
2.2.3 Capital structure and firm performance based on high-tech firms 18
2.2.4 Firm-specific determinants of firm performance 20
2.3 Debt finance 22
2.3.1 Advantages of debt finance 22
2.3.2 Disadvantages of debt finance 22
3. Development of hypotheses 23
3.1 Positive impact on firm performance 23
3.2 Negative impact on firm performance 24
4. Research method 25
4.1 Research design 25
4.2 Dependent variables 27

4.3 Independent variables 28
4.4 Control variables 28
4.5 Robustness tests 31
5. Sample and data 32
5.1 Sampling procedure 32
5.2 Data collection 32
5.3 Availability of necessary data 33
6. Analysis and results 34
6.1 Outliers 34
6.2 Descriptive statistics 34
6.3 Correlation matrix 36
6.4 Assumptions regression 38
6.5 Multiple regression results 38
6.5.1 Impact of capital structure on firm performance (ROE) 38
6.5.2 Impact of capital structure on firm performance (ROA) 41
6.5.1 Impact of capital structure on firm performance (Tobin's Q) 42
6.6 Robustness tests 41
6.6.1 Lagged variables 41
6.6.2 Subsample 41
7. Conclusion and limitations 42
7.1 Conclusion 42
7.2 Limitations and recommendation for future research 43
References 44
Appendices 49

1. Introduction

1.1 Background information

Nowadays, technology becomes increasingly important in the society and businesses. Financial managers' objective is to maximize the value of their firm. Technology can help to improve this value. Barney (1991) states that competitive advantages can be achieved by offering a wide variety of products. Distinguishing a firm relative to competitors is thus a key aspect in order to create competitive advantages. One of the important elements to stay ahead of competition is to focus on research and development (R&D) and innovation management (Dereli, 2015). In addition, Zahra and Bogner (1999) state that technological capability is one of the essential resources for new ventures to develop and grow. Financial resources have an important contribution to make these innovations possible (Zahra & Bogner, 1999). Therefore, managers have to determine their financial needs and examine the optimal capital structure that leads to higher performance. Chen et al. (2009) examine the impact of technological and financial capabilities on firm performance based on 238 high-tech firms. They conclude that technological and financial resources have a significant impact on firm performance (Chen et al., 2009).

Technology firms differ from other companies because of their unique characteristics. One of their characteristics is that the core business of technology firms is based on technological activities (Grinstein & Goldman, 2006). Also, technology firms differ from other firms because they mainly focus on R&D and their aim is to keep innovating. These firms have a main contribution in increasing the economic situation of a country and contribute to the creation of new products, services and industries (Grinstein & Goldman, 2006). These firms also sell their products and services to customers that adapt to technological changes easily. Based on these unique characteristics of technology firms, it is interesting to examine these firms. According to Chen et al. (2009), high-tech firms operate mostly in industries such as pharmaceutical products, electronics equipment and information technology. Insufficient financial resources will restrict the investment opportunities of high-tech firms and could have a negative impact on firm value (Ang, 1992).

Besides that, high-tech firms are also unique because of the level of information asymmetry. As already mentioned, high-tech firms are mainly focused on R&D investments. According to Gharbi et al. (2014), companies that invest in R&D have higher information asymmetry compared to companies that invest in tangible assets for a couple of reasons. First of all, information asymmetry between managers and outsiders increases because high-tech firms do not prefer to share detailed information in order to protect their innovation advantages (Gharbi et al., 2014). Secondly, these investments are more difficult to value because of their uniqueness, uncertainty and complex nature (Gharbi et al., 2014). Finally, R&D investments are most of the time only reported in the profit and loss statement. As a result, the values of these investments are not provided completely (Gharbi et al., 2014).

Investigating the fluctuations of firm performance is an important aspect in order to make financial decisions in businesses. The aim of financial managers is to increase the performance and maximize the value of the firm. Growing literature investigate the relation between capital structure and firm performance. This research is related to previous studies that investigate the effect of differences in capital structure. For example, Jadoua and Mostapha (2020) argue that small and medium-sized companies that have a higher percentage of debt finance related to the total assets of the firm also have higher performance. Weill (2008) examines the impact of institutional environment on the relation between firm performance and capital structure. The findings show that

the impact of capital structure differs across countries, which confirms the impact of institutional factors. These results are supported by the study of Rajan and Zingales (1995). Multiple theories are developed to explain the relation between capital structure decisions and firm performance, for example the irrelevance theory that is developed by economists Modigliani and Miller, pecking-order theory and trade-off theory. Several empirical studies have tested the hypotheses of these capital structure theories. For example, Harris and Raviv (1991) tested the pecking-order hypothesis and confirmed the theory. A combination of these theories gives insights in the decisions managers make according to their financial mix and the effect of capital structure on firm performance. These theories are discussed in the second chapter of this study. Since many years, researchers are performing theoretical and empirical studies on capital structure. Academicians investigated this topic and developed theoretical models to get a better understanding about capital structure decisions firms make and its impact on firm value (Kamath, 1997; Scott, 1979). Myers (2001) states that capital structure decisions vary across countries and the empirical study of Omran and Pointon (2009) concludes that the capital structure depends on the industry in which the firm operates.

1.2 Research objective and contribution

To the best of my knowledge, existing research does not explain the relation between capital structure and firm performance based on a sample of technology firms that are based in the United Kingdom (UK). According to Crick and Crick (2014), high-tech firms that are based in the UK have an international strategy. These high-tech firms grow faster than high-tech firms that are located in other countries (Crick & Crick, 2014). As mentioned earlier, high-tech firms are unique because they differ from other firms. This is the reason it is interesting to investigate the performance of British high-tech firms. Therefore, the main objective of this study is to investigate the effect of capital structure on the performance of British technology firms. This leads to the following research question that will be answered:

"Does capital structure have an impact on the performance of high-technology firms?"

In order to answer this question, one sample of 466 British high-tech firms is used. Most data is collected from the database ORBIS over the sample period of 2015 till 2018. This study uses the OLS regression method in order to test the impact of capital structure on firm performance.

This study is important for a couple of reasons. First of all, the conclusion contributes to the general research field of finance, capital structure and firm performance. Secondly, it fills the existing gap in the literature and extends the literature by analyzing the relation between capital structure and firm performance of British high-tech firms. Finally, financial managers of tech firms can get a better understanding of factors that influence firm performance and can use this information to make capital structure decisions and to maximize the performance of their firms. To conclude, the findings of this study are useful new insights for managers of high-tech firms.

1.3 Outline of the study

The remaining chapters of this study are organized as follow: the second chapter of this thesis describes the theoretical and empirical literature associated with the research topic. In the third chapter hypotheses are formulated based on the theoretical background. Chapter four and five explain which research method is used and describe the data sources and sampling procedure. Chapter six presents the analyses and results of this study, including the robustness tests. Lastly, in chapter seven the conclusion is outlined in which the key findings are summarized and an answer to the research question is given, followed by the limitations of this study and recommendations for future research.

2. Theories and empirical research

In this chapter literature associated with the research topic is described and used as a theoretical background to develop the hypotheses. After that, empirical review is outlined in which studies associated with the research question are included. The literature and empirical research is outlined in the following sections and subsections.

2.1 Theories on capital structure

A firm's capital structure indicates how assets of a firm are financed and refers to the combination of debt and equity finance (Cekrezi, 2013; Myers, 2001). Debt holders and equity holders represent the two main financial sources of a company (Kochhar, 1997). According to Myers (2001), the optimal capital structure refers to the best combination of equity and liabilities that maximizes firm performance and minimizes cost of capital (WACC). A highly leveraged firm has financed its assets with more debt than equity finance and an unleveraged firm is financed with only equity (Cekrezi, 2013).

The theories associated with capital structure started with the economists Modigliani and Miller. According to Chen and Chen (2011), the trade-off theory, pecking-order theory and agency theory are theories that are mostly discussed in financial literature. These theories further investigated the rationale behind capital structure decisions. Capital structure has an impact on the value of the firm, therefore academicians investigated how firms choose their capital mix and their level of leverage (Cekrezi, 2013). Theories associated with capital structure mention the following main reasons; tax benefits, asymmetric information and agency costs (Myers, 2001). These theories are outlined in the next subsections.

2.1.1 Irrelevance theory

The irrelevance theory is developed by Modigliani and Miller in 1958 (Modigliani & Miller, 1963; Myers, 2001; Scott, 1976). According to Cekrezi (2013), this theory started the debate and increased the interest in capital structure and its impact on firm value and performance. The irrelevance theory states that differences in capital structure of a firm does not have an impact on the value of firms, assuming that taxes, bankruptcy costs and transaction costs does not exist (Cekrezi, 2013; Modigliani & Miller, 1963; Myers, 2001; Scott, 1976). The last assumption is that investors and corporations can borrow and lend at the same rate (Modigliani & Miller, 1963). Thus, Myers (2001) concludes that this theory is based on a perfect capital market.

If two firms are identical, but the first firm is financed with only equity and the second firm is highly leveraged, this theory argues that the value of the two firms does not differ from each other (Myers, 2001). This is the reason this theory is known as the 'capital structure irrelevance principle' (Cekrezi, 2013). Thus, Modigliani and Miller (1963) argued that the value of a firm only depends on the left side of the balance sheet and is not affected by the financial decisions of the company. This is based on two arguments. First of all, the 'law of conservation of value' states that the present value of debt and equity finance is combined the same as the sum of their present values, which means that it does not matter how a company would slide the 'financial pie' (Myers, 2001). Secondly, investors can offset the changes that are made by the company because they can borrow and lend at the same rate, this is also referred to as homemade leverage (Myers, 2001). As a result, the value of the firm will not change. The irrelevance theory can be summarized as follow:

Value unlevered firm = Value levered firm

This theory is further developed by the same economists Modigliani and Miller in 1963, this is referred to as proposition II (Chen & Chen, 2011; Modigliani & Miller, 1963; Myers, 2001). This proposition excludes taxes and shows that the value of the WACC does not change with a different mix of equity and debt finance. However, capital structure decisions do have an impact on the cost of equity (Modigliani & Miller, 1963). The cost of equity will increase in proportion to the debt-equity ratio. Equity investors will require a premium to compensate for extra risk (Myers, 2001). To conclude, the first proposition of Modigliani & Miller states that capital structure does not have an influence on firm performance and shareholders' wealth. The second proposition explains that the rate of return they can expect increases if the debt-equity ratio of the firm increases. After the M&M propositions, more researchers were focused on investigating the impact of capital structure.

2.1.2 Trade-off theory

As described in the previous section, the irrelevance theory assumed that taxes do not exist. The trade-off theory is the first theory that further develops the theory of Modigliani and Miller. This theory is developed by Kraus and Litzenberger in 1973 and states that a firm should make decisions about their capital structure by keeping the costs and incomes in balance, in order to determine the optimal capital structure and maximize the value of the firm (Cekrezi, 2013; Chen & Chen, 2011; Fama & French, 2002; Kraus & Litzenberger, 1973). So this theory balances the tax benefits of borrowing against costs of financial distress, as a result firms determine a target capital structure and aim to reach it. Kraus and Litzenberger (1973) state that the theoretical optimum is reached when the costs of financial distress is equal to the benefits of debt finance (tax shield).The interest firms pay because of having debt finance, can be distracted before paying taxes. Therefore, financial managers will increase their debt ratio in order to maximize tax advantages (Fama & French, 2002; Kraus & Litzenberger, 1973; Myers, 2001). Based on the WACC formula also can be concluded that the tax rate has to be distracted from the cost of debt (Attaoui, 2016; Harris & Pringle, 1985; Mari & Marra, 2019). The trade-off theory predicts that firms mostly use a combination of debt and equity finance and seek for the optimal capital structure. Therefore, Kraus and Litzenberger (1973) argue that companies should find the right balance between the tax benefits of using debt finance and the costs associated with financial distress (Fama & French, 2002; Myers, 2001). Of all theories that investigate capital structure, Hackbarth, Hennessy and Leland (2007) argue that the trade-off theory has the most added value to the field of finance and that the rationale behind this theory can explain most of the variation in firm performance.

Using more external sources increase the opportunity of financial distress. Financial distress can occur as a result of having a high percentage of debt finance related to the total value of the firm (Altman, 1984; Mari & Marra, 2019; Opler & Titman, 1994). The incoming cash flow is not enough to meet firm's debt obligations. This is the reason debt and equity holders take more risk when they invest in a high-leverage firm (Cekrezi, 2013; Kraus & Litzenberger, 1973; Myers, 2001). Costs of financial distress consist of direct and indirect bankruptcy costs (Myers, 2001). Direct bankruptcy costs are associated with the legal process of reorganizing a firm, for example lawyers and accountants. Indirect bankruptcy costs are related to firms that are close to bankruptcy. Myers (2001) states that agency costs will also increase as a result of financial distress, this is the reason agency costs are also a part of 'financial distress costs'. The interests of debt holders and stockholders are not aligned. However, the temptation to follow your own interest increases when a firm is in financial distress. According to Cekrezi (2013), companies should estimate the ideal debt

ratio that maximize firm performance and should search for a trade-off between maximizing tax benefits and minimizing financial distress costs. Based on the trade-off theory the value of a company should be calculated as follow (Kraus & Litzenberger, 1973):

> *Value firm = Value unlevered firm + Present value (tax shield) – Present value (costs of financial distress)*

Cekrezi (2013) assumes that firms with higher levels of performance use more external financial sources to decrease the amount of taxes they have to pay. According to this theory, more profitable firms should increase their debt ratio in order to have more taxable income to shield. As a result, this theory predicts a positive relation between debt ratios and firm performance. However, a disadvantage of this theory is that it cannot explain why some successful companies have lower debt ratios. The pecking-order theory (see next subsection) does explain this relationship.

2.1.3 Pecking-order theory

The trade-off theory states that firms should aim to determine its optimal financial mix and financial managers should set a target debt ratio. However, the pecking-order theory states that firms prefer a specific order to finance its business activities and should not set a specific target debt ratio (Fama & French, 2002; Jarallah, Saleh, & Salim, 2019; Myers, 2001). This theory is developed by Donaldson in 1961 and extended by Myers and Majluf in 1984. The theory states that a firm should first use its internal sources to finance itself, for example retained profits (Chen & Chen, 2011; Fama & French, 2002; Jarallah et al., 2019; Myers & Majluf, 1984). This is the profit left after paying taxes and dividend to shareholders. Financial managers can choose to re-invest this profit in the firm. If this financial source is not available or sufficient, firms should then use debt finance (Chen & Chen, 2011; Myers, 2001). Lastly, if internal sources and debt finance are not enough to achieve firm's objective, they should issue new equity in order to finance itself. As a result, existing owners have to share their ownership with 'new' stockholders, which mean that the price of a stock will decrease (Myers & Majluf, 1984). This is called dilution. Myers and Majluf (1984) assume that managers always operate in the interest of existing owners and aim to maximize the value of their shares. Therefore, they would only issue new shares if the debt ratio is already too high. To conclude, the pecking-order theory states that companies should follow the following order when choosing between financial sources; internal finance, debt finance and finally equity finance. This pecking order is based on asymmetric information (Chen & Chen, 2011; Fama & French, 2002; Jarallah et al., 2019; Myers, 2001; Myers & Majluf, 1984).

Myers and Majluf (1984) conclude that the pecking order is based on the differences between the available information between managers (insiders) of the firm and external investors (outsiders). Managers are aware of the risks, opportunities and value of the firm, while investors have less information available (Fama & French, 2002; Myers, 2001). Firms prefer internal funds because they do not have to share information or to send signals to external investors. However, issuing new securities will have a negative impact on the stock price because equity investors will worry that the firm has unfavorable information and they will predict that the shares are overpriced (Fama & French, 2002). As a result, the securities can only be sold at a lower market price. Debt holders are less affected by the signals than shareholders. This is the reason that pecking-order theory, which is based on asymmetric information, prefers debt issues over equity issues. To conclude, firms prefer internal finance over external finance because of the costs of the various sources of finance. Besides that, information asymmetry costs also arise as a result of more external

finance.

This theory explains why companies should prefer debt financing over equity financing in order to maximize firm value. Besides that, this theory points out the importance of having internal funds. Without internal funds, a firm can be forced to issue undervalued shares. Myers and Majluf (1984) also explain that firms with higher profits have less external finance because their internal financial source is mostly sufficient to achieve the objective of the firm (Myers, 2001). As a result, this theory predicts a negative relation between debt ratios and firm performance. To conclude, the trade-off theory predicts that firms increase their debt ratio until the target debt ratio is reached, while the pecking-order theory states that firms do not have a target debt ratio and use debt until the debt capacity is reached. Some empirical studies tested this theory and investigated if firms use the pecking-order theory to make capital structure decisions, these studies are outlined in section 2.2.

2.1.4 Agency theory

Also the agency theory plays a role in capital structure decisions. According to Myers (2001), this theory is developed by Jensen and Meckling in 1976. Agency problems can arise when ownership and control are separate in a company and managers do not run the company in the best interest of the owners, therefore they do not prefer to maximize the value of the firm (Berger & Di Patti, 2006; Myers, 2001).

If managers decide to issue new shares, existing owners have to share their ownership with new owners. Also, managers have to align their interests with more owners. Chen and Chen (2011) state that multiple mechanisms exist in order to motivate managers to follow the interests of stakeholders (owners) of the company, for example remuneration and board of directors. Costs that are associated with agency problems are called, agency costs (Berger & Di Patti, 2006). Myers (2001) states that agency costs also increase as a result of conflicts between debt holders and equity investors. These costs can be divided in equity agency costs and debt agency costs (Chen & Chen, 2011). Agency costs of equity arise as a result interest conflicts between managers and shareholders, while agency costs of debt increase as a result of conflicts between shareholders and debt holders (Chen & Chen, 2011; Hasan et al., 2014).

According to this theory, the optimal financial mix is achieved when the total agency costs are at the lowest level (Myers, 2001). High debt ratios reduces agency costs, because the company will issue less new shares and will have less equity agency costs, which will lead to higher firm values (Berger & Di Patti, 2006). Myers (2001) also states that debt financing will motivate managers to align their interests because of the increasing pressure to generate enough cash flow in order to pay the cost of debt finance. This is the reason the agency theory prefers debt financing over equity finance in the capital structure of a company. However, this theory also argues that debt ratios should not become too high because of an increase in bankruptcy costs (Berger & Di Patti, 2006). Therefore, this theory partly supports the trade-off theory in explaining that a high debt ratio will also lead to higher costs and therefore managers should not only focus on the benefits of debt finance in order to maximize firm performance. To conclude, agency costs hypothesis states that high leverage reduces agency costs and increases firm value and performance.

2.1.5 Signaling theory

In consistence with the pecking-order theory (see subsection 2.1.3), the signaling theory is based on the presence of asymmetric information. This means that internal information is not available for external parties. Spence (1973) developed this theory by stating that a high quality company can send a signal about their quality to their external environment. This signal will be effective if companies that have a lower level of quality are not able to send comparable signals to capital markets. This theory is further developed in 1977. Ross (1977) argued that debt ratios could be a signal that firms can use in order to distinguish itself from other companies due to the presence of asymmetric information between managers and potential investors. He also stated that firms with voluntary high debt ratios are associated with high quality because of the assumption that the firm predicts an optimistic future and will be able to pay their debt obligations. The signaling theory therefore states that debt ratios have a positive relation with attracting new financial resources and higher firm performance (Ross, 1977). To conclude, this theory can be used by managers to send a specific signal to investors in order to maximize the possibility of attracting financial resources.

2.1.6 Free cash flow theory

Lastly, the free cash flow theory is developed by Jensen in 1986 (Myers, 2001). Free cash flow refers to the amount of cash that is left over after the firm pays its required expenses and investments. A positive free cash flow means that the firm has excess cash. A negative value indicates that the firm does not have sufficient profit to pay its costs and investments. The free cash flow theory is built on the rationale of the agency theory. Both theories are based on agency costs and the conflict between shareholders' and managers' interests and incentives (Jensen, 1986; Myers, 2001). For example, managers have the control over the distribution and use of free cash flow. Therefore, managers can choose to use free cash flows to increase dividend, which is beneficial for shareholders. However, managers can also use free cash flows in their own interest.

The problem is how to encourage managers to invest free cash flows in a way that will lead to a maximization of firm value. Jensen (1986) says that leverage can be beneficial in order to solve these conflicts because debt forces a firm to generate enough cash flow in order to pay debt liabilities instead of using it in their own interest. As a result, managers will be more motivated and it will increase their efficiency and productivity, which will lead to lower agency costs and higher performance. This theory can mainly be applied to firm with large free cash flows (Jensen, 1986).

According to Myers (2001), free cash flow theory predicts that high leverage will have a positive impact on firm performance when the free cash flow of a company is higher than the profitable investment opportunities. Therefore, this theory does not necessary predicts how managers make capital structure decisions but is more focused on the consequences of capital structure decisions (Myers, 2001). This theory can partly explain why managers do not voluntarily increase their debt ratios, which can be used in order to explain why managers do not take full advantage of the tax benefits. Therefore, this reasoning may support why managers do not fully follow the trade-off theory.

2.1.7 Conclusion

There are multiple theories that explain the relation between capital structure and firm performance and firm value. The theory of Modigliani and Miller is based on a perfect capital market, which is not in line with the real circumstances in which firms operate. Based on the previous subsections, it can be concluded the trade-off theory recognizes the tax benefits of debt finance and states that the

value of a firm increases when it is more financed with debt financing. However, this theory also argues that companies should not aim to maximize debt financing in their capital structures and that a trade-off between debt and equity finance is the optimal financial mix. The trade-off theory therefore states that managers of companies should estimate the ideal debt ratio that maximizes firm performance.

However, the pecking-order theory states that firms prefer a specific order to finance its business activities and should not set a specific target debt ratio. According to this theory, managers should prefer debt financing over equity financing in order to maximize firm value. This order is based on the difference between the available information between managers and external investors. This order is in line with the signaling theory that states that high-leverage firms are associated with high quality because of the assumption that the firm predicts an optimistic future. The agency theory argues that high debt ratios reduces agency costs, because the company will issue less new shares and will have less equity agency costs, which will lead to higher firm values.

As mentioned earlier, Myers (2001) states that none of these theories can explain the general optimal capital structure. Therefore, none of these theories is valid for every firm. A combination of theories is required to get a total overview of capital structure strategies and its impact on firm performance. This study estimates the impact of capital structure on firm performance based on a sample of British high-tech firms. The third chapter of this thesis will use these theories as a theoretical background in order to develop hypotheses.

2.2 Empirical review

Several studies have empirically tested the capital structure theories, which are discussed in the previous section. These studies are outlined in this section. Besides that, many researchers have investigated the impact of capital structure on firm performance. In subsections 2.2.2 and 2.2.3, empirical evidence on the effect of capital structure on firm performance is described. The first part consists of studies that investigate the relation between capital structure and firm performance, not based on technology firms. The empirical studies outlined in the second part examine the same relation based on a sample of high-tech firms. An overview of the findings can be found in table 1 at the end of this section.

2.2.1 Empirical studies about capital structure theories

Irrelevance theory

As mentioned earlier, Modigliani and Miller have developed two propositions about the relation between firm value and capital structure. A couple of researchers have tested these equations. For example, Fosberg (2010) has investigated and tested the predictions of irrelevance theory. He found that neither the first proposition nor the last proposition can be used in order to estimate firm value because the results show that the level of leverage has an impact on firm value. Besides that, the coefficient of the interest expense variable has a negative sign, which contradicts the prediction of Modigliani and Miller. Additionally, the study of Fama and French (1998) investigates the relation between debt finance and firm value in order to test the second proposition. They used cross-sectional regressions with firm value as the dependent variable. The results of the study show a negative and significant impact of interest expenses on firm value which is not in line with the irrelevance theory.

Trade-off theory

Several studies have tested the relation between capital structure and firm performance in the context of trade-off theory. Most studies confirm that the factors, used by trade-off theory, are relevant in order to estimate capital structure decisions. For example, the study of Ju et al. (2005) concludes that tax shields and bankruptcy costs affect the desired capital mix of financial managers, therefore these results are consistent with the trade-off theory. Titman and Wessels (1988) empirically analyze the impact of multiple capital structure theories over the period 1974 till 1982. They used three capital structure ratios namely, short-term debt, long-term debt, and convertible debt. Titman and Wessels (1988) find that trade-off theory has a significant impact in determining capital structure decisions. However, Booth et al. (2001) analyze the hypotheses of the trade-off theory and the pecking-order theory. The following trade-off hypothesis is developed, firms with higher debt ratios have higher performances. They based their study on 10 developing countries. The findings show that firms with higher performances have lower debt ratios, which is not in line with trade-off theory. As a result, the researchers rejected the trade-off hypothesis and confirmed the pecking-order hypothesis. Additionally, the study of De Jong et al. (2011) analyzes the predictions of both trade-off theory and pecking-order theory. They developed the following hypothesis, when the target debt ratio is already reached but is not near the debt capacity, the trade-off theory predicts a decrease of leverage. However, in the same context, the pecking-order theory predicts an increase of debt ratio until the capacity is reached. Based on US firms, the findings are not consistent with the trade-off theory (De Jong et al., 2011).

According to this theory, firms have a target level of leverage, which is supported by several empirical studies. For example, Bhaduri (2002) confirms that firms have an optimal debt ratio that they aim to reach. Besides that, he tested the hypothesis that firm performance is positively related to leverage, which is developed based on trade-off theory. Based on the findings, he confirmed the hypothesis. In addition, Bancel and Mittoo (2004) compared the contribution of capital structure theories in capital structure decisions, based on a sample of 737 European countries. They used a qualitative approach and interviewed managers related to their debt policies. Reaching the target debt ratio is ranked as the most important determine of leverage. Also interest benefits are highly ranked by the participants. However, the findings show less support for the pecking-order theory and agency theory. Bradley et al. (1984) conclude that most of the firms in their sample establish an optimal capital mix based on the forecasted financial costs and tax benefits.

Pecking-order theory

Most studies provided significant findings regarding the role of pecking-order theory in making capital structure decisions. Researchers have tested this theory in order to investigate if companies use this order to make capital structure decisions. First of all, Chen and Chen (2011) examine the decisions managers make in their capital structures based on 305 Taiwan companies. Their results indicate that companies first use retained profits to finance itself which leads to a lower debt rate (Chen & Chen, 2011). Therefore, their study concludes that the pecking order is followed by the firms in their sample. Based on their empirical study, Chen and Chen (2011) also argue that firm performance is negatively associated with debt financing, because managers will prefer to use their internal financial sources to finance business activities. Jarallah et al. (2019) also argue that companies follow the pecking-order theory. The firms in their sample did not have an optimal debt ratio or capital structure, this indicates that the decisions of these managers are not in line with the trade-off theory. The study of Fama and French (2002) confirms that firms with more profit have

lower debt ratios and is therefore consistent with the pecking-order theory. De Haan and Hinloopen (2003) investigate the financial hierarchy that is used by Dutch companies. They conclude that Dutch companies prefer internal finance over external funds, which is in line with the hierarchy of pecking-order theory. Hovakimian et al. (2001) conclude that firms do not make capital structure decisions based on a target debt ratio. Also they find that firm profitability and performance are important predictors in order to estimate the level of leverage, after controlling for control variables. The findings of the study of Sheel (1994) show that leverage negatively impacts firm performance, therefore he found empirical evidence that supports the pecking-order theory. Lastly, Graham and Harvey (2001) used a qualitative approach to investigate if CFOs follow the pecking-order or trade-off theory to choose between debt and equity finance. The findings show support for the pecking-order hypothesis because the participants say that having sufficient internal finance is one of the key factors that lead to a reduction of leverage.

Agency theory

Agency theory states that debt finance reduces agency costs which lead to higher firm value and performance. Multiple empirical studies provide empirical evidence for the hypothesis of this theory. One of these studies is written by Berger and Di Patti (2006). They test if high-leverage firms have lower agency costs. The results are in line with the agency theory because the outcomes show a positive and significant relation between debt ratio and firm performance. They argue that using more debt finance decline agency cost of equity and motivate managers to act in the interest of shareholders. Li and Cui (2003) also examine the impact of capital structure on agency costs based on 211 Chinese firms. Their main finding show a negative and significant impact of capital structure, which is measured by debt to asset ratio, on agency costs. Firms with a higher debt to asset ratio have lower agency costs and higher ratio of return-on-equity (Li & Cui, 2003). According to these researchers, high leverage leads to creditors that are more worried that the firm is unable to repay the principal including the interest expenses. Therefore it motivates creditors to monitor the firm more precisely, which is confirmed by this empirical study.

Signaling theory

Limited researchers have tested the signaling theory. One of these studies is written by Eldomiaty (2004). He investigates the relation between capital structure and firm value based on the signaling theory. First of all, Eldomiaty (2004) divides firms based on their systematic risk into high, medium, and low. The results show that high debt ratios will give a negative signaling effect for high systemic risk firms, for both voluntary and involuntary high debt ratios. As a result, this researcher concludes that the signaling hypothesis have to be rejected based on the sample of this study.

Free cash flow theory

Free cash flow theory predicts that high leverage will have a positive impact on firm performance and value when the free cash flow of a company is higher than the profitable investment opportunities. As a result, higher debt ratios will lead to lower agency costs. Several empirical studies have tested the hypotheses of this theory. Park and Jang (2013) examine the relation between capital structure, free cash flow and firm performance. They developed the free cash flow hypothesis and tested it based on 308 companies over the period 1995-2008. The findings show that free cash flow is negatively related to firm performance. In addition, leverage is significantly and positively related to firm performance. Therefore, Park and Jang (2013) confirmed the free cash flow hypothesis. Brush et al. (2000) also investigated the agency argument that free cash flows have a negative impact on firm

performance, when a firm is mostly equity financed. Their results show that cash flow has a positive impact on firm growth and performance, however free cash flow is negatively related to firm performance. Thus, the study of Brush et al. (2000) found empirical evidence for the free cash flow theory.

Additionally, the study of Agrawal and Jayaraman (1994) aim to find empirical evidence for the free cash flow theory. They tested the hypothesis that firms with less leverage will tend to follow a dividend policy of higher payouts. Thus, they test if these two mechanisms can substitute each other in order to increase the pressure on managers and as a result reduce agency costs. The researchers divided the sample in an experimental group, unlevered firms, and control group, levered firms. The results show that dividends are significantly higher in unlevered firms than in firms with debt finance. Therefore, this study confirms that dividend payouts and leverage are substitute mechanisms to reduce agency costs (Agrawal & Jayaraman, 1994). Mansourlakoraj and Sepasi (2015) examine the relation between free cash flows, capital structure and firm performance based on 80 companies listed in Tehran. The results indicate that leverage has a positive impact on firm performance. Finally, Wang (2010) empirically tested the free cash flow theory based on Taiwanese firms. The findings show that agency costs negatively impact firm performance. However, he founds a positive relation between free cash flows and firm performance. As a result, he did not find evidence to confirm the free cash flow theory.

2.2.2 Capital structure and firm performance

Capital structure indicates the combination of debt and equity finance. In contrast to Modigliani and Miller (1963), most capital structure theories state that leverage can be related to firm performance. However, studies that investigate the impact of capital structure on firm performance show mixed empirical results (see table 1). According to Saad (2010), the financial structure choices of a firm have an impact on the performance of the firm because fluctuations in firm performance can partly be explained by the differences in capital structure. Nguyen and Nguyen (2020) argue that the relation can be stronger or weaker, depending on the industry in which the company operates.

Multiple existing studies find empirical evidence that leverage impacts firm performance. Ebaid (2009) examines the relation between debt ratios and firm performance based on a sample of non- financial companies listed in Egypt. The author finds that there is a negative impact of debt ratio on performance. That means that an increase in debt relative to total assets will result in lower firm performance. Also Khan (2012) finds a negative impact of capital structure on firm performance for firms that operate in the engineering sector and are based in Pakistan. The author concludes that an increase in debt ratio influences performance in a negative way. Also, based on a study of 117 listed companies in China, researchers find that debt ratio is negatively and significantly related to firm performance (Wei et al., 2020). In addition, Salim and Yadav (2012) found empirical evidence that the relation between capital structure and firm performance significantly negative, based on sample of Malaysian companies. The study of Vithessonthi and Tongurai (2015) shows a negative relation between leverage and firm performance for non-financial firms in Thailand. Tian and Zeitun (2007) also investigated the impact of capital structure on firm performance using a sample of 167 Jordanian companies. Their results show a negative and significant impact of capital structure on both the accounting and market measures of firm performance. Additionally, Cole et al. (2015) investigate the relation between capital structure and firm performance to provide a better understanding of how to make financial decisions. Based on U.S. firms, they found a negative relation between leverage and return on assets. Črnigoj and Mramor (2009) found a negative relation

between leverage and profitability based on Slovenian firms. Multiple other studies provide the same negative relation between capital structure and firm performance such as, (Muritala, 2012; Babalola, 2012). These findings are in line with the proposition of pecking-order theory.

On the other hand, the study of Arbabiyan and Safari (2009) shows that the performance of Iranian firms increases as a result of an increase in debt ratio. Also Margaritis and Psillaki (2010) find a positive and significant relation between debt ratio and firm performance. Hasan et al. (2014) investigated the influence of capital structure on firm performance based on 36 Bangladeshi firms. They used four performance measures as dependent variables and three ratios of capital structure as independent variables. The results show a positive and significant relation between earnings per share and short-term debt. However, the relation between return on assets and long-term debt is negative and significant. The study of Abor (2005) investigates the effect of capital structure on profitability based on a sample companies listed on the Ghana stock exchange. The results show a positive and significant association between debt ratio and return on equity. In addition, Gill et al. (2011) examine the impact of capital structure on profitability based on 272 American manufacturing firms for a sample period of 2005 to 2007. The findings of this study show a positive and significant relationship between 1) short-term debt ratio and profitability, 2) long-term debt ratio and profitability and 3) total debt ratio and profitability. Fosu (2013) examines the relation between leverage and firm performance based on South African firms over the period 1998-2009. The results of this paper show a positive impact of leverage on firm performance. The researcher also found a positive interaction effect of debt and competition on firm performance. Therefore, higher competition will improve the positive effect of debt finance (Fosu, 2013). To conclude, many empirical studies show a positive relation between leverage and capital structure. These results are in line with the view of trade-off theory based on the tax benefits of leverage.

2.2.3 Capital structure and firm performance based on high-tech firms

Considering that this research focusses on technology firms, the findings of studies that investigate the impact of capital structure on firm performance based on a sample of only high-tech firms are discussed.

Aaboen et al. (2006) investigate a couple of correlations and one of them is between debt ratio and firm performance. Their results are based on a sample of high-tech firms that are located in Sweden. The authors argue that tech firms face difficulties while obtaining external finance. However, having external finance available is a key component in order to increase the performance of Swedish high-tech firms. Their study concludes a positive relationship between debt ratio and firm performance. Especially young tech firms can achieve a higher performance by obtaining more external finance because most of those firms have an innovative strategy (Aaboen et al., 2006). As a result, managers have more financial resources to keep innovating and investing in R&D in order to increase the performance.

In addition, Columbo et al. (2014) also state that the level of performance depends on the financial resources of high-tech firms. They argue that the core business of tech firms is about innovative ideas and managers need financial resources to develop and implement these innovations in order to increase the performance. The authors also argue that firm leverage has a positive relation with performance because financial institutions will be more motivated to control the managers of tech firms if a firm has a higher debt ratio (Columbo et al., 2014). As a result they will use external finance in an efficient way, which leads to higher performance. The authors also state that a high debt ratio will lead to lower agency costs. Based on these arguments, the authors developed the hypothesis that debt ratio has a positive impact on firm performance. The results are based on a sample of 255 high-tech firms that are located in Italy. Columbo et al. (2014) confirm the hypothesis and therefore conclude that debt ratio has a positive and significant impact on the performance of Italian high-tech firms.

Lastly, high-tech firms operate in an unstable and flexible environment (Wu, 2007). The study of Wu (2007) confirms that more external finance has a positive impact on firm performance. This research is based on 200 Taiwanese high-tech firms. However, Wu (2007) points out that managers of high-tech firms have to possess dynamic capabilities to convert the financial resources into competitive advantages in order to maximize the performance. Table 1 shows an overview of existing studies that investigate the relation between capital structure and firm performance.

Table 1 – Empirical studies about the impact of capital structure on firm performance

Source	Sample	Impact
(Nguyen & Nguyen, 2020)	Vietnamese non-financial firms	-
(Ebaid, 2009)	Egyptian firms	-
(Khan, 2012)	Pakistani firms	-
(Wei et al., 2020)	Chinese firms	-
(Salim & Yadav, 2012)	Malaysian firms	-
(Arbabiyan & Safari, 2009)	Iranian firms	+
(Margaritis & Psillaki, 2010)	French firms	+
(Vithessonthi & Tongurai, 2015)	Thai firms	-
(Tian & Zeitun, 2007)	Jordanian firms	-
(Cole et al., 2015)	American firms	-
(Muritala, 2012)	Nigerian firms	-
(Babalola, 2012)	Nigerian firms	-
(Hasan et al., 2014)	Bangladeshi firms	+/-
(Abor., 2005)	Ghanaian firms	+
(Gill et al., 2011)	American firms	+
(Črnigoj & Mramor, 2009)	Slovenian firms	-
(Fosu, 2013)	South African firms	+
(Aaboen et al., 2006)	Swedish high-tech firms	+
(Columbo et al., 2014)	Italian high-tech firms	+
(Wu, 2007)	Taiwanese high-tech firms	+

2.2.4 Firm-specific determinants of firm performance

The already mentioned, capital structure theories explain the impact of capital structure on firm performance. Besides capital structure, there are also other predictors that can explain differences in firm performance across firms. There are three groups of factors that can explain differences in firm performance: firm-specific, industry-specific and country-specific determinants. Lazăr (2016) investigates the factors that influence firm performance the most. His results show that leverage, size, tangibility and growth have the most impact on firm performance. These findings are supported by multiple empirical studies (e.g. Asimakopoulos et al., 2009; Lee, 2009).

In this study only firm-specific factors are included because the sample consists of British high-tech firms. So these firms have the same country- and industry-specific factors, therefore only firm-specific factors could lead to differences in the sample of this study. Because the dependent variable of this study is firm performance, the most common firm-specific determinants that can influence firm performance are outlined.

The first determinant is capital structure, which indicates how assets of a firm are financed and refers to the combination of debt and equity finance (Cekrezi, 2013; Myers, 2001). As described earlier, multiple capital structure theories predict the influence of leverage on firm value and performance. First of all, the trade-off theory states that leverage has a positive impact on firm performance. According to this theory, firms should make a trade-off between the advantages and disadvantages of debt finance and as a result establish a target debt ratio. Therefore, financial managers will increase their debt ratio in order to maximize tax advantages (Fama & French, 2002; Kraus & Litzenberger, 1973; Myers, 2001). Based on the WACC formula also can be concluded that the tax rate has to be distracted from the cost of debt (Attaoui, 2016; Harris & Pringle, 1985; Mari & Marra, 2019). This is confirmed by the study of Ju et al. (2005), they conclude that tax shields and bankruptcy costs affect the desired capital mix of financial managers, therefore these results are consistent with the trade-off theory. Thus, this theory states that tax benefits of leverage can lead to higher firm performances. On the other side, if the target debt ratio is reached and a firm continues to increase the debt ratio, the costs of financial distress will become higher than the benefits of debt finance (Fama & French, 2002; Kraus & Litzenberger, 1973). As a result, firm performance will decrease.

The second theory, agency theory, predicts a positive impact of debt finance on firm performance. According to Berger and Di Patti (2006), agency costs are costs that are associated with agency conflicts. These costs can be declined by reducing these problems (Myers, 2001). This theory states that high debt ratios will motivate managers to align their interests with shareholder because debt finance increase the pressure to generate enough cash flow in order to pay the cost of debt finance (Myers, 2001). This will lead to higher productivity and efficiency, and lower agency costs. As a result, the agency theory predicts a positive impact of debt finance on firm performance.

The third theory, free cash flow theory, is based on the same rationale as the agency theory. Agency conflicts can arise when a firm has free cash flows. The problem is how to keep managers motivated and how to encourage them to invest free cash flows in a way that will lead to a maximization of firm value. Jensen (1986) says that leverage can be beneficial in order to solve these conflicts because debt forces a firm to generate enough cash flow in order to pay debt liabilities instead of using it in their own interest. Therefore, this theory also predicts a positive impact of debt finance on firm performance.

According to the last theory, a negative impact of debt finance on firm performance is expected. The pecking-order theory states that managers should first use internal funds to re-invest

in their firm. If this financial source is not available or sufficient, firms should then use debt finance (Chen & Chen, 2011; Myers, 2001). Lastly, if internal sources and debt finance are not enough to achieve firm's objective, they should issue new equity in order to finance itself. This order is based on asymmetric information. Thus this theory mainly predicts the relation between firm performance and capital structure decisions. However, this theory predicts also the impact of debt finance on firm performance in an indirect way. The costs of financing will increase if asymmetric information also increases, on which the pecking-order is based. This is the reason, firms prefer to use internal finance over debt and equity finance. Managers that use internal finance will therefore have less costs of finance than firms that have to issue debt or equity. As a result, firm performances will be higher if firms use internal finance. To conclude, debt finance will have a negative impact on firm performance because its costs are higher than the costs of internal finance.

The second determinant is size. Firm size is considered as an important predictor of firm performance. Empirical evidence has shown that the size of the firm is significantly related to firm performance. For example, Lazăr (2016) and Asimakopoulos et al. (2009) find that size has a positive impact on firm performance. They state that this effect is mainly caused by the benefits of economies of scale and a better access to capital markets. Also they say that larger firms have more capabilities, resources and diversification. However, they also say that size can have negative impact on firm performance based on the agency theory. Lager firms face generally more conflicts of interests between managers and shareholders which lead to lower performance (Asimakopoulos et al., 2009; Lazăr, 2016).

The third determinant is age. The age of a firm is also considered as a variable that has an impact on firm performance. Coad et al. (2018) state that age can only causes performance and not the other way around. They conclude that age influences firm performance because the firm consists for a longer period and have therefore more experience. Also employees are used to the routine and work more efficiently. Lastly, they conclude that firms that exist for a longer period have accumulated reputation which influences firm performance in a positive way (Coad et al., 2018). These arguments are supported by multiple studies (e.g. Grazzi & Moschella, 2018).

The fourth determinant is liquidity. Liquidity indicates the ease of a firm to convert its assets into cash. The pecking-order theory states that a firm first uses its internal sources to finance itself (Chen & Chen, 2011). If firms have sufficient internal financial sources, the cost of debt finance reduces which leads to an increase of performance. Prior studies investigate the relation between liquidity and firm performance. The study of Khidmat and Rehman (2014) concludes that liquidity has a positive and significant impact on ROA.

The fifth determinant is growth. In general, it is assumed that firm growth has a positive impact on firm performance because growth will lead to more income. As a result, firm performance will increase. This is tested and supported by several researchers (e.g. Asimakopoulos et al., 2009; Lazăr, 2016; Lee, 2009).

The last determinant is asset tangibility. A tangible asset of a firm is any physical asset that can be seen or touched, for example buildings and real estate. Lazăr (2016) investigates the relation between tangibles intensity and firm performance. He states that it is difficult to develop a hypothesis between tangibility and firm performance because there is not a clear theory that predicts this relation. However, he argues that firms with high investments in tangible assets will have less financial distress costs because they can use the tangible assets as collateral for debt financing. The results show a significant impact of tangibility on ROA.

To conclude, besides the capital structure of a firm, also other predictors have an impact on

firm performance. This is the reason these predictors will be included in this study as control variables (see section 4.4).

2.3 Debt finance

Some capital structure theories explain positive impacts of debt finance on firm performance and value, while other theories state negative effects of debt finance. Besides the mentioned advantages and disadvantages also other positive and negative effects of debt finance exist. These effects are outlined in the following subsections.

2.3.1 Advantages of debt finance

Existing studies investigate the benefits of debt finance. Firms that have the objective to grow, invest or expend need financial resources to achieve their aim and to improve their performance (Demirgüç-Kunt & Maksimovic, 1998; Mussu & Schiavo, 2008). Financial constraints have a negative effect on research and development and especially start-ups face these difficulties, because their internal financial resources are commonly not sufficient to invest in research and development (Demirgüç-Kunt & Maksimovic, 1998). Mussu and Schiavo (2008) investigate the relation between availability of external financial resources and sales, survival and employment. Their outcomes show that firms with more financial constraints are more likely to go bankrupt than firms that have more access to external finance and have thus more debt financing (Mussu & Schiavo, 2008). Besides that, they conclude that debt financing has a positive impact on sales growth and employment. Firms with less financial resources will have to decrease their costs and therefore have to decline the amount of employees. Also Aghion et al. (2007) conclude that debt financing is an important financial resource for startups to be able to compete on a more equal level with firms that already exist for a longer period.

2.3.2 Disadvantages of debt finance

Financing firms with debt finance does not only have advantages, but also disadvantages. First of all, attracting new financial resources becomes more difficult. High debt ratios have an impact on the credit analysis. A common evaluation used by creditors and financial institutions is the traditional 'Five C's analysis'. The five C's of credit analysis are: character, capability, conditions, capital and collateral (Chen, Guo, & Huang, 2009; Gustafson, 1989; Marqués, García, & Sánchez, 2012; Strischek, 2000). A high debt ratio influences a part of the credit analysis. *Character* is the general impression a creditor gets of the borrower and *Capital* indicates if the entrepreneur also personally invests in his company (Strischek, 2000). A high debt ratio has a negative impact on these two parts of the credit analysis because this indicates that the personal risk of the entrepreneur is not equal to the risk of the lenders. Besides that, a high debt ratio will influence the *Capacity* which is one of the most important parts of credit analysis. *Capacity* points out if the borrower is able to repay their debt obligations (Marqués et al., 2012; Strischek, 2000). If the company generates enough cash flow this would not be a problem, however when the firm has a high debt ratio and lot of debt obligations, repaying the loan could become problematic.

In addition, Opler and Titman (1994) conclude that firms with a higher percentage of debt finance have significant lower performances. They argue that firms with financial distress face difficulties to improve their financial condition. Based on the outlined advantages and disadvantages of debt financing, it can be concluded that estimating the optimal capital structure is important in order to maximize the advantages while minimizing the disadvantages of debt financing.

3. Development of hypotheses

As previously mentioned, the main objective of this study is to investigate the effect of capital structure on the performance of British high-tech firms. This leads to the following research question that will be answered:

"Does capital structure have an impact on the performance of high-technology firms?"

In order to answer this question hypotheses have to be formulated based on the theoretical background that is outlined in the previous chapter. Since the irrelevance theory of Modigliani and Miller, capital structure has been investigated more intensively in the finance literature. Academicians investigated the impact of capital structure decisions on firm performance and developed theoretical models to get a better understanding about this topic (Kamath, 1997; Scott, 1979). These theories mention the following main reasons; tax benefits, asymmetric information and agency costs (Myers, 2001). However, the theories that are developed predict different signs between capital structure and firm performance. Also empirical studies that examine the impact of capital structure on firm performance show mixed results, see table 1. Therefore, there is no generally accepted hypothesis about the impact of capital structure on firm performance. Chapter 2 provided an overview of the rationale behind capital structure theories, which is used as a theoretical background to develop the hypotheses of this study. First theories are discussed that predict a positive impact on firm performance. After that, theories are discussed that predict a negative impact on firm performance.

3.1 Positive impact on firm performance

A couple of theories predict a positive effect of capital structure on firm performance. First of all, the agency theory states that agency problems can arise when ownership and control are separate in a company and managers do not run the company in the best interest of the owners (Berger & Di Patti, 2006; Myers, 2001). Costs that are associated with agency problems are called, agency costs (Berger & Di Patti, 2006). The agency theory states that debt finance will motivate managers to align their interests because of the increasing pressure to generate enough cash flow in order to pay the cost of debt finance. Thus, higher debt ratios will lower agency costs and reduce inefficiency. Therefore, the agency hypothesis predicts that high leverage improve firm performance. This theory is tested and confirmed by several empirical studies (e.g. Berger & Di Patti, 2006; Li & Cui, 2003).

Secondly, the free cash flow theory predicts also a positive impact of leverage on firm performance. Free cash flow refers to the amount of cash that is left over after the firm pays its required expenses and investments. The free cash flow theory is built on the rationale of the agency theory. Both theories are based on agency costs and the conflict between shareholders' and managers' interests and incentives (Jensen, 1986; Myers, 2001). This theory predicts that leverage can motivate and encourage managers to increase their efficiency and productivity, which will lead to lower agency costs and higher firm performance. This theory is supported by multiple empirical studies (see subsection 2.2.1).

Lastly, the trade-off theory balances the tax benefits of debt finance (tax shield) against the costs of financial distress. This theory predicts that firms mostly use a combination of debt and equity finance and seek for the optimal capital structure. Therefore, Kraus and Litzenberger (1973) argue that companies should find the right balance between the tax benefits of using debt finance and the costs associated with financial distress (Fama & French, 2002; Myers, 2001). The interest firms pay

because of having debt finance, can be distracted before paying taxes. Therefore, financial managers will increase their debt ratio in order to maximize tax advantages (Fama & French, 2002; Kraus & Litzenberger, 1973; Myers, 2001). Because of the tax benefits of debt finance, leverage can have a positive impact on firm performance when the target deb ratio is not reached yet.

It is also interesting that a couple of empirical studies (subsection 2.2.3) that are based on a sample of high-tech firms show a positive impact of capital structure on firm performance. Based on the mentioned theories, capital structure (leverage) can have a positive impact on firm performance. This results in the following hypothesis:

Hypothesis 1: Capital structure has a positive impact on firm performance.

3.2 Negative impact on firm performance

However, a couple of theories predict a negative impact of leverage on firm performance. First of all, the pecking-order theory states that companies should follow the following order when choosing between financial sources; internal finance, debt finance and finally equity finance. This pecking order is based on asymmetric information (Chen & Chen, 2011; Fama & French, 2002; Jarallah et al., 2019; Myers, 2001; Myers & Majluf, 1984). Thus this theory mainly predicts the impact of firm performance on capital structure decisions because firms with higher firm performance will have higher internal funds available which will lead to lower debt ratios. However, based on this theory also the impact of leverage on firm performance can be predicted. The costs of finance will increase if asymmetric information also increases, on which the pecking-order is based. This is the reason, firms prefer to use internal finance over debt finance. Managers that use internal finance will therefore have less costs of finance than firms that have to issue debt. As a result, firm performance will be higher if firms use internal finance. So based on the pecking-order theory the impact of firm performance on capital structure can be predicted but also the impact of capital structure (leverage) on firm performance. Thus, debt finance will have a negative impact on firm performance because its costs are higher than the costs of internal finance. As mentioned earlier, high-tech firms differ from other firms because of their R&D intensity and high level of information asymmetry (Gharbi et al., 2014). Managers of high-tech firms do not prefer to share detailed information in order to protect their innovation advantages (Gharbi et al., 2014). Therefore, these firms prefer to use internal finance over debt finance to finance their activities, which is in line with the pecking-order theory.

Secondly, the trade-off theory also pays attention to the costs of financial distress when debt ratios increase. Financial distress can occur as a result of having a high percentage of debt finance related to the total value of the firm (Altman, 1984; Mari & Marra, 2019; Opler & Titman, 1994). The incoming cash flow is then not enough to meet firm's debt obligations. So if the target debt ratio is already reached and a firm continues to increase the debt ratio, the costs of financial distress will become higher than the tax benefits of debt finance (Fama & French, 2002; Kraus & Litzenberger, 1973). As a result, firm performance will decrease because of more leverage. Thus, a higher debt ratio can have a negative impact on firm performance because of the increasing possibilities of financial distress.

Based on the mentioned theories, capital structure (leverage) can have a negative impact on firm performance. This results in the following hypothesis:

Hypothesis 2: Capital structure has a negative impact on firm performance.

4. Research method

This chapter discusses the methods that are used in existing empirical studies to estimate the impact of capital structure on firm performance. After that, the method that is used in this study is explained including its advantages, disadvantages and assumptions. Lastly, the dependent, independent and control variables of the study are described. Table 2 shows an overview of the measurements of the variables that are used in this study, including the supporting literature. Figure 1 shows the research model.

4.1 Research design

After reviewing existing research that investigate the impact of capital structure on firm performance, researchers mostly used the ordinary least squares regression model (OLS). Yegon et al. (2014) investigated the relation between capital structure and firm profitability by using OLS regression methods. Ramadan and Ramadan (2015) also studied the effect of capital structure on firm performance based on a sample of 72 companies. By applying OLS regression models, they conducted the analysis. In addition, Wei et al. (2020) collected data on 117 firms. By using OLS regression model, they investigated the relation between the capital structure of Chinese firms and their performance. Also the study of Margaritis and Psillaki (2010) uses OLS regressions to estimate the effect of leverage on firm performance. Lastly, Le and Phan (2017) studied the same relation based on a sample of Vietnamese firms over a sample period of 5 years. To conduct the analysis, they used OLS regression method. To conclude, most empirical studies that examine the impact of capital structure on firm performance used the OLS regression model (e.g. Abor., 2005; Cole et al., 2015; Črnigoj & Mramor, 2009; Ebaid, 2009; Fosu, 2013; Gill et al., 2011; Hasan et al., 2014; Khan, 2012; Le & Phan, 2017; Margaritis & Psillaki, 2010; Muritala, 2012; Nguyen & Nguyen, 2020; Salim & Yadav, 2012; Tian & Zeitun, 2007; Wei et al., 2020; Yegon et al., 2014).

The ordinary least squares regression is a method that is commonly used in statistics in order to estimate unknown parameters in a linear regression model. This regression model not only investigates if there is a relation between the dependent and independent variable, but also estimates the size of the effect (Osborne, 2000). The model will search for the linear line that 'fit' the data in the best way possible. So an OLS regression is a linear regression that estimates the relationship between one or more independent variables and a dependent variable. Because of that, the regression model summarizes the values. The parameters are found by minimizing the sum of squared residuals. Researchers aim to minimize these parameters in order to estimate the coefficients in the best possible way. The intercept (β_0) indicates the starting point of the dependent variables when all variables in the model have value zero. The sign of the regression coefficient (β_x) shows if there is a positive or negative relation between each independent and dependent variable. Besides that, the coefficient shows the change in the dependent variable when the independent variable changes with 1 unit. Lastly, the error term (ε) represents the margin of error within the model and indicates the difference between the theoretical and real value of the dependent variable.

According to Osborne (2000), an advantage of using this regression method is that it can be used to investigate multiple independent variables and its impact on a dependent variable. Therefore, OLS regression method can be used to answer complex research questions. However, this method also has some disadvantages. For example, the model is sensitive to outliers. Besides that, endogeneity problems can arise. This means that an independent variable in the model is correlated to the error term of the model (De Veaux, Velleman, & Bock, 2016). This problem can occur as a

result of measurement errors or when important variables are not included in the model.

The OLS regression method has some assumptions. First of all, the variables should be quantitative and obvious outliers should not exist. Besides that, the scatterplots of the data should show a line that is straight enough in order to confirm the linearity assumption. Also, the variance around the line should be more or less equally distributed across every value of the independent variables. This assumption is also called homoscedasticity. This can be checked by plotting the residuals and predicted values. The plot should not show any patterns. Besides that, residuals should be normally distributed (multivariate normality), otherwise the outcomes would be less reliable. Another important assumption is about multicollinearity. The independent variables should not be correlated with each other because that could have an influence on the coefficients of the model. This can be tested by using Variance Inflation Factor (VIF) values or by computing a correlation matrix. If the VIF value is lower than 10, the model has no multicollinearity problems. The simplest way in order to solve multicollinearity is by identifying the variables that cause multicollinearity problems and exclude them from the regression model. Lastly, autocorrelation should not exit. This means that the residuals should be independent from each other (De Veaux et al., 2016).

Even though the OLS model is most frequently used in previous empirical studies, other methods can also be used to examine the relation between variables. For example, Wei et al. (2012) used besides the OLS model also advanced panel data methods to examine the impact of capital structure on firm performance. They choose between two regression models, fixed effects and random effects model. A fixed effects model is a model in which the variables of the model are fixed, while the parameters of a random effects model are random variables and not fixed. The fixed effects model is preferred if the intercept of the model is correlated with the independent variables, otherwise the random effects model is preferred. The study of Vithessonthi and Tongurai (2015) uses both OLS model and generalized method of moments (GMM). To conclude, limited studies did not use the OLS model to investigate the impact of capital structure on firm performance.

So based on the advantages of the OLS model and in line with most studies, Abor., 2005; Cole et al., 2015; Črnigoj & Mramor, 2009; Ebaid, 2009; Fosu, 2013; Gill et al., 2011; Hasan et al., 2014; Khan, 2012; Le & Phan, 2017; Margaritis & Psillaki, 2010; Muritala, 2012; Nguyen & Nguyen, 2020; Salim & Yadav, 2012; Tian & Zeitun, 2007; Wei et al., 2020; Yegon et al., 2014, the hypotheses are tested by conducting the OLS method. This study makes use of panel (longitudinal) data, which means that data is collected over multiple years.

The analysis consists of a couple of steps. First, an univariate analysis is conducted to analyze the descriptive statistics, followed by the correlation matrix in order to examine the correlation between the variables. After that, multiple regression analyses between the dependent and independent variable are carried out by using OLS method. These analyses are performed by using the statistical program SPSS.

Consistent with existing studies that investigate the relation between capital structure and firm performance (Ebaid, 2009; Khain, 2012; Le & Phan, 2017; Salim & Yadav, 2012), the following OLS regression equation is used in order to test hypothesis 1 and 2:

$$PERF_{it} = \beta_0 + \beta_1 DEBT_{it} + \beta_x CONTROL_{it} + \varepsilon_{it} \quad (1)$$

Where;

β	= Regression coefficient;
$PERF_{it}$	= Firm performance of firm I in year t;
$DEBT_{it}$	= Debt ratio of firm I in year t;
$CONTROL_{it}$	= Control variables of firm I in year t;
ε_{it}	= Error term.

This equation is used for multiple OLS regression models. Model 1 to 5 examines the impact of each control variable on the dependent variable separately. These models could also be used to check multicollinearity. Regression model 6 consists of all the control variables that are a part of this study in order to estimate the explanatory power of these variables on the dependent variable. The independent variable, capital structure, can be measured in multiple ways which is explained in section 4.3. These variables are divided among the models to check multicollinearity. Model 7 consists of the control variables and the independent variable, total debt ratio. Model 8 replaces the total debt ratio by long-term debt ratio and the last model replaces long-term debt ratio by short-term debt ratio. Also firm performance can be measured in multiple ways, see next section. The models first include the dependent variable, ROE. After that, another operationalization of firm performance (ROA) is used. Finally, the variable ROA is replaced by the variable Tobin's Q.

4.2 Dependent variables

The objective of this research is to analyse the effect of capital structure on firm performance. Therefore, the dependent variable is firm performance. Existing studies that investigate the effect of leverage on firm performance measure the dependent variable by using market-based measures and accounting-based measures. Accounting-based measures are based on the financial statements of the firm while market-based measures rely on investor perception. This study uses both ways to operationalize firm performance.

The two accounting-based measurements are return on assets (ROA) and return on equity (ROE). ROA is calculated by the EBIT divided by the book value of total assets and ROE is calculated by the net income divided by the book value of total equity, which is in line with previous studies (e.g. Ebaid, 2009; Liu, Wie, & Xie, 2014; Nguyen & Nguyen, 2020; Salim & Yadav, 2012). ROE indicates how effectively a firm is using its equity in order to generate income. ROA shows how effectively a firm is using its assets to generate income. However ROE and ROA are different ways in measuring firm performance, they are related to each other. Besides that, firm performance can also be measured by a market-based measurement, Tobin's Q (e.g. Hasan et al., 2014; Khan, 2012; Salim & Yadav, 2012; Tian & Zeitun, 2007; Vithessonthi & Tongurai, 2015). Following studies that investigate the impact of capital structure on firm performance, Tobin's Q is calculated by the sum of total market value of equity and book value of debt, divided by book value of total assets (Tian & Zeitun, 2007; Vithessonthi & Tongurai, 2015). This variable is included in the study because it is interesting to investigate if capital structure has an influence on the market value of a firm.

4.3 Independent variables

The independent variable of this study is capital structure. A firm's capital structure shows how the assets of the firm are financed and refers to the combination of debt and equity finance (Cekrezi, 2013; Myers, 2001). Capital structure is measured in three ways. First of all by the total debt ratio. The total debt ratio indicates the amount of debt value relative to the total value of a company (Saad, 2010). This ratio is measured by the amount of debt financing related to the total liabilities and equity of the firm (total assets) (Črnigoj & Mramor, 2009; Ebaid, 2009; Khan, 2012; Nguyen & Nguyen, 2020). Thus, the ratio of total debt to total assets gives an indication about the proportion of firm's assets that is financed with debt finance.

However, there are different types of debt financing. Salim and Yadav (2012) also investigate the relation between capital structure and firm performance and divide total debt into long-term debt and short-term debt. They state that managers have to make financial decisions and therefore also have to choose between short and long-term debt. Khain (2012) investigates the same relation and divides total debt into long- and short-term debt to estimate if the time period of debt has an impact on firm performance. Ramadan and Ramadan (2015) also studied the effect of capital structure on firm performance and measured capital structure by the total debt ratio and the long-term debt ratio. These studies measure capital structure by multiple ratios. This is the reason this study also uses the long-term debt ratio and short-term debt ratio. These ratios are measured by the ratio of long-term debt or short-term debt relative to total assets (Ebaid, 2009; Khain, 2012; Salim & Yadav, 2012). To conclude, this study uses the total debt ratio, long-term debt ratio and short-term debt ratio in order to measure capital structure.

4.4 Control variables

Section 2.2.4 describes that besides capital structure, also other determinants can influence firm performance. As previously mentioned, there are three groups of factors that can explain differences in firm performance: firm-specific, industry-specific and country-specific factors. In this study only firm-specific control variables are included because the sample consists of British high-tech firms. So these firms have the same country- and industry-specific factors, therefore only firm-specific factors could lead to differences in firm performance. Lazăr (2016) investigates the factors that influence firm performance the most. His results show that leverage, size, age, tangibility and growth have the most impact on firm performance. These findings are supported by multiple empirical studies (e.g. Asimakopoulos et al., 2009; Ebaid, 2009; Khain, 2012; Lee, 2009; Nguyen & Nguyen, 2020; Salim & Yadav, 2012). Based on theories and empirical studies that also investigate the relation between capital structure and firm performance, this study includes multiple control variables. Because the dependent variable of this study is firm performance, the most common firm-specific control variables that can influence firm performance are outlined.

Size. The first control variable represents the size of the firm. Firm size is considered as one of the most important determinants of firm performance. Empirical studies have shown that firm size significantly impacts firm performance. For example, Lazăr (2016) and Asimakopoulos et al. (2009) find that size has a positive impact on firm performance. They state that this effect is mainly caused by the benefits of economies of scale and a better access to capital markets. Also they say that larger firms have more capabilities, resources and diversification. However, they also say that size can have negative impact on firm performance based on the agency theory. Lager firms face generally more conflicts of interests between managers and shareholders which lead to lower performance (Asimakopoulos et al., 2009; Lazăr, 2016). Ebaid (2009) states that larger firms have more capacity,

which lead to a higher performance. This variable is measured by the natural logarithm of the total assets of the company which is consistent with multiple studies (e.g. Ebaid, 2009; Khain, 2012; Lazăr, 2016; Salim & Yadav, 2012). The logarithm is used to respond to skewness and get a more normalized variable.

Age. The second control variable indicates for how long the company has already existed. The age of a firm is also considered as a variable that has an impact on firm performance. Coad et al. (2018) state that age can only causes performance and not the other way around. They conclude that age influences firm performance because the firm consists for a longer period and have therefore more experience. Also employees are used to the routine and work more efficiently. Lastly, they conclude that firms that exist for a longer period have accumulated reputation which influences firm performance in a positive way (Coad et al., 2018). These arguments are supported by multiple studies (e.g. Grazzi & Moschella, 2018). Thus, prior studies conclude that companies that exist for a longer period also have more experience and other advantages that have a positive impact on the level of performance. This variable is measured by the natural logarithm of the number of years since the date of incorporation of the company (Muritala, 2012; Vithessonthi & Tongurai, 2015).

Growth. The third control variable indicates the growth of the firm. In general, it is assumed that firm growth has a positive impact on firm performance because growth leads to more income. As a result, firm performance will increase. This is tested and supported by several researchers (e.g. Asimakopoulos et al., 2009; Lazăr, 2016; Lee, 2009). In line with previous studies, growth is measured by the annual change in total sales (e.g. Abor, 2005; Gill et al., 2011; Margaritis & Psillaki, 2010; Nguyen & Nguyen, 2020; Wei et al., 2020).

Liquidity. Liquidity indicates the ease of a firm to convert its assets into cash. The pecking-order theory states that a firm first uses its internal sources to finance itself (Chen & Chen, 2011). If firms have sufficient internal financial sources, the cost of debt finance reduces and it declines potential costs of financial distress, which leads to an increase of performance. Prior studies investigate the relation between liquidity and firm performance. The study of Khidmat and Rehman (2014) concludes that liquidity has a positive and significant impact on ROA. Following existing empirical studies (Khidmat & Rehman, 2014; Saleem & Rehman, 2011), liquidity is measured by the current ratio. This ratio is calculated by dividing current assets by current liabilities.

Tangibility. Examples of tangible asset are buildings and real estate. Lazăr (2016) investigates the relation between tangibles intensity and firm performance. He states that it is difficult to develop a hypothesis between tangibility and firm performance because there is not a clear theory that predicts this relation. However, he argues that firms with high investments in tangible assets will have less financial distress costs because they can use the tangible assets as collateral for debt financing. Therefore, firms with more tangible assets face lower financing costs which has a positive impact on firm performance. The study of Lazăr (2016) shows a significant impact of tangibility on ROA. Therefore, tangibility is included in the study as a control variable. In line with existing studies, tangibility is measured by the fixed assets divided by the total assets (Črnigoj & Mramor, 2009; Fosu, 2013; Margaritis & Psillaki, 2010; Nguyen & Nguyen, 2020; Tian & Zeitun, 2007; Vithessonthi & Tongurai, 2015).

Year effects. The last control variable of this study is included as year dummies to control for temporal conditions. This study makes use of panel data, which means that data is collected over multiple years. The sample period is from 2015 till 2018. To control for specific year effects, year dummies are included. The relation between the independent, dependent and control variables are shown in figure 1.

Table 2 – Measurements variables

Variables	Measurements	Supporting literature
Dependent variables		
ROA	EBIT/book value total assets	(Ebaid, 2009; Nguyen & Nguyen, 2020; Salim & Yadav, 2012; Tian & Zeitun, 2007; Vithessonthi & Tongurai, 2015; Wei et al., 2020)
ROE	Net income/book value total equity	(Abor., 2005; Ebaid, 2009; Gill et al., 2011; Hasan et al., 2014; Khan, 2012; Muritala, 2012; Nguyen & Nguyen, 2020; Salim & Yadav, 2012; Tian & Zeitun, 2007)
Tobin's Q (TOB)	Total market value equity + book value debt/total book value assets	(Khan, 2012; Salim & Yadav, 2012; Tian & Zeitun, 2007; Vithessonthi & Tongurai, 2015)
Independent variables		
Total debt to total asset ratio (TDTA)	Total debt/total assets	(Črnigoj & Mramor, 2009; Ebaid, 2009; Khan, 2012; Nguyen & Nguyen, 2020)
Long-term debt to asset ratio (LDTA)	Total long-term debt/total assets	(Abor., 2005; Cole et al., 2015; Ebaid, 2009; Gill et al., 2011; Hasan et al., 2014; Khan, 2012; Nguyen & Nguyen, 2020; Salim & Yadav, 2012; Tian & Zeitun, 2007)
Short-term debt to asset ratio (SDTA)	Total short-term debt/total assets	(Gill et al., 2011; Khan, 2012; Nguyen & Nguyen, 2020)
Control variables		
Size	Total assets firm	(Črnigoj & Mramor, 2009; Fosu, 2013; Khan, 2012; Margaritis & Psillaki, 2010; Nguyen & Nguyen, 2020; Salim & Yadav, 2012; Tian & Zeitun, 2007; Vithessonthi & Tongurai, 2015)
Age	Years since the date of incorporation	(Fosu, 2013; Muritala, 2012; Vithessonthi & Tongurai, 2015)
Growth	Annual sales growth	(Abor., 2005; Gill et al., 2011; Margaritis & Psillaki, 2010; Nguyen & Nguyen, 2020; Wei et al., 2020)
Liquidity	Current ratio (current assets/current liabilities)	(Fosu, 2013; Nguyen & Nguyen, 2020)
Tangibility	Total fixed assets/total assets	(Črnigoj & Mramor, 2009; Fosu, 2013; Margaritis & Psillaki, 2010; Nguyen & Nguyen, 2020; Tian & Zeitun, 2007; Vithessonthi & Tongurai, 2015)
Year dummy	1 for specific year, otherwise 0	(Nguyen & Nguyen, 2020; Tian & Zeitun, 2007)

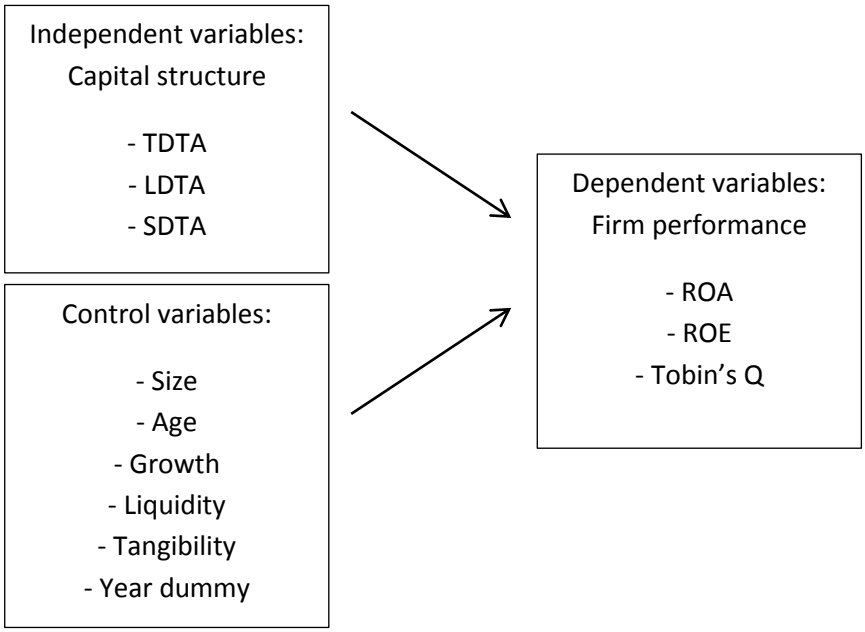

Figure 1. Research model

4.5 Robustness tests

Robustness tests are included in the study to increase the validity and reliability of the main findings. First of all, the independent variables and control variables are lagged by one period in order to prevent the revered causality conflict between capital structure and firm performance. If the findings of the lagged variables are in line with the findings of the non-lagged variable, it can be assumed that the independent and control variables indeed influence firm performance and not the other way around. Therefore this robustness tests is conducted based on the following equation:

$$PERF_{it} = \beta_0 + \beta_1 DEBT_{it-1} + \beta_x CONTROL_{it-1} + \varepsilon_{it} \qquad (2)$$

Where;

β=	Regression coefficient;
$PERF_{it}$ =	Firm performance of firm I in year t;
$DEBT_{it-1}$ =	Debt ratio of firm I in year t-1;
$CONTROL_{it-1}$ =	Control variables of firm I in year t-1;
ε_{it} =	Error term.

In multiple studies, the sample is divided based on industries or countries in order to conduct robustness tests. The sample of this study is based on one country. Therefore, the sample cannot be divided among different countries. However, five industries are classified as high-tech industries, see next chapter. The sample is split to perform the regression analysis based on a subsample. The subsample contains the two most dominant industries. Based on this subsample, the second robustness test is carried out.

5. Sample and data

This chapter describes the sampling procedure of this study including the way in which high-tech firms are selected. After that, the availability of the necessary data is checked. Lastly, the final sample size is compared to the sample size of prior studies in order to assess if the size is appropriate to answer the research question.

5.1 Sampling procedure

In order to collect data from companies, first the sampling procedure has to be presented. To select the sample a couple of sampling criteria are applied. Following the selections criteria, first companies that are active and based in the UK are selected. Secondly, the analysis is narrowed to companies that can be characterized as high-technology firms. The selection of tech firms is based on the OECD classification for Science, Technology and Industry (2011). This classification is used in similar research to identify technology firms, for example by Nunes, Serrasqueiro, and Leitão (2012). The classification divides industries into high-technology industries, medium-high-technology industries, medium-low-technology industries and low-technology industries, based on R&D intensities. Considering that this research is about technology firms, the industries that are part of the first subcategory are selected. This subcategory has a R&D intensity that is far above the other three subcategories. Based on the OECD classification, the following five industries are classified as high-tech industries and are therefore a part of the sample (including their codes);

High-technology industries

- Aircraft and spacecraft (3030)
- Pharmaceuticals (2120)
- Office, accounting and computing machinery (2620)
- Radio, TV and communication equipment (2630)
- Medical, precision and optical instruments (2670)

Finally, companies that do not provide the necessary information or are not alive for the whole sample period (see section 5.3) are excluded. As mentioned in the previous chapter, the second robustness test will be based on the two most dominant high-tech industries.

5.2 Data collection

The data of these firms is taken from the database Orbis. Following Salim and Yadav (2012), this study relies on a sample period in which most recent firm observations are available. Therefore, the sample period is from 2015 till 2018. This database offers users the opportunity to compare and analyze firms. Orbis contains information about financial statements, general characteristics and changes over time of firms. Important for this research, Orbis contains accurate information about the capital structure and firm performance of technology firms in the UK. This information makes it possible to conduct the research on the basis of accurate search criteria. Annual reports of firms are used to collect the needed data if the information is not available in Orbis.

5.3 Availability of necessary data

In order to establish the final sample size, a sampling procedure is followed (see table 3). First of all, British firms that can be classified as high-tech firms are selected. Therefore the mentioned five industries are selected according to the following OECD codes; 3030, 2120, 2620, 2630, 2670. As a result, the initial sample consists of 524 firms. After that, it is checked if the firms were alive during the sample period. 15 firms were eliminated due to the fact that they were not alive from 2015 till 2018. Moreover, the data from table 2 is needed in order to conduct the analyses. 43 firms are eliminated because the data is not shown in Orbis or the annual reports of the firms. As a result, the full sample consists of 466 British high-tech firms. The needed data is extracted for each year in the sample period.

Table 3 – Sampling procedure

Steps	Sample size
Original dataset from Orbis	524
Excluding firms that were not alive	509
Excluding firms with missing data	466
	↓
Final sample size	466
Sample period	2015-2018 (4 years)
Number of firm year observations	466 firms * 4 years = 1864

In order to assess the final sample size, it is compared to prior empirical studies that examine the same relation. Salim and Yadav (2012) also investigate the relation between capital structure and firm performance, based on a sample of 237 companies. Columbo et al. (2014) conclude a positive relation between debt ratio and the performance of Italian high-tech firms. These authors drawn their conclusions based on 255 Italian high-tech firms. Lastly, Wu (2007) argues that more external finance has a positive impact on firm performance, based on a sample of 200 Taiwanese high-tech firms. Therefore, it can be concluded that the final sample size of 466 British high-tech firms is appropriate to conduct the analyses.

6. Analysis and results

This chapter presents the analysis and results of this study. In the first section, outliers are discussed. The second and third section contain the univariate analysis followed by the bivariate analysis. In the fourth section, the assumptions for multiple regression analysis are discussed. Section five presents the results of the OLS regression analyses in order to test the hypotheses. Lastly, the results of the robustness test are shown.

6.1 Outliers

As earlier mentioned, the OLS regression has some underlying assumptions that have to be fulfilled in order to be able to trust the findings of the study. One of the assumptions is that obvious outliers should not exist. Outliers are extreme observations that lie at an abnormal distance from the other values in a data set. Therefore, it is necessary to identify outliers before conducting the analysis. In order to limit the impact of those outliers, the variables were first winsorized at the 1% level at both sides of the distribution, which means that values below 1st percentile are set to the 1st percentile, and the values above 99th percentile to the 99th percentile. After that, some obvious outliers were still part of the data set. Therefore, variables are winsorized at the 5% level at both sides of the distribution. This method is used in multiple empirical studies (e.g. Guest, 2009; Merendino & Melville, 2019; Wang, 2014). Other assumptions are discussed in section 6.4.

6.2 Descriptive statistics

A univariate analysis describes individual variables. Descriptive statistics are a summary of quantitative data of a sample of a population. Table 4 shows the descriptive statistics for 466 British high-tech firms over the time period of 2015 till 2018. In the table the dependent, independent and control variables are split. As mentioned in the previous section, the variables are winsorized at the 5% level at both sides of the distribution, in order to minimize the influence of outliers.

First of all, the dependent variable 'firm performance' is measured in three different ways, namely ROA, ROE and Tobin's Q. ROA indicates how efficient a firm is relative to its assets. The ROA of this study has a mean of 14.4% and a median of 10.5%. Khan (2012) also investigates the impact of capital structure on firm performance. He found a mean of 9.4% and a median of 8.4% based on a sample period of 2003 till 2009. The study of Columbo et al. (2014) is based on a sample of Italian high-tech firms and presents a lower mean for ROA, namely 6.2%. Comparing this study with the study of Columbo et al. (2014), shows that British high-tech firms on average have higher ROA than Italian high-tech firms. In addition, Salim and Yadav (2012) also found a lower mean with a value of 3.4% and Tian and Zeitun (2007) found a ROA mean of 1.2%. For the variable ROE, a mean of 17.2% and a median of 12.0% are found in this study. However, Khan (2012) found a mean of 19.3%, which is higher than the mean of this study. Columbo et al. (2014) found a lower mean with the value of 11.6%, for Italian high-tech firms. In line with the comparison of the variable ROA, British high-tech firms have on average a higher ROE than Italian high-tech firms. In addition, the study of Salim and Yadav (2012) found a lower mean with the value of 3.0% and a median of 6.8%. Lastly, the variable Tobin's Q has a mean of .854 and a median of .820. A Tobin's Q between 0 and 1 means that the assets of the firm are higher than the total market value of the firm, which is on average the case for British high-tech firms. Salim and Yadav (2012) found a Tobin's Q mean of .781 and a median of .806. The study of Tian and Zeitun (2007) shows higher results for the Tobin's Q. They found a mean of 1.701 which means that on average the firms in their sample are worth more than the total asset

value of the firm.

The descriptive statistics are also shown for each independent variable. The TDTA of this study has a mean value of .286. This variable measures the total amount of debt finance relative to the firm's assets. The higher the ratio, the higher the amount of debt finance. A mean of .287 indicates that 28.7% of its assets are financed by debt finance which means that British high-tech firms have on average more equity finance than debt finance in their capital structure. The study of Columbo et al. (2014) found a much higher TDTA mean, namely 69.6%, for Italian high-tech firms. This means that high-tech firms that are based in Italy are on average more financed with debt finance than with equity finance, which is not in line with high-tech firms that are based in the UK. Nguyen and Nguyen (2020) found a TDTA mean of 50.0%, Salim and Yadav (2012) found a TDTA mean of 44.1% and Tian and Zeitun (2007) a TDTA mean of 35.7%. The variable LDTA has a mean of 14.6% and a median of 15.0% in this study. Tian and Zeitun (2007) found a lower LDTA mean of 6.1% and Nguyen and Nguyen (2020) found a mean of 9.0%. For the variable SDTA, a mean of 16.6% is found in this study. This means that on average British high-tech firms have a similar percentage of short-term debt (16.6%) and long-term debt (14.6%) in their capital structure.

Analyzing the statistics of control variables, the results in table 4 report an average value of firm SIZE of 14.932 million, and a median of 16.982 million, which indicate the total assets of the firm before the logarithm change. The study of Salim and Yadav (2012) found a higher mean of total assets and the study of Tian and Zeitun (2007) found a lower average SIZE. The mean value of AGE indicates the number of years since the date of incorporation of the company (Fosu, 2013; Muritala, 2012; Vithessonthi & Tongurai, 2015). The mean value of AGE for British high-tech firms is 42 and the median has a value of 46, before the logarithm change. As mentioned earlier, the logarithm of the variables SIZE and AGE is used in order to respond to skewness and get a more normalized variable. The mean value of GROW is .147 and the median is .128, which indicates that on average British high-tech firms have an annual sales growth of 14.7%. This growth is similar to the annual sales growth of Malaysian firms that is found by Salim and Yadan (2012). The mean value of LIQ in this study is 1.415 and the median value of this variable is 1.412, which means that the average current ratio of British high-tech firms is 1.415. In general, a current ratio below 1 would mean that the firm does not have enough liquid assets to cover its current liabilities. As mentioned, the mean value of this study is 1.415. This means that on average British high-tech firms have enough current assets to cover its current liabilities. This mean is lower than the mean found by Nguyen and Nguyen (2020). The mean of TANG is in this study 0.380, which means that on average 38.0% of the total assets of British high-tech firms consists of tangible assets. This mean is lower for Vietnamese firms that is found by Nguyen and Nguyen (2020) and similar to the mean that is found by Tian and Zeitun (2007).

The descriptive statistics of this study might differ from existing studies that investigate the same relation. This can be caused by different samples or sample periods.

Table 4 – Descriptive statistics

Variables	N	Mean	Std. Dev.	Min	Q1	Median	Q3	Max
Dependent variables								
ROA (%)	1864	.144	.119	.010	.060	.105	.195	.594
ROE (%)	1858	.172	.156	.011	.039	.120	.264	.653
TOB	1864	.854	.518	.100	.416	.820	1.253	1.987
Independent variables								
TDTA (%)	1855	.287	.188	.102	.114	.244	.372	.799
LDTA (%)	1855	.146	.122	.050	.075	.150	.278	.689
SDTA (%)	1855	.166	.126	.071	.122	.151	.304	.698
Control variables								
SIZE (assets in millions)	1863	14.932	3.204	.014	2.795	16.982	37.658	69.452
AGE (years)	1864	42	19	4	34	46	54	132
GROW (%)	1864	.147	.071	.010	.106	.128	.165	.399
LIQ	1864	1.415	.445	.300	1.102	1.412	1.778	2.388
TANG (%)	1864	.380	.216	.100	.155	.354	.611	.699

Note – All statistics are calculated after the data was winsorized at the 5% level at both sides of the distribution and before the logarithm change of the variable SIZE and AGE. N indicates the number of observations. All variables are defined in table 2.

6.3 Correlation matrix

A correlation analysis is a bivariate analysis that measures the correlated between two variables. It is important to mention that a bivariate analysis does not show a dependent or independent variable and therefore does not determine which variables influence or cause the outcome. A correlation matrix is a table that shows the correlation coefficients between variables. The correlation matrix of this study is presented in table 5 and is based on the Pearson's correlation coefficients. The firm performance variables, ROA and ROE, are highly positively (r=.548**) and significantly correlated at the 0.01 level. Also the firm performance variables ROA and Tobin's Q are positively (r=.284*) and significant correlated at the 0.05 level. The positive and significant correlation between measures of firm performance is also found by Nguyen and Nguyen (2020). This is no surprise because all variables measure firm performance. The positive and significant coefficients between ROA and ROE mean that when ROA increases also ROE will increase and vice versa.

This matrix also shows that correlations between the independent variables and dependent variables of this study. In general, the independent variables that measure capital structure are negatively and significantly correlated to the dependent variables. The variable TDTA is negatively and significantly (r=-.095**, r=-.066** and r=-.046*) correlated with ROA, ROE and Tobin's Q. The variable LDTA is also significantly and negatively correlated with ROA, ROE and Tobin's Q. In addition, the independent variable SDTA is negatively and significantly correlated with the three measurements of firm performance (r=-.047*, r=-.062** and r=-.003*). The negative and significant correlations between the measures of firm performance and capital structure are also found by Nguyen and Nguyen (2020). Table 5 also shows the correlation between independent variables. TDTA and LDTA are highly positively and significantly (r= .639**) correlated, which confirms the alternativeness between these variables. Additionally, TDTA and SDTA also show a positive and significant (r= .675**) correlation. Because the three measurements of capital structure are highly

correlated, they are divided among the models to prevent multicollinearity.

The correlations between the control variables of this study and the dependent and independent variables are illustrated in table 5. SIZE is positively and significantly (r=.102**, r=.088** and r=.106**) correlated with ROA, ROE and Tobin's Q. In addition, AGE shows a positive and significant correlation with the three measurements of firm performance. Table 5 also shows that AGE has a significant correlation with TDTA and SDTA. The variable GROW shows a positive and significant correlation with the three measurements of firm performance. Besides that, GROW shows a significant correlation with TDTA. The correlation with TDTA is negative (r=-.065**) and significant at the 0.01 significance level. Another control variable that is included in the study is LIQ. This variable is positively correlated with ROA and Tobin's Q at the 0.01 significance level. Finally, the control variable TANG is not significantly correlated with ROA, ROE or Tobin's Q.

As mentioned in section 4.1, multicollinearity can exist if variables of a model are correlated with each other. Table 5 shows that some variable are indeed significantly correlated. In the next section, the problem of multicollinearity among variables is checked.

Table 5 – Correlation Matrix

	1	2	3	4	5	6	7	8	9	10	11	VIF
1 ROA	1											
2 ROE	.548**	1										
3 TOB	.284**	.099**	1									
4 TDTA	-.095**	-.066**	-.046*	1								4.715
5 LDTA	-.122**	-.085**	-.092**	.639**	1							2.620
6 SDTA	-.047*	-.062**	-.003*	.675**	.100**	1						2.825
7 SIZE	.102**	.088**	.106**	.009	.011	-.035	1					1.015
8 AGE	.049*	.093**	.056*	-.096**	-.078*	.081**	.094**	1				1.020
9 GROW	.185**	.095**	.175**	-.065**	-.136*	-.014	.030	.005	1			1.022
10 LIQ	.103**	.038*	.118**	-.053*	.032	-.052*	-.048*	.011	.013	1		1.006
11 TANG	.002	.015	-.014	.007	.035	-.027	.050**	.023	.008	-.004	1	1.003

Note – This table presents the Pearson correlation coefficients including their statistical significance and the VIF values for the independent and control variables.

* Correlation is significant at the .05 level (2-tailed).

** Correlation is significant at the .01 level (2-tailed).

6.4 Assumptions regression

As earlier mentioned, the OLS regression has some underlying assumptions that have to be fulfilled in order to be able to trust the findings of the study. Firstly, residuals should be normally distributed (multivariate normality), otherwise the outcomes would be less reliable. This can be checked by plotting a histogram of the residuals. This shows a normal distribution which shows that the normality assumptions can be met. For the sake of brevity, the assumption plots are not reported.

Secondly, another important assumption is about multicollinearity. The independent variables should not be correlated with each other because that could have an influence on the coefficients of the model. This can be tested by using Variance Inflation Factor (VIF) values or by computing a correlation matrix. If the VIF value is lower than 10, the model has no multicollinearity problems. The last column in table 5 shows the VIP values. It can be concludes that there exists no multicollinearity because all variables have a VIF value below 10. Model 1 to 5 of table 6, 7 and 8 will examine the impact of each control variable on the dependent variable separately. Comparing these models with models 6, 7, 8 and 9, can also indicate whether there are multicollinearity problems. Thirdly, the straight enough condition demands that the data is approximately linear. So the scatterplots of the data should show a line that is straight enough in order to confirm the linearity assumption. After assessing the scatterplots between the variables of this study, the data roughly shows a linear relationship. Therefore, the straight enough condition is fulfilled. Finally, the variance around the line should be more or less equally distributed across every value of the independent variables. This assumption is also called homoscedasticity. This can be checked by plotting the residuals and predicted values. The plots show no patterns which confirms that the data is homoscedastic. After assessing the assumptions, the OLS analyses seem to be appropriate.

6.5 Multiple regression results

In order to test the two hypotheses of this study, a couple of regression models have been constructed. The OLS regression results are presented in table 6, 7 and 8, where the results of the independent and control variables on ROE, ROA and Tobin's Q are illustrated respectively. These tables show the unstandardized coefficients including their statistical significance for British high-tech firms for the period of 2015 till 2018.

6.5.1 Impact of capital structure on firm performance (ROE)

As previously mentioned, the main objective of this study is to investigate the effect of capital structure on the performance of British high-tech firms. Therefore two hypotheses are formulated. Hypothesis 1 states that capital structure has a positive impact on firm performance, while hypothesis 2 states that capital structure has a negative impact on firm performance.

Table 6 shows the regression results of the impact of capital structure on firm performance. In this table firm performance is measured by ROE. Model 1 to 5 examines the impact of each control variable on the dependent variable separately. Model 6 includes all the control variables of this study. Model 7 adds the variable TDTA in order to measure capital structure. Model 8 replaces TDTA with LDTA and the last model replaces LDTA with SDTA.

Model 7 shows a negative and significant, at the 5% level, impact of TDTA on ROE. This result indicates that firms with higher total debt relative to its total assets have lower ROE. Model 7 shows a coefficient of -.045** for the impact of TDTA on ROE. This indicates that, all other variables in model 7 held constant, an increase of 1% in TDTA leads to a decrease in ROE of 4.5%. Model 8 shows a negative and significant impact of LDTA on ROE, at the 1% level. This result indicates that firms with

higher long-term debt relative to its total assets have lower ROE. Model 8 shows a coefficient of -.082*** for the impact of LDTA on ROE. This indicates that, all other variables in model 8 held constant, an increase of 1% in LDTA leads to a decrease in ROE of 8.2%. The last model investigates the impact of SDTA on ROE. As shown in table 6, short-term debt ratio has also a negative and significant impact on ROE. Model 9 shows a coefficient of -.060** for the impact of SDTA on ROE. This indicates that, all other variables in model 9 held constant, an increase of 1% in TDTA leads to a decrease in ROE of 6.0% in ROE. Comparing the impact of LDTA and SDTA, an increase of 1% in LDTA will lead to a decrease in ROE of 8.2%, while an increase of 1% in SDTA will lead to a decrease in ROE of 6.0%. Overall, all measurements of capital structure have a negative and significant impact on ROE. These findings indicate that if firms increase their level of debt in their capital structure, regardless of the duration of leverage, its ROE will decrease. This is the reason hypothesis 1 can be *rejected* and hypothesis 2 can be *confirmed* when firm performance is measured by ROE. Relating this to the capital structure theories, the pecking-order theory and trade-off theory predict a negative impact of leverage on firm performance. As mentioned in chapter 3, the trade-off theory states that if the target debt ratio is already reached and a firm continues to increase the debt ratio, the costs of financial distress will become higher than the tax benefits of debt finance (Fama & French, 2002; Kraus & Litzenberger, 1973). So, high amounts of debt increase the chances of financial distress and lead to financial distress costs. As a result, firm performance will decrease. These findings are consistent with the results that are found by Nguyen and Nguyen (2020). Their results also show a negative and significant impact of total debt, long-term debt and short-term debt on ROE. In addition, Khan (2012) also found evidence that an increase of leverage will impact ROE negatively. Also Salim and Yadav (2012) found similar results about the impact of leverage on ROE.

According to the empirical evidence presented above, hypothesis 1 is not supported. These results indicate that the positive impact of leverage, which is states by the agency and free cash flow theory, does not hold for British high-tech firms. The agency theory states that debt finance will motivate managers to align their interests because of the increasing pressure to generate enough cash flow in order to pay the cost of debt finance. Thus, higher debt ratios will lower agency costs and reduce inefficiency. The free cash flow theory predicts that leverage can motivate and encourage managers to increase their efficiency and productivity, which will lead to lower agency costs and higher firm performance. A possible explanation for the negative impact of leverage on firm performance may be due to the negative consequences of increasing leverage that outweigh the positive consequences of leverage.

For the control variables, model 1 to 5 examines the impact of each control variable on the dependent variable separately. These models indicate that four control variables have a significant impact on ROE. First of all, SIZE and AGE have a positive and significant impact on ROE, which indicates that an increase in firm size and firm age will lead to an increase in firm performance, measured by ROE. This is in line with the expectations. Lazăr (2016) and Asimakopoulos et al. (2009) state that size has a positive impact on firm performance. According to these researchers, this impact is mainly caused by the benefits of economies of scale and a better access to capital markets. Also they say that larger firms have more capabilities, resources and diversification. Besides that, Coad et al. (2018) conclude that age influences firm performance in a positive way because the firm consists for a longer period and have therefore more experience. Also employees are used to the routine and work more efficiently. Lastly, they conclude that firms that exist for a longer period have accumulated reputation which influences firm performance in a positive way (Coad et al., 2018). Based on the empirical evidence of this study, the expectations are supported. These findings are in

line with the results found by Lazăr (2016) and Asimakopoulos et al. (2009). In addition, Ebaid (2009) also found a positive and significant impact of AGE on ROE. Secondly, growth also shows a positive and significant impact on ROE. Model 3 shows a coefficient of .189*** for the impact of GROW on ROE. This indicates that an increase of 1% in GROW leads to an increase of 18.9% in ROE. This indicates that if the annual sales of a firm grow, this will lead to higher ROE. These results are in line with the expectations. In general, it is assumed that firm growth has a positive impact on firm performance because growth leads to more income (e.g. Asimakopoulos et al., 2009; Lazăr, 2016; Lee, 2009). As a result, firm performance will increase. In addition, liquidity also shows a positive and significant impact on ROE. This is supported by the pecking-order theory. This theory states that a firm first uses its internal sources to finance itself (Chen & Chen, 2011). If firms have sufficient internal financial sources, the cost of debt finance reduces and it declines potential costs of financial distress, which leads to an increase of performance. Existing studies investigated the impact of liquidity on ROE. The study of Khidmat and Rehman (2014) concludes that liquidity has a positive and significant impact on firm performance, which is in line with the results of this study. Lastly, tangibility does not show a significant impact on ROE, which is against the expectations. As mentioned in section 4.4, Lazăr (2016) expects that asset tangibility has a positive impact on firm performance because firms with a high level of tangible assets can use these assets as collateral for debt financing. As a result, they will have less financial distress costs, compared to firms with more intangible assets. This predication is not confirmed by the table 6. This may be due to the sample that is used in this study. High-tech firms differ from other companies because of their unique characteristics. These firms have a higher level of information asymmetry because they do not prefer to share information. This could be the reason that the predicted positive impact of asset tangibility is not confirmed in this study. Model 6 includes all the previous mentioned control variables in one model. For the variables SIZE, AGE and GROW, the results are similar to the models 1 to 3. The impact of these variables stay significant at the same significance level. Liquidity becomes insignificant in model 6 till 9, while it did have a significant impact in model 4. This could be caused by the other variables that are added to the model. As shown in the correlation matrix, some variables are correlated to each other. Lastly, tangibility shows no significant impact on ROE in model 6 till 9, which is in line with model 5.

The explanation power of these models is measured by the adjusted R^2. The adjusted R^2 shows how much of the variance in the dependent variable (ROE) can be explained by the independent and control variables. Model 1 to 5 show the lowest adjusted R^2, compared to the other models, which only includes one control variables of this study. After adding all control variables in one model (model 6) and including one of the measurements of capital structure, the explanation power increases. Model 7 has an adjusted R^2 of 11.3%, model 8 has an adjusted R^2 of 11.5% and the last model has the highest explanation power of 11.7%. This means that 11.7% of the variation in ROE can be explained by model 9. Compared to the adjusted R^2 in the study of Tian and Zeitun (2007), the explanation power of this study is lower. In their study the explanation power is around 20-30%. However, the models in the study of Khan (2012) that explain ROE have lower explanation power, around 4%. The R^2 of this study can be improved by adding more variables in the model that have an impact on ROE.

6.5.2 Impact of capital structure on firm performance (ROA)

Table 7 also shows the regression results of the impact of capital structure on firm performance. In this table firm performance is measured by ROA. Model 1 to 5 examines the impact of each control variable on the dependent variable separately. Model 6 includes all the control variables of this study. Model 7 adds the variable TDTA in order to measure capital structure. Model 8 replaces TDTA with LDTA and the last model replaces LDTA with SDTA.

Model 7 shows a negative and significant impact of TDTA on ROA, which indicates that firms with higher total debt ratios will have lower ROA. This model shows a coefficient of -.043*** for the impact of TDTA on ROA. This indicates that, all other variables in model 7 held constant, an increase of 1% in TDTA leads to a decrease in ROA of 4.3%. Model 8 also shows a negative and significant impact of long-term debt ratio on ROA. This result indicates that firms with higher long-term debt relative to its total assets will have lower ROA. This model shows a coefficient of -.085*** for the impact of LDTA on ROA. This indicates that, all other variables in model 8 held constant, an increase of 1% in LDTA leads to a decrease in ROA of 8.5%. Lastly, model 9 shows a negative and significant impact of short-term debt ratio on ROA. This model shows a coefficient of -.030** for the impact of SDTA on ROA. This indicates that, all other variables in model 9 held constant, an increase of 1% in SDTA leads to a decrease in ROA of 3.0%. Comparing the impact of LDTA and SDTA, an increase of 1% in LDTA will lead to a decrease in ROA of 8.5%, while an increase of 1% in SDTA will lead to a decrease in ROA of 3.0%. As represented in table 7, all measurements of capital structure have a negative and significant impact on ROA. These findings indicate that if firms increase their level of debt in their capital structure, regardless of the duration of leverage, its ROA will decrease. This is the reason hypothesis 1 can be *rejected* and hypothesis 2 can be *confirmed* when firm performance is measured by ROA. Comparing the findings of table 6 and 7, both tables reject and confirm the same hypothesis. Tian and Zeitun (2007) also found a negative and significant impact of total debt ratio (-0.124***), long-term debt ratio (-0.138***) and short-term debt ratio (-0.007**) on ROA. Additionally, Khan (2012) also found a negative impact of capital structure decisions on firm performance (ROE and ROA). In line with this study, Nguyen and Nguyen (2020) found a negative and significant impact of total debt, long-term debt and short-term debt on ROA.

For the control variables, the results of model 1 to 4 are similar to the results of model 1 to 4 in table 6. As mentioned in the previous subsection, four control variables have a significant impact on the dependent variable ROE. Table 7 shows that size, age, growth and liquidity have a significant and positive impact on ROA. This indicates that firms with higher total assets (size), higher annual sales growth and higher current ratio, will have higher ROA. However, model 6 to 9 show that the variable age becomes insignificant, while this variable did have a significant impact in model 2. As shown in the correlation matrix, some variables are correlated. This could be the reason that AGE becomes insignificant after adding other variables to the model. Lastly, in line with table 6, tangibility does not show a significant impact on ROA.

The explanation power of model 1 to 5 show the lowest adjusted R^2, compared to the other models, which only includes one control variables of this study. After adding all control variables in one model (model 6) and including one of the measurements of capital structure, the explanation power increases. Model 7 has an adjusted R^2 of 10.1%, model 8 has an adjusted R^2 of 10.4% and the last model shows a highest explanation power of 10.0%. This means that 10.0% of the variation in ROA can be explained by model 9. Model 9 of table 6 shows a similar explanation power of 11.7%. Compared to existing studies, the adjusted R^2 of table 7 is similar (e.g. Khan, 2012; Tian & Zeitun,

2007). As earlier mentioned, the explanation power can increase if more variables, that have an impact on the dependent variable, are added to the model.

6.5.1 Impact of capital structure on firm performance (Tobin's Q)

Table 8 also shows the regression results of the impact of capital structure on firm performance. In this table firm performance is measured by Tobin's Q. Model 1 to 5 examines the impact of each control variable on the dependent variable separately. Model 6 includes all the control variables of this study. Model 7 adds the variable TDTA in order to measure capital structure. Model 8 replaces TDTA with LDTA and the last model replaces LDTA with SDTA.

The results represented in table 8 are similar to the findings in table 6 and 7. Model 7 shows a negative and significant impact of TDTA on Tobin's Q, which indicates that firms with higher total debt ratios will have lower Tobin's Q. This model shows a coefficient of -.071* for the impact of TDTA on Tobin's Q. This indicates that, all other variables in model 7 held constant, an increase of 1% in TDTA leads to a decrease in Tobin's Q of .071. Model 8 shows that an increase of 1% in LDTA leads to a decrease in Tobin's Q of .268 and the last model shows that an increase of 1% SDTA leads to a decrease in Tobin's Q of .053. Comparing the impact of LDTA and SDTA, an increase of 1% in LDTA will lead to a decrease in Tobin's Q of .268, while an increase of 1% in SDTA will lead to a decrease in Tobin's Q of .053. Overall, if firm performance is measured by Tobin's Q, all measurements of capital structure have a significant and negative impact on firm performance. This indicates that if a firm increases its total debt ratio, long-term debt ratio or short-term debt ratio, its Tobin's Q will decrease. This is the reason hypothesis 1 can be *rejected* and hypothesis 2 can be *confirmed* when firm performance is measured by Tobin's Q. Comparing the results of table 6, 7 and 8, the main findings in these tables confirm the same hypothesis. So regardless of whether firm performance is measured by ROE, ROA or Tobin's Q, the three measurements of capital structure show a negative impact on firm performance, which confirms the alternativeness between the measurements of firm performance. The study of Khan (2012) also shows a negative and significant impact of SDTA and TDTA on Tobin's Q. Besides that, Tian and Zeitun (2007) found a significant impact of capital structure measurements on Tobin's Q.

After analyzing the control variables, model 1 to 4 show that size, age, growth and liquidity have a significant and positive impact on ROA. This indicates that firms with higher total assets (size), higher annual sales growth and higher current ratio, will have higher Tobin's Q. However, in line with table 6 and 7, tangibility does not show a significant impact on firm performance. Comparing the results of model 1 to 4 and model 6 to 9, the variables size, growth and liquidity stay significant at the same significance level. However, the variable age becomes less significant in model 6 to 9. As mentioned earlier, this could be caused by the other variables that are added to the model.

Table 6 – OLS regressions for the impact of capital structure on firm performance (ROE).

	Dependent variable: ROE								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Independent variables									
TDTA							-.045**		
							(-1.980)		
LDTA								-.082***	
								(-2.771)	
SDTA									-.060**
									(-2.110)
Control variables									
SIZE	.081***					.073***	.076***	.074***	.071***
	(3.544)					(3.189)	(3.329)	(3.243)	(3.079)
AGE		.086***				.079***	.073***	.073***	.074***
		(3.767)				(3.447)	(3.173)	(3.175)	(3.233)
GROW			.189***			.184***	.179***	.161***	.185***
			(3.778)			(3.693)	(3.579)	(3.192)	(3.697)
LIQ				.020*		.023	.022	.020	.021
				(.862)		(.997)	(.937)	(.885)	(.895)
TANG					.011	.009	.009	.012	.009
					(.635)	(.550)	(.569)	(.734)	(.536)
Constant	-1.070	-1.005	-4.776	-4.445	-2.125	-8.041	-7.495	-5.994	-7.005
	(-2.362)	(-1.355)	(-3.316)	(-3.359)	(-2.359)	(-4.870)	(-3.785)	(-2.506)	(-3.684)
Year Dummy	YES	YES	YES	YES	YES	YES	YES	YES	YES
Number of observations	1863	1864	1864	1864	1864	1864	1864	1864	1864
Adjusted R^2	.028	.029	.031	.023	.022	.084	.113	.115	.117
F-statistic	7.796	8.629	8.674	6.752	7.752	6.507	3.275	3.644	4.171

Note - This table shows the unstandardized coefficients including their statistical significance. Annual data for the period of 2015 till 2018 are analyzed based on the full sample. The dependent variable in this table is ROE. All variables are described in table 2. The numbers in parenthesis represent the t-statistics. The following regression model has been used: $ROE_{it} = \beta_0 + \beta_1 DEBT_{it} + \beta_x CONTROL_{it} + \varepsilon_{it.}$

* statistical significance at the 10% level.

** statistical significance at the 5% level.

*** statistical significance at the 1% level.

Table 7 – OLS regressions for the impact of capital structure on firm performance (ROA).

	Dependent variable: ROA								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Independent variables									
TDTA							-.043***		
							(-3.034)		
LDTA								-.085***	
								(-3.931)	
SDTA									-.030*
									(-1.429)
Control variables									
SIZE	.090***					.087***	.091***	.090***	.089***
	(4.010)					(3.925)	(4.110)	(4.076)	(3.997)
AGE		.038*				.029	.024	.024	.028
		(1.690)				(1.322)	(1.068)	(1.084)	(1.268)
GROW			.287***			.282***	.275***	.266***	.290***
			(7.742)			(7.660)	(7.458)	(7.165)	(7.861)
LIQ				.020***		.021***	.020***	.020***	.021***
				(3.308)		(3.532)	(3.404)	(3.376)	(3.444)
TANG					.002	.001	.002	.002	.003
					(.103)	(.040)	(.073)	(.149)	(.203)
Constant	.075	.131	.099	.105	.144	-.017	-.092	-.199	.074
	(4.666)	(9.731)	(5.962)	(1.506)	(5.755)	(-.834)	(-.132)	(-.625)	(.702)
Year Dummy	YES	YES	YES	YES	YES	YES	YES	YES	YES
Number of observations	1863	1864	1864	1864	1864	1864	1864	1864	1864
Adjusted R^2	.010	.002	.034	.020	.001	.096	.101	.104	.100
F-statistic	3.467	4.511	5.962	2.874	.091	4.033	7.511	6.462	7.366

Note - This table shows the unstandardized coefficients including their statistical significance. Annual data for the period of 2015 till 2018 are analyzed based on the full sample. The dependent variable in this table is ROA. All variables are described in table 2. The numbers in parenthesis represent the t-statistics. The following regression model has been used: $ROA_{it} = \beta_0 + \beta_1 DEBT_{it} + \beta_x CONTROL_{it} + \varepsilon_{it.}$

* statistical significance at the 10% level.

** statistical significance at the 5% level.

*** statistical significance at the 1% level.

Table 8 – OLS regressions for the impact of capital structure on firm performance (TOB).

	Dependent variable: TOB								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Independent variables									
TDTA							-.071*		
							(-1.135)		
LDTA								-.268***	
								(-2.773)	
SDTA									-.053**
									(-.570)
Control variables									
SIZE	.105***					.103***	.107***	.103***	.105***
	(4.559)					(4.541)	(4.692)	(4.543)	(4.600)
AGE		.055***				.045**	.043*	.040*	.044*
		(2.363)				(1.969)	(1.890)	(1.754)	(1.930)
GROW			.174***			.171***	.170***	.166***	.174***
			(7.620)			(7.563)	(7.490)	(7.274)	(7.675)
LIQ				.136***		.141***	.142***	.140***	.144***
				(5.048)		(5.340)	(5.345)	(5.287)	(5.432)
TANG					-.034	-.038	-.044	-.034	-.038
					(-.621)	(-.700)	(-.819)	(-.634)	(-.702)
Constant	3.398	3.469	3.969	1.751	-.371	6.110	7.230	4.115	.150
	(.263)	(.955)	(1.654)	(.450)	(-1.065)	(.287)	(.339)	(.660)	(1.850)
Year Dummy	YES	YES	YES	YES	YES	YES	YES	YES	YES
Number of observations	1863	1864	1864	1864	1864	1864	1864	1864	1864
Adjusted R^2	.011	.003	.030	.013	.001	.065	.112	.134	.189
F-statistic	1.010	3.403	9.661	.849	.802	2.790	2.357	2.541	2.977

Note - This table shows the unstandardized coefficients including their statistical significance. Annual data for the period of 2015 till 2018 are analyzed based on the full sample. The dependent variable in this table is Tobin's Q. All variables are described in table 2. The numbers in parenthesis represent the t-statistics. The following regression model has been used: $TOB_{it} = \beta_0 + \beta_1 DEBT_{it} + \beta_x CONTROL_{it} + \varepsilon_{it.}$

* statistical significance at the 10% level.

** statistical significance at the 5% level.

*** statistical significance at the 1% level.

6.6 Robustness tests

This section shows the robustness tests of this study. These tests are conducted in order to increase the validity and reliability of the main findings that are discussed in the previous section. Firstly, lagged independent and control variables are used in the analysis. Secondly, the sample is split to conduct the analysis based on a subsample. The results of these robustness tests are presented in Appendix A and B.

6.6.1 Lagged variables

The independent variables and control variables are lagged by one period in order to prevent the revered causality conflict between capital structure and firm performance. In the regular regression models, non-lagged variables are used. If the findings of the lagged variables are in line with the findings of the non-lagged variable, it can be assumed that the independent and control variables indeed influence firm performance and not the other way around.

Table 10 in appendix A shows the impact of lagged measurements of capital structure on firm performance (ROE). As shown in model 7, 8 and 9, the impact of TDTA, LDTA and SDTA on ROE is negative and significant as represented in table 6. Overall, the results of the impact of the lagged independent variables on ROE are in line with the results of the impact of non-lagged independent variables on ROE.

In addition, also table 11 and 12 show similar results compared to the regular regression models that use non-lagged independent variables. Both tables show negative and significant impacts of TDTA, LDTA and SDTA on ROA and Tobin's Q. This indicates that the robustness test confirm the main findings that are discussed in the previous section. To conclude, capital structure influences firm performance in a negative way and not the other way around, which means that reverse causality does not play a role in this study.

6.6.2 Subsample

As mentioned earlier, the full sample of this study consists of five industries that can be characterized as high-technology industries. The industry 'Pharmaceuticals' is the most dominant industry in the sample of this study. It represents 28.3% of the full sample. Followed by the industry 'Radio, TV and communication equipment', which represents 26.6% of the full sample. Therefore, the subsample consists of these two dominant industries.

The results are shown in table 13, 14 and 15 in appendix B. The main findings showed that the three measurements of capital structure (TDTA, LDTA and SDTA) have a negative impact on firm performance. Table 13 shows the impact of capital structure on firm performance, measured by ROE. Based on the subsample, a negative and significant impact of TDTA, LDTA and SDTA on ROE is shown. Table 14 and 15 show the impact of capital structure on ROA and Tobin's Q. Compared to the main regression models, the main results are similar to the results that are based on the subsample.

7. Conclusion and limitations

In the first section of this chapter, the conclusion is presented and the research question is answered. The second section discusses the limitations of this study followed by recommendations for future research.

7.1 Conclusion

The main objective of this study is to investigate the impact of capital structure on firm performance based on a sample of high-technology firms that are based in the UK. Therefore the following research question has been formulated: *"Does capital structure have an impact on the performance of high-technology firms?".* In order to answer this question, capital structure is measured by TDTA, LDTA and SDTA, while firm performance is measured by ROE, ROA and Tobin's Q. One sample of 466 British high-tech firms is used. Most data is collected from the database ORBIS over the sample period of 2015 till 2018, while some other data is collected manually from annual reports of the firms. Based on multiple capital structure theories, two hypotheses are formulated. The first hypothesis predicts that capital structure has a positive impact on firm performance. However, the second hypothesis predicts a negative impact. These hypotheses are tested by conducting multiple regression analyses. Also multiple firm-specific control variables are added to the models for example, firm age and firm size.

After assessing the assumptions of OLS regression analyses, multiple regression models with ROE as the dependent variable were conducted. All measurements of capital structure have a negative and significant impact on ROE. These findings indicate that if firms increase their level of debt in their capital structure, regardless of the duration of leverage, its ROE will decrease. This is the reason hypothesis 2 was confirmed when firm performance was measured by ROE. Hypothesis 2 was also confirmed when firm performance is measured by ROA. Lastly, firm performance was measured by Tobin's Q. In these models all measurements of capital structure has a negative and significant impact on Tobin's Q. This indicates that if firms' total debt ratio, long-term debt ratio or short-term debt ratio increases, its Tobin's Q will decrease. This is the reason that hypothesis 1 is rejected and hypothesis 2 is confirmed, when firm performance is measured by ROE, ROA and Tobin's Q.

Robustness tests are conducted in order to increase the validity and reliability of the main findings. The independent variables and control variables were lagged by one period. Overall, the results of the impact of the lagged independent variables on firm performance were in line with the main results. So, capital structure impacts firm performance in a negative way and not the other way around, which means that reverse causality does not play a role in this study. The second robustness test is based on a subsample which consists of the two most dominant high-tech industries. These results show a negative significant impact of TDTA, LDTA and SDTA on the three measurements of firm performance.

After concluding the main result, the research question can be answered. Capital structure (TDTA, LDTA and SDTA) has a negative impact on the firm performance of British high-tech firms, as predicted by pecking-order theory and trade-off theory. As mentioned earlier, high-tech firms differ from other firms because of their high level of information asymmetry. Therefore, high-tech firms could reduce their innovation advantages by using more debt finance and sharing more information, which could lead to lower firm performance. Besides that, increasing leverage increase the chances of financial distress and lead to financial distress costs. As a result, firm performance will decrease.

7.2 Limitations and recommendation for future research

As described, the conclusion of this study contributes to the general research field of finance, capital structure and firm performance. Also, it fills the existing gap in the literature and it gives useful new insights for managers of high-tech firms. However, it is important to discuss the limitations of this study and recommendations for future research. One of the limitations is that this research is only based on British high-tech firms. Firms located in the UK are exposed to certain country-specific characteristics, which companies in other countries are not exposed to, for example institutional environment and corporate governance practices. Therefore, the results of this study are not generalizable to all high-tech firms worldwide. Besides that, these results are also not generalizable to firms that operate in another industry. This is the reason these results are very specific to high-tech firms that are based on the UK. Even though the objective of this study is to expend country-specific research about capital structure and firm performance, it has a negative influence on the external validity of the study. Another limitation is based on the sample period. This study relies on a sample period in which most recent firm data was available in Orbis. Therefore, the sample period was from 2015 till 2018. However, this study does not show the development of the impact of capital structure on firm performance over a longer time period. Lastly, companies that were not alive during the sample period were excluded from the sample. This sampling criterion could lead to survival bias because these companies did not exist for the whole sample period.

Based on the mentioned limitations, recommendation for future research can be given. The first recommendation is based on the limitation that the results of this study are not generalizable to high-tech firms that are based in other countries. It would be interesting to analyze whether the impact of capital structure on firm performance differs among high-tech firms that are located in different countries. The second recommendation is to use a larger sample period and analyze the development of the impact of capital structure on firm performance. These results could answer the question whether the impact has increased or decreased during the past decade.

References

Aaboen, L., Lindelöf, P., Von Koch, C., & Löfsten, H. (2006). Corporate governance and performance of small high-tech firms in Sweden. *Technovation*, *26*(8), 955-968.

Abor, J. (2005). The effect of capital structure on profitability: an empirical analysis of listed firms in Ghana. *The Journal of Risk Finance. 6*(4), 306-318.

Aghion, P., Fally, T., & Scarpetta, S. (2007). Credit constraints as a barrier to the entry and post-entry growth of firms. *Economic Policy*, *22*(52), 732-779.

Agrawal, A., & Jayaraman, N. (1994). The dividend policies of all-equity firms: A direct test of the free cash flow theory. *Managerial and Decision Economics, 15*(2), 139-148.

Altman, E. I. (1984). A further empirical investigation of the bankruptcy cost question. *The Journal of Finance*, *39*(4), 1067-1089.

Ang, J. S. (1992). On the theory of finance for privately held firms. *The Journal of Entrepreneurial Finance, 1*(3), 185-203.

Arbabiyan, A. A., & Safari, M. (2009). The effects of capital structure and profitability in the listed firms in Tehran Stock Exchange. *Journal of Management Perspective, 33*(12), 159-175.

Asimakopoulos, I., Samitas, A., & Papadogonas, T. (2009). Firm-specific and economy wide determinants of firm profitability: Greek evidence using panel data. *Managerial Finance, 35*(11), 930-939.

Attaoui, S. (2016). Capital structure and tax convexity when the maturity of debt is finite. *International Journal of Theoretical and Applied Finance*, *19*(01), 165-185.

Babalola, Y. A. (2012). The effects of optimal capital structure on firms' performances in Nigeria. *Journal of Emerging Trends in Economics and Management Sciences, 3*(2), 131-133.

Bancel, F., & Mittoo, U. R. (2004). Cross-country determinants of capital structure choice: a survey of European firms. *Financial Management*, *4*(33), 103-132.

Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, *17*(1), 99-120.

Berger, A. N., & Di Patti, E. B. (2006). Capital structure and firm performance: A new approach to testing agency theory and an application to the banking industry. *Journal of Banking and Finance*, *30*(4), 1065-1102.

Bhaduri, S. N. (2002). Determinants of corporate borrowing: some evidence from the Indian corporate structure. *Journal of Economics and Finance, 26*(2), 200-215.

Booth, L., Aivazian, V., Demirguc-Kunt, A., Maksimovic, V. (2001), Capital structure in developing countries, *Journal of Finance, 56*, 87-130.

Brush, T., Bromiley, P., Hendrickx, M., 2000. The free cash flow hypothesis for sales growth and firm performance. *Strategic Management Journal, 21*, 455–472.

Bradley, M., Jarrell, G., Kim, E., 1984. On the existence of an optimal capital structure: theory and evidence. *Journal of Finance, 39,* 857–878.

Cekrezi, A. (2013). A literature review of the trade− off theory of capital structure. *International Review*, *3*(1), 125-134.

Chen, L. J., & Chen, S. Y. (2011). How the pecking-order theory explain capital structure. *Journal of International Management Studies*, *6*(3), 92-100.

Chen, Y., Guo, R. J., & Huang, R. L. (2009). Two stages credit evaluation in bank loan appraisal. *Economic Modeling*, *26*(1), 63-70.

Chen, X., Zou, H., & Wang, D. T. (2009). How do new ventures grow? Firm capabilities, growth strategies and performance. *International Journal of Research in Marketing, 26*(4), 294-303.

Coad, A., Holm, J. R., Krafft, J., & Quatraro, F. (2018). Firm age and performance. *Journal of Evolutionary Economics, 28*(1), 1-11.

Cole, C., Yan, Y., & Hemley, D. (2015). Does capital structure impact firm performance: an empirical study of three US sectors. *Journal of Accounting and Finance, 15*(6), 57-80.

Colombo, M. G., Croce, A., & Murtinu, S. (2014). Ownership structure, horizontal agency costs and the performance of high-tech entrepreneurial firms. *Small Business Economics*, *42*(2), 265-282.

Crick, D., & Crick, J. (2014). The internationalization strategies of rapidly internationalizing high-tech UK SMEs: planned and unplanned activities. *European Business Review*, *26*(5), 421-448.

Črnigoj, M., & Mramor, D. (2009). Determinants of capital structure in emerging European economies: evidence from Slovenian firms. *Emerging Markets Finance and Trade, 45*(1), 72-89.

De Haan, L., & Hinloopen, J. (2003). Preference hierarchies for internal finance, bank loans, bond, and share issues: evidence for Dutch firms. *Journal of Empirical Finance, 10*(5), 661-681.

De Jong, A., Verbeek, M., & Verwijmeren, P. (2011). Firms' debt–equity decisions when the static tradeoff theory and the pecking order theory disagree. *Journal of Banking and Finance, 35*(5), 1303-1314.

De Veaux, R., Velleman, P., & Bock, D. (2016). Stats: Data and Models (4th ed.). Harlow, CA: Pearson Education.

Demirgüç-Kunt, A., & Maksimovic, V. (1998). Law, finance, and firm growth. *The Journal of Finance*, *53*(6), 2107-2137.

Dereli, D. D. (2015). Innovation management in global competition and competitive advantage. *Procedia-social and Behavioral Sciences*, *195*, 1365-1370.

Douma, S., George, R. and Kabir, R. (2006). Foreign and domestic ownership, business groups and firm performance: evidence from a large emerging market. *Strategic Management Journal*, *27*, 637-657.

Duffhues, P. and Kabir, R. (2008). Is the pay-performance relationship always positive? Evidence from the Netherlands. *Journal of Multinational Financial Management*, *18*, 45-60.

Ebaid, I.E. (2009). The impact of capital structure choice on firm performance empirical evidence from Egypt. *The Journal of Risk Finance*, *10*(50), 477-487.

Eldomiaty, T. I. (2004). Dynamics of financial signaling theory and systematic risk classes in transitional economies: Egyptian economy in perspective. *Journal of Financial Management and Analysis*, *17*(2), 41-59.

Fama, E. F., & French, K. R. (1998). Taxes, financing decisions, and firm value. *The Journal of Finance, 53*(3), 819-843.

Fama, E. F., & French, K. R. (2002). Testing trade-off and pecking order predictions about dividends and debt. *The Review of Financial Studies*, *15*(1), 1-33.

Fosberg, R. H. (2010). A test of the M&M capital structure theories. *Journal of Business and Economics Research, 8*(4), 23-28.

Fosu, S. (2013). Capital structure, product market competition and firm performance: Evidence from South Africa. *The Quarterly Review of Economics and Finance, 53*(2), 140-151.

Gharbi, S., Sahut, J. M., & Teulon, F. (2014). R&D investments and high-tech firms' stock return volatility. *Technological Forecasting and Social Change, 88*, 306-312.

Gill, A., Biger, N., & Mathur, N. (2011). The effect of capital structure on profitability: Evidence from the United States. *International Journal of Management, 28*(4), 3-15

Graham, J. R., & Harvey, C. R. (2001). The theory and practice of corporate finance: Evidence from the field. *Journal of Financial Economics, 60*(2-3), 187-243.

Grazzi, M., & Moschella, D. (2018). Small, young, and exporters: New evidence on the determinants of firm growth. *Journal of Evolutionary Economics, 28*(1), 125-152.

Grinstein, A., & Goldman, A. (2006). Characterizing the technology firm: An exploratory study. *Research Policy*, *35*(1), 121-143.

Guest, P. M. (2009). The impact of board size on firm performance: evidence from the UK. *The European Journal of Finance, 15*(4), 385-404.

Gustafson, C. R. (1989). Credit evaluation: monitoring the financial health of agriculture. *American Journal of Agricultural Economics*, *71*(5), 1145-1151.

Hackbarth, D., Hennessy, C. A., & Leland, H. E. (2007). Can the trade-off theory explain debt structure?. *The Review of Financial Studies*, *20*(5), 1389-1428.

Harris, M., & Raviv, A. (1991). The theory of capital structure. *The Journal of Finance*, *46*(1), 297-355.

Harris, R. S., & Pringle, J. J. (1985). Risk-adjusted discount rates-extensions from the average-risk case. *Journal of Financial Research*, *8*(3), 237-244.

Hasan, M. B., Ahsan, A. M., Rahaman, M. A., & Alam, M. N. (2014). Influence of capital structure on firm performance: evidence from Bangladesh. *International Journal of Business and Management, 9*(5), 184- 194.

Hovakimian, A., Opler, T., & Titman, S. (2001). The debt-equity choice. *Journal of Financial and Quantitative Analysis, 36*(1), 1-24.

Jadoua, Z. A., & Mostapha, N. F. (2020). The effect of access to debt on Lebanese small and medium enterprises performance. *Journal of Finance and Risk Perspectives, 9*(1), 32-44.

Jarallah, S., Saleh, A. S., & Salim, R. (2019). Examining pecking order versus trade-off theories of capital structure: new evidence from Japanese firms. *International Journal of Finance and Economics*, *24*(1), 204-211.

Jensen, M. C. (1986). Agency costs of free cash flow, corporate finance, and takeovers. *The American Economic Review, 76*(2), 323-329.

Ju, N., Parrino, R., Poteshman, A. M., & Weisbach, M. S. (2005). Horses and rabbits? Trade-off theory and optimal capital structure. *Journal of Financial and Quantitative Analysis*, *40*(2), 259-281.

Kamath, R. R. (1997). Long-term financing decisions: views and practices of financial managers of NYSE Firms. *Financial Review*, *32*(2), 331-356.

Khan, A.G. (2012). The relationship of capital structure decisions with firm performance: a study of the engineering sector of Pakistan. *International Journal of Accounting and Financial Reporting, 2*(1), 245-262.

Khidmat, W. B., & Rehman, M. (2014). Impact of liquidity & solvency on profitability chemical sector of Pakistan. *Economics Management Innovation*, *6*(3), 34-67.

Kochhar, R. (1997). Strategic assets, capital structure, and firm performance. *Journal of Financial and Strategic Decisions*, *10*(3), 23-36.

Kraus, A., & Litzenberger, R. H. (1973). A state-preference model of optimal financial leverage. *The Journal of Finance*, *28*(4), 911-922.

Lazăr, S. (2016). Determinants of firm performance: evidence from Romanian listed companies. *Review of Economic and Business Studies, 9*(1), 53-69.

Le, T. P. V., & Phan, T. B. N. (2017). Capital structure and firm performance: empirical evidence from

a small transition country. *Research in International Business and Finance*, *42*, 710-726.
Lee, J. (2009). Does size matter in firm performance? evidence from US public firms. *International Journal of the Economics of Business, 16*(2), 189-203.
Li, H., & Cui, L. (2003). Empirical study of capital structure on agency costs in Chinese listed firms. *Nature and Science, 1*(1), 12-20.
Liu, Y., Wie, Z. and Xie, F. (2014). Do women directors improve firm performance in China? *Journal of Corporate Finance*, *28*, 169-184.
Mansourlakoraj, R., & Sepasi, S. (2015). Free cash flow, capital structure and the value of listed companies in Tehran stock exchange. *International Journal of Management, Accounting and Economics, 2*(2), 144-148.
Margaritis, D., & Psillaki, M. (2010). Capital structure, equity ownership and firm performance. *Journal of Banking and Finance*, *34*(3), 621-632.
Mari, C., & Marra, M. (2019). Valuing firm's financial flexibility under default risk and bankruptcy costs: a WACC based approach. *International Journal of Managerial Finance*, *15*(5), 688-699.
Marqués, A. I., García, V., & Sánchez, J. S. (2012). Exploring the behaviour of base classifiers in credit scoring ensembles. *Expert Systems with Applications*, *39*(11), 10244-10250.
Merendino, A., & Melville, R. (2019). The board of directors and firm performance: empirical evidence from listed companies. *Corporate Governance: The International Journal of Business in Society.*
Modigliani, F., & Miller, M. H. (1963). Corporate income taxes and the cost of capital: a correction. *The American Economic Review*, 433-443.
Muritala, T. A. (2012). An empirical analysis of capital structure on firms' performance in Nigeria. *International Journal of Advances in Management and Economics, 1*(5), 116-124.
Musso, P., & Schiavo, S. (2008). The impact of financial constraints on firm survival and growth. *Journal of Evolutionary Economics*, *18*(2), 135-149.
Myers, S. C. (2001). Capital structure. *Journal of Economic Perspectives*, *15*(2), 81-102.
Myers, S. C., & Majluf, N. S. (1984). Corporate financing and investment decisions when firms have information that investors do not have. *Journal of Financial Economics*, *13*(2), 187–221.
Nguyen, T. H., & Nguyen, H. A. (2020). Capital structure and firm performance of non-financial listed companies: cross-sector empirical evidences from Vietnam. *Accounting, 6*(2), 137-150.
Nunes, P. M., Serrasqueiro, Z., & Leitão, J. (2012). Is there a linear relationship between R&D intensity and growth? Empirical evidence of non-high-tech vs. high-tech SMEs. *Research Policy*, *41*(1), 36-53.
Omran, M. M., & Pointon, J. (2009). Capital structure and firm characteristics: an empirical analysis from Egypt. *Review of Accounting and Finance, 8*(4), 454-474.
Opler, T. C., & Titman, S. (1994). Financial distress and corporate performance. *The Journal of Finance*, *49*(3), 1015-1040.
Osborne, J. W. (2000). Advantages of hierarchical linear modeling. *Practical Assessment, Research, and Evaluation, 7*(1), 1-5.
Park, K., & Jang, S. S. (2013). Capital structure, free cash flow, diversification and firm performance: a holistic analysis. *International Journal of Hospitality Management, 33*, 51-63.
Rajan, R. G., & Zingales, L. (1995). What do we know about capital structure? Some evidence from international data. *The Journal of Finance*, *50*(5), 1421-1460.
Ramadan, Z. S., & Ramadan, I. Z. (2015). Capital structure and firm's performance of Jordanian manufacturing sector. *International Journal of Economics and Finance*, *7*(6), 279-284.

Roden, D., & Lewellen, W. (1995). Corporate capital structure decisions: Evidence from leveraged buyouts. *Financial Management, 24*(2), 76-87.

Ross, S. A. (1977). The determination of financial structure: the incentive-signalling approach. *The Bell Journal of Economics*, *8*(1), 23-40.

Saad, N. M. (2010). Corporate governance compliance and the effects to capital structure in Malaysia. *International Journal of Economics and Finance*, *2*(1), 105-114.

Saleem, Q., & Rehman, R. U. (2011). Impacts of liquidity ratios on profitability. *Interdisciplinary Journal of Research in Business*, *1*(7), 95-98.

Salim, M., & Yadav, R. (2012). Capital structure and firm performance: Evidence from Malaysian listed companies. *Procedia-Social and Behavioral Sciences*, *65*, 156-166.

Scott Jr, J. H. (1976). A theory of optimal capital structure. *The Bell Journal of Economics*, *7*(1), 33-54.

Sheel, A. (1994). Determinants of capital structure choice and empirics on leverage behavior: a comparative analysis of hotel and manufacturing firms. *Hospitality Research Journal, 17*(3), 1-16.

Spense, M. (1973). Job market signaling. *The Quarterly Journal of Economics*, *87*(3), 355-374.

Strischek, D. (2000). The quotable five c's. *Journal of Lending and Credit Risk Management, 82*(7), 47-49.

Tian, G. G., & Zeitun, R., (2007). Capital structure and corporate performance: evidence from Jordan. *Australasian Accounting Business and Finance Journal*, *1*(4), 40-61.

Titman, S., & Wessels, R. (1988). The determinants of capital structure choice. *The Journal of Finance, 43*(1), 1-19.

Vithessonthi, C., & Tongurai, J. (2015). The effect of leverage on performance: domestically-oriented versus internationally-oriented firms. *Research in International Business and Finance, 34*, 265-280.

Wang, G. Y. (2010). The impacts of free cash flows and agency costs on firm performance. *Journal of Service Science and Management, 3*(4), 408.

Wang, C. F. (2014). International diversification and firm performance: the moderating effects of corporate governance. *European Journal of International Management, 8*(4), 415-439.

Wei, X., Che, H., Sheng, N., Hsiao, C. Y. L., Tong, Q., & Yan, G. (2020). Research on the development status of china's renewable energy industry-the Impact of capital structure on company performance. *Frontiers in Energy Research*, *8*(71), 1-10.

Weill, L. (2008). Leverage and corporate performance: does institutional environment matter? *Small Eusiness Economics, 30*(3), 251-265.

Wu, L. Y. (2007). Entrepreneurial resources, dynamic capabilities and start-up performance of Taiwan's high-tech firms. *Journal of Business Research*, *60*(5), 549-555.

Yegon, C., Cheruiyot, J., Sang, J., & Cheruiyot, P. K. (2014). The effects of capital structure on firm's profitability: evidence from Kenya's banking sector. *Research Journal of Finance and Accounting*, *5*(9), 181-189.

Zahra, S. A., & Bogner, W. C. (1999). Technology strategy and software new ventures' performance: exploring the moderating effect of the competitive environment. *Journal of Business Venturing*, *15*(2), 135–173.

Appendices

Appendix A: Robustness checks with lagged independent and control variables

Appendix B: Robustness checks with subsample

Appendix A: Robustness checks (lagged variables)

Table 10 – OLS regressions for the impact of capital structure on firm performance (ROE) with lagged independent and control variables

	Dependent variable: ROE								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Independent variables									
TDTA							-.039**		
							(-1.701)		
LDTA								-.092***	
								(-2.604)	
SDTA									-.050*
									(-1.479)
Control variables									
SIZE	.085***					.074***	.074***	.075***	.072***
	(3.207)					(2.763)	(2.779)	(2.823)	(2.715)
AGE		.079***				.067***	.061***	.059***	.063***
		(2.982)				(2.505)	(2.280)	(2.190)	(3.238)
GROW			.200***			.189***	.180***	.167***	.186***
			(3.460)			(3.288)	(3.128)	(2.870)	(3.238)
LIQ				.028*		.027	.024	.025	.024
				(1.065)		(.997)	(.916)	(.933)	(.908)
TANG					.021	.019	.009	.013	.009
					(.635)	(.550)	(.569)	(.785)	(.536)
Constant	-2.070	-3.075	-5.210	-4.445	-2.125	-6.041	-7.495	-5.994	-7.005
	(-2.462)	(-2.355)	(-2.316)	(-3.359)	(-2.359)	(-3.870)	(-3.785)	(-2.506)	(-3.684)
Year Dummy	YES	YES	YES	YES	YES	YES	YES	YES	YES
Number of observations	1391	1391	1391	1391	1391	1391	1391	1391	1391
Adjusted R^2	.022	.023	.025	.018	.004	.065	.087	.128	.119
F-statistic	2.096	3.784	1.355	1.369	1.411	4.912	6.050	4.268	8.060

Note – This table shows the unstandardized coefficients including their statistical significance. Annual data for the period of 2015 till 2018 are analyzed based on the full sample. The dependent variable in this table is ROE. The independent and control variables are lagged for one period. All variables are described in table 2. The numbers in parenthesis represent the t-statistics. The following regression model has been used: $ROE_{it} = \beta_0 + \beta_1 DEBT_{it-1} + \beta_x CONTROL_{it-1} + \varepsilon_{it.}$ * statistical significance at the 10% level. ** statistical significance at the 5% level. *** statistical significance at the 1% level.

Table 11 – OLS regressions for the impact of capital structure on firm performance (ROA) with lagged independent and control variables.

	Dependent variable: ROA								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Independent variables									
TDTA							-.040**		
							(-2.313)		
LDTA								-.086***	
								(-3.304)	
SDTA									-.029*
									(-1.148)
Control variables									
SIZE	.008***					.007***	.007***	.007***	.007***
	(4.584)					(4.229)	(4.255)	(4.312)	(4.189)
AGE		.066**				.045*	.038	.035	.043*
		(2.528)				(1.765)	(1.476)	(1.381)	(1.658)
GROW			.301***			.290***	.282***	.269***	.289***
			(6.996)			(6.816)	(6.598)	(6.273)	(6.776)
LIQ				.025***		.025***	.024***	.024***	.025***
				(3.555)		(3.659)	(3.493)	(3.537)	(3.550)
TANG					-.005	-.006	-.005	-.003	-.006
					(-.347)	(-.388)	(-.327)	(-.220)	(-.421)
Constant	-9.505	-7.261	-.8.741	-8.699	-7.354	-6.477	-6.212	-6.384	-6.563
	(-4.854)	(-4.906)	(-5.841)	(-3.713)	(-5.755)	(-5.630)	(-4.608)	(-4.649)	(-4.642)
Year Dummy	YES	YES	YES	YES	YES	YES	YES	YES	YES
Number of observations	1391	1391	1391	1391	1391	1391	1391	1391	1391
Adjusted R^2	.069	.057	.085	.061	.053	.105	.108	.112	.106
F-statistic	5.801	3.073	5.573	6.375	9.760	8.415	5.195	6.088	4.549

Note – This table shows the unstandardized coefficients including their statistical significance. Annual data for the period of 2015 till 2018 are analyzed based on the full sample. The dependent variable in this table is ROA. The independent and control variables are lagged for one period. All variables are described in table 2. The numbers in parenthesis represent the t-statistics. The following regression model has been used: $ROA_{it} = \beta_0 + \beta_1 DEBT_{it-1} + \beta_x CONTROL_{it-1} + \varepsilon_{it.}$ * statistical significance at the 10% level. ** statistical significance at the 5% level. *** statistical significance at the 1% level.

Table 12 – OLS regressions for the impact of capital structure on firm performance (TOB) with lagged independent and control variables.

	Dependent variable: TOB								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Independent variables									
TDTA							-.063*		
							(-.856)		
LDTA								-.255**	
								(-2.280)	
SDTA									-.089**
									(-.838)
Control variables									
SIZE	.041***					.037***	.037***	.038***	.038***
	(5.482)					(5.115)	(5.121)	(5.169)	(5.139)
AGE		.091***				.065**	.062*	.058**	.067**
		(3.404)				(2.516)	(2.395)	(2.242)	(2.579)
GROW			.214***			.206***	.204***	.197***	.207***
			(8.190)			(8.040)	(7.933)	(7.623)	(8.062)
LIQ				.162***		.163***	.161***	.160***	.165***
				(5.306)		(5.508)	(5.433)	(5.420)	(5.558)
TANG					-.045	-.049	-.048	-.042	-.048
					(-.703)	(-.798)	(-.774)	(-.681)	(-.773)
Constant	-.604	-4.492	-.839	-.382	-.182	6.734	7.155	7.011	7.002
	(-.112)	(-.423)	(-.203)	(-.128)	(-.441)	(.204)	(.217)	(.213)	(.212)
Year Dummy	YES	YES	YES	YES	YES	YES	YES	YES	YES
Number of observations	1391	1391	1391	1391	1391	1391	1391	1391	1391
Adjusted R^2	.020	.017	.045	.019	.001	.086	.107	.143	.135
F-statistic	5.130	5.099	6.643	4.182	.350	2.808	3.004	2.705	2.741

Note – This table shows the unstandardized coefficients including their statistical significance. Annual data for the period of 2015 till 2018 are analyzed based on the full sample. The dependent variable in this table is Tobin's Q. The independent and control variables are lagged for one period. All variables are described in table 2. The numbers in parenthesis represent the t-statistics. The following regression model has been used: $TOB_{it} = \beta_0 + \beta_1 DEBT_{it-1} + \beta_x CONTROL_{it-1} + \varepsilon_{it.}$ * statistical significance at the 10% level. ** statistical significance at the 5% level. *** statistical significance at the 1% level.

Appendix B: Robustness checks (subsample)

Table 13 – OLS regressions for the impact of capital structure on firm performance (ROE) based on a subsample (two most dominant high-tech industries).

	Dependent variable: ROE								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Independent variables									
TDTA							-.025**		
							(-.772)		
LDTA								-.087**	
								(-2.472)	
SDTA									-.103**
									(-1.858)
Control variables									
SIZE	.085***					.078**	.078**	.079**	.077**
	(2.633)					(2.429)	(2.429)	(2.440)	(2.369)
AGE		.159***				.089***	.092***	.093***	.088***
		(4.933)				(2.750)	(2.830)	(2.839)	(2.708)
GROW			.147**			.147**	.150**	.150**	.148**
			(2.157)			(2.155)	(2.194)	(2.194)	(2.159)
LIQ				.009*		.008	.008	.004	.002
				(1.582)		(1.322)	(1.212)	(1.007)	(.590)
TANG					.005	.001	.028	.003	.004
					(.140)	(.040)	(.281)	(.301)	(.549)
Constant	-.995	-5.281	-6.039	.639	-.258	-.398	-.633	-.378	-.879
	(-1.229)	(-1.917)	(-.782)	(1.784)	(-1.478)	(-1.525)	(-1.395)	(-1.455)	(-1.735)
Year Dummy	YES	YES	YES	YES	YES	YES	YES	YES	YES
Number of observations	1023	1024	1024	1024	1024	1024	1024	1024	1024
Adjusted R^2	.032	.033	.030	.015	.025	.087	.092	.104	.126
F-statistic	6.740	3.299	4.255	2.448	1.229	7.655	3.448	6.685	3.178

Note – This table shows the unstandardized coefficients including their statistical significance. Annual data for the period of 2015 till 2018 are analyzed. The sample used in the regression models consist of the two most dominant high-tech industries. The dependent variable in this table is ROE. All variables are described in table 2. The numbers in parenthesis represent the t-statistics. The following regression model has been used: $ROE_{it} = \beta_0 + \beta_1 DEBT_{it} + \beta_x CONTROL_{it} + \varepsilon_{it.}$ * statistical significance at the 10% level. ** statistical significance at the 5% level. *** statistical significance at the 1% level.

Table 14 – OLS regressions for the impact of capital structure on firm performance (ROA) based on a subsample (two most dominant high-tech industries).

	Dependent variable: ROA								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Independent variables									
TDTA							-.071**		
							(-2.269)		
LDTA								-.071**	
								(-2.043)	
SDTA									-.059**
									(-1.673)
Control variables									
SIZE	.065***					.063**	.063**	.065**	.066**
	(2.057)					(2.005)	(2.009)	(2.069)	(2.105)
AGE		.035*				.040	.030	.033	.038
		(1.120)				(1.263)	(.949)	(1.042)	(1.216)
GROW			.264***			.262***	.256***	.262***	.269***
			(4.954)			(4.937)	(4.817)	(4.903)	(5.052)
LIQ				.058**		.067**	.061**	.060**	.062**
				(1.826)		(3.532)	(2.945)	(1.936)	(1.977)
TANG					.007	.007	.002	.002	.011
					(.402)	(.377)	(.073)	(.149)	(.353)
Constant	.075	.358	.909	.675	.949	-.017	-.092	-.199	-.262
	(4.963)	(9.731)	(5.515)	(7.475)	(7.713)	(-.834)	(-.132)	(-.625)	(-.702)
Year Dummy	YES	YES	YES	YES	YES	YES	YES	YES	YES
Number of observations	1023	1024	1024	1024	1024	1024	1024	1024	1024
Adjusted R^2	.062	.059	.082	.061	.028	.087	.114	.149	.138
F-statistic	2.153	3.570	3.954	1.675	3.988	4.409	2.526	2.521	2.478

Note – This table shows the unstandardized coefficients including their statistical significance. Annual data for the period of 2015 till 2018 are analyzed. The sample used in the regression models consist of the two most dominant high-tech industries. The dependent variable in this table is ROA. All variables are described in table 2. The numbers in parenthesis represent the t-statistics. The following regression model has been used: $ROA_{it} = \beta_0 + \beta_1 DEBT_{it} + \beta_x CONTROL_{it} + \varepsilon_{it.}$ * statistical significance at the 10% level. ** statistical significance at the 5% level. *** statistical significance at the 1% level.

Table 15 – OLS regressions for the impact of capital structure on firm performance (TOB) based on a subsample (two most dominant high-tech industries).

	Dependent variable: TOB								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Independent variables									
TDTA							-.263***		
							(-2.822)		
LDTA								-.217*	
								(-1.486)	
SDTA									-.091***
									(-.970)
Control variables									
SIZE	.122***					.123***	.123***	.122***	.124***
	(3.783)					(3.806)	(3.820)	(3.760)	(3.841)
AGE		.017***				.019**	.012**	.017**	.011**
		(.517)				(.586)	(.445)	(.744)	(.530)
GROW			.136***			.134***	.129***	.135***	.134***
			(4.226)			(4.190)	(4.047)	(4.018)	(4.175)
LIQ				.091***		.088***	.081***	.105***	.097***
				(2.381)		(2.731)	(2.494)	(2.776)	(2.577)
TANG					.002	.013	.015	.020	.016
					(.075)	(.170)	(.192)	(.262)	(.203)
Constant	2.283	3.722	3.525	1.784	-2.870	1.565	7.230	4.791	4.524
	(.624)	(.955)	(1.636)	(.635)	(-1.065)	(1.040)	(.339)	(.878)	(1.850)
Year Dummy	YES	YES	YES	YES	YES	YES	YES	YES	YES
Number of observations	1023	1024	1024	1024	1024	1024	1024	1024	1024
Adjusted R^2	.017	.024	.032	.012	.002	.114	.142	.158	.143
F-statistic	2.973	2.069	3.025	.988	.789	4.749	3.488	4.525	2.005

Note – This table shows the unstandardized coefficients including their statistical significance. Annual data for the period of 2015 till 2018 are analyzed. The sample used in the regression models consist of the two most dominant high-tech industries. The dependent variable in this table is Tobin's Q. All variables are described in table 2. The numbers in parenthesis represent the t-statistics. The following regression model has been used: $TOB_{it} = \beta_0 + \beta_1 DEBT_{it} + \beta_x CONTROL_{it} + \varepsilon_{it.}$ * statistical significance at the 10% level. ** statistical significance at the 5% level. *** statistical significance at the 1% level.