Review of Managerial Science
https://doi.org/10.1007/s11846-019-00344-5

ORIGINAL PAPER

Capital structure and firm performance: evidence of Germany under IFRS adoption

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Received: 29 November 2018 / Accepted: 18 June 2019

Abstract
This paper is an attempt to empirically examine the relationship between firm performance and capital structure. The study sample consists of the non-financial firms listed in Germany during the period 1993–2016. The European stock market transition to IFRS in 2005 is also considered as a shifting point that might have influenced the extent of the relationship. We observed that more than 60% of the total assets of German non-financial firms are financed through debt, i.e. they are highly levered compare to similar countries. The results confirm a positive relationship between firm performance and capital structure. We also found that IFRS adoption has led to increased firm performance of our sample, whereas it weakened the relationship between capital structure and firm performance. One plausible explanation for the positive association between capital structure and firm performance is the benefits of the tax shield and the lower costs of issuing debt compared to equity.

Keywords Capital structure · Firm performance · IFRS · Non-financial listed firms · Germany

JEL Classification G30 · C33

1 Introduction

One of the core issues in finance and accounting is the combination of debt and equity, which is referred to as the capital structure, and its potential influence on firm performance. Theoretically, a number of hypotheses explain this relationship

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Published online: 24 June 2019

between capital structure and firm performance. The foundation theory is considered to be the Modigliani–Miller (MM) theory, which suggests that capital structure is irrelevant to a firm's value (Hoffmann 2014). Nevertheless, the key assumptions of the MM theory are based on the conditions of a perfect capital market, which are thought to be practically unobservable in the real world. Conversely, other standing theories such as agency cost theory, pecking order theory and trade-off theory have been proposed in the field to account for an imperfect capital market. Although these theories propose different arguments, they agree that capital structure is value relevant. Nevertheless, it is important to note that there is no individual theory that can completely explain the precise relationship between capital structure and firm performance.

Empirically, previous studies provide some supporting evidence on the association between capital structure and firm performance in both developed and developing economies. Nevertheless, to our knowledge, no research has investigated the moderating effect of the International Financial Reporting Standards (IFRS) transition on that relationship. It is worthwhile examining this research question because there are several existing arguments around the benefits of IFRS adoption on the information environment. This study examines the relationship between capital structure and firm performance in the context of a developed country such as Germany by considering the moderating role of IFRS adoption in 2005. Germany is considered because it is one of the most financially competitive countries in Europe (Schwab and Sala-i-Martin 2016) and it is among those who initially adopted IFRS in 2005 (Lin et al. 2012).

Firm performance could be influenced by changes in financial regulations, such as the adoption of IFRS by stock markets. IFRS codes, formulated by the International Accounting Standard Board (FASB), were implemented as an attempt to harmonise accounting information worldwide. The aim is to establish a common business language that is easy to understand by all (Das 2015). Europe adopted IFRS on January 1st, 2005 (Abdullah 2013) and since then, the financial statements of listed firms are prepared accordingly. It is believed that IFRS adoption increases earnings quality and decreases information asymmetry because it requires more disclosure in a firm's financial statements (Gassen and Sellhorn 2006). Additionally, IFRS enhances the performance measurement ratio in general (Devalle et al. 2010; Abiodun and Asamu 2018). Therefore, the impact of IFRS implementation should be considered when investigating the relationship between capital structure and firm performance.

The current research differs from previous studies in two aspects. First, a large body of research has examined how capital structure can influence firm performance in different countries. However, there is no evidence as to whether the major financial regulatory transitions such as IFRS adoption have placed any significant impact on that relationship between capital structure and firm performance. IFRS adoption is largely believed to improve information environment in general. Second, the sample size of this study covers a large number of observations, 2448 firm-years, for an extended period of time from 1993 to 2016 and the sample is divided into two sub-samples, namely pre-IFRS and post-IFRS adoption. However, prior studies have mostly examined the relationship between capital structure and firm performance

based on a relatively smaller sample of firms and for a shorter period of time (see, for instance, Berger and Di Patti 2006; Chechet and Olayiwola 2014; Jouida 2018; Vo and Ellis 2017).

According to the objectives of this study, the paper attempts to address three questions: What is the nature of the relationship between capital structure and firm performance in Germany? What is the impact of IFRS adoption in 2005 on the relationship between capital structure and firm performance? Do the results vary between small and large size firms? In other words, does firm size have any possible impact on firm performance? The results of this research could possibly be generalised to countries with a similar level of development in Europe or even other continents. However, the findings cannot simply be generalised to all countries because, on the one hand, investors from different financial environment can have different characteristics (Reitan and Sorheim 2000). On the other hand, different financial markets could respond differently to changes in financial rules and regulations.

The reminder of this paper is organised as follows. The theoretical and empirical literature is reviewed in Sect. 2. Section 3 describes the sample data and the method undertaken. Section 4 discusses the empirical results before the conclusion and recommendations are reported in the last section.

2 Literature review

2.1 Theoretical perspective

The initial theory to explain the relationship between firm value and capital structure is the *MM theory*, named after Modigliani and Miller (1958). The theory asserts that capital structure tends to have no significant influence on firm value. In other words, firm value could not be determined by the portion of equity or debt issued. Instead, it would rather be explained by the size of assets. This claims that any possible combination of debt and equity would be value irrelevant. Nevertheless, there are several underlying assumptions on which the MM proposition is based (Ahmeti and Prenaj 2015; Bandyopadhyay and Barua 2016; Le and Phan 2017). The theory assumes that the capital market is perfect where there are no taxes, bankruptcy and transaction costs are zero, market information is not symmetric, borrowing costs are identical for everyone, a firm's profit is homogeneously expected by investors, all managers desire to maximize value, and the level of risk is consistent for organizations operating with similar conditions. Moreover, Miller (1977) considers the trade-off between the disadvantage of personal tax of debt and the advantage of corporate tax, and concludes that providing there exists a variety of investors with different marginal rates of personal taxes, capital structure would be irrelevant. The reason is the cost of financing a project is stable in equilibrium status. From this perspective, the weighted average cost of capital ought to be constant regardless of the changes in the capital structure.

Using contrary approaches, three other existing theories (namely, agency cost theory, pecking order theory and trade-off theory) claim the existence of a theoretical relationship between capital structure and firm value. In other words, the

proportional combination of debt and equity in the capital of a firm has an influence on the firm value. The arguments behind these theories will be discussed in the following paragraphs.

Agency cost theory, developed through a series of works by Jensen and Meckling (1976), Jensen (1986), Eisenhardt (1989) and Hart and Moore (1994), states that a conflict of interest exists between stakeholders such as principals and agents, which creates agency costs for the firm. Accordingly, an ideal capital structure tends to increase firm value if it has the potential to reduce aggregate agency costs. Precisely, Jensen and Meckling (1976) classified the agency costs into two types: the agency cost of equity and the agency cost of debt. The former is created by the shareholder-managers conflict, whereas the latter is produced by the equity holder-debt holder's conflict. The agency cost of equity implies that managers prefer their individual purposes to shareholder's return and firm value growth (Jerzemowska 2006). Jensen (1986) contended that in the circumstances of high leverage, managers are under high pressure to concentrate more on profitable investments in order to be able to generate sufficient cash flow for interest payments. Berger and Di Patti (2006) and Margaritis and Psillaki (2010) argued that more debt decreases the agency costs of equity or persuades principals to perform more in the interest of shareholders. In this respect, managers are less able to concentrate on their personal objectives (Guizani 2017). Consequently, leverage is likely to have a positive influence on firm value via the reduction of equity's agency costs. However, debt can have a negative influence on firm value because it increases the agency cost of debt (Becker and Stromberg 2012). Myers (1977) maintained that lenders tend to require superior interest rates to compensate for the high risks involved with high firm leverage. In summary, agency theory expects a significant relationship between capital structure and firm performance.

Developed by Myers and Majluf (1984), *pecking order theory* states that leverage raises the perception of the market for value and, in turn, leads the firm value to increase. Here, firms follow a specific hierarchy for financing their sources in a way that internal financing comes before external financing and debt is preferred to equity (Shubita and Alsawalhah 2012). In other words, firms prefer to issue equity only when there is no more debt to borrow. This is because debt issuance generates lower information costs than issuing equity (Lemmon and Zender 2016). Although the theory gives preference to debt over equity for the purpose of value maximization, it does not identify the optimal leverage ratio.

Alternatively, *trade-off theory* claims that firms can create an optimal capital structure which maximizes firm value through debt issuance. However, the cause is different and, in this case, it is because of the tax savings benefit of debt. The theory states that the costs and benefits of debt are compromised by a firm in order to increase firm value (Kraus and Litzenberger 1973; Myers 1984). The benefits of debt in a capital structure persist up to the point where the optimal capital structure is achieved (Al-Kahtani and Al-Eraij 2018). The tax shield is the initial benefit of debt (Modigliani and Miller 1963), which indicates that firms are able to decrease their taxable income via interest payments. Previous research has presented empirical evidence to support this (see, for example, Arzac and Glosten 2005; Graham 2000; Saona and San Martin 2018; Titman and Wessels 1988). Kim (1978) and

Leland (1994) asserted that the cost of debt originally comes from the financial risk of leverage, which might later lead to bankruptcy costs. In summary, trade-of theory specifies that the difference between the values of levered and unlevered firms comes from the tax shield minus the costs of financial distress.

2.2 Empirical evidence

Since 1958, when MM theory first emerged, the debates about whether capital structure might influence firm performance have been continuing. It is widely thought that leverage can have an impact on firm performance or firm value in the real world where the market is imperfect, and this is theoretically supported by several theories in the literature. However, the empirical evidence provides diverse conclusions on this relationship.

Ardalan (2017) argued that the precise association between capital structure and firm performance might differ with regard to dissimilar contexts. As we observed in the current literature, specific conditions such as the level of development in the country and firm size tend to influence the nature of the relationship between capital structure and firm performance. This paper reviews the most relevant and contemporary literature, aiming to identify a pattern in the results by comparing sample countries according to their level of development and comparing firms with regard to their size.

A number of studies show that capital structure has a positive impact on firm performance in financially or economically developed countries (see, for instance, Adair and Adaskou 2015; Berger and Di Patti 2006; Fosu 2013; Jouida 2018; Margaritis and Psillaki 2007). However, other empirical studies (see, for instance, Chechet and Olayiwola 2014; Le and Phan 2017; Salim and Yadav 2012; Tong and Green 2005; Vo and Ellis 2017) have investigated the relationship in developing countries and ultimately presented evidence showing that the relationship between a firm's leverage and performance is significantly negative. Moreover, Bandyopadhyay and Barua (2016) and Jaisinghani and Kanjilal (2017) found both positive and negative impacts of capital structure on firm performance in India, which is recognised as a newly industrialised country. Consequently, they claimed the existence of

Table 1 Summary of some related past studies

Author(s)	Year	Sample	Duration	Findings
Jouida	2018	Financial firms in France	2002–2012	Positive (+)
Margaritis and Psillaki	2010	A sample of manufacturing firms in France	2002–2005	Positive (+)
Berger and Di Patti	2006	Commercial banks in USA	1990–1995	Positive (+)
Simerly and Li	2000	A number of large USA firms	In 1992	Negative (−)
Chechet and Olayiwola	2014	Listed firms in Nigeria	2000–2009	Negative (−)
Jaisinghani and Kanjilal	2017	Publicly traded manufacturing firms in India	2005–2014	Non-linear relationship

a non-linear relationship. Table 1 illustrates a summary of several empirical studies that investigated the relationship between capital structure and firm performance.

Despite the country's level of development, firm size can also play an important role in identifying the relationship between leverage and firm performance. Ibhagui and Olokoyo (2018) found a negative impact of leverage on firm performance for a sample of 101 small non-financial firms in Nigeria over the period 2003–2007. However, the impact tended to be positive when the firm size was considerably large. Moreover, Jaisinghani and Kanjilal (2017) found that the performance of Indian manufacturing firms with a size greater than a specific threshold (148 m rupees) was positively influenced by raising the leverage ratio. Similarly, Saona and San Martin's (2018) findings indicate that both country level and firm size play a crucial role in the case of firms in Latin America.

There is no empirical evidence showing the moderating effect of IFRS adoption on the relationship between capital structure and firm performance. However, evidence exist that IFRS adoption, as an important regulatory change in stock market, can positively influence the key financial indicators such as the financial dispersion cost of capital and information asymmetry. Van Beusichem et al. (2016) examined the impact of IFRS in the case of Dutch listed firms. Their outcomes suggest that transparency has increased substantially under IFRS, and that the determinants of transparency have very little disparity after the adoption of IFRS. Studies conducted by Abad et al. (2018) and Gassen and Sellhorn (2006) empirically confirmed that IFRS adoption decreases information asymmetry as it can cause the cost of capital to decline. Similarly, Turki et al. (2016) and Turki et al. (2017) outlined that IFRS adoption has significantly reduced financial dispersion and the cost of capital.

There are also a number of studies that have investigated the differences in the quality of accounting information between the pre and post IFRS adoption periods. IFRS demands more financial disclosure and mandates the listed companies to publish their financial statements more frequently, on a quarterly base. This would provide more up-to-date information to the financial market, which in turn has more potential in aiding investors in the process of determining firm value. Empirically, Devalle et al. (2010) found that accounting information has become more value relevant in Europe under IFRS compared to pre-IFRS. This was also confirmed by Abdullah (2013) in the case of the UK during 2005–2012. Moreover, Bocking et al. (2015) emphasized that the enforcement of financial reporting in Germany is more effective in detecting earnings management under IFRS. In general, accounting information has become more useful under IFRS (Li et al. 2017).

3 Methodology

3.1 Sample and data

From a preliminary data sample containing all companies quoted on the Frankfurt Stock Exchange from 1993 to 2016, the final data sample consists of 2448 firm-year observations. We considered listed firms in Germany because they have been mandated to prepare their financial statements in accordance with IFRS since January

1st, 2005, while non-listed firms have the option to choose between IFRS and German commercial code (HGB). Following the studies of Al-Najjar and Hussainey (2011), Le and Phan (2017) and Vo and Ellis (2017), since financial firms have their own types of business operations and capital structure which are different from non-financial firms, banks, real estate, security and investment, and insurance firms are excluded from our sample. Additionally, firms whose stock price data and year-end accounting data were unavailable for the entire period are also excluded. Secondary longitudinal data were collected from DataStream for a period of 24 years. The panel data type is a balanced panel. In order to achieve the objectives of the study, the sample period will be divided into two sub-periods, namely 1993–2004 and 2005–2016, in order to capture the moderating impact of IFRS adoption on the relationship between capital structure and firm performance in Germany.

3.2 The variables

3.2.1 Firm performance

The dependent variable of this study is firm performance. We measure firm performance using the accounting proxies of return on assets (ROA) and the return on equity (ROE). These measures are widely used in the literature (see, for instance, Abor 2005; Ibhagui and Olokoyo 2018; Jouida 2018; Lins et al. 2017; Tong and Green 2005). ROA is calculated by dividing net income over total assets whereas ROE is measured by dividing net income over total equity. In addition, we use stock price as market measure of firm performance, following Gok and Peker (2017) and Kalkan et al. (2014).

3.2.2 Capital structure

Capital structure is a combination of debt and equity that a company holds to fund its assets (Geske et al. 2016). Capital structure, in terms of leverage, is the major explanatory variable of our study. Different proxies were used in the literature to measure capital structure, including short-run debt to total assets, long-run debt to total assets and total debt to total assets. Based on previous literature (see, for instance, Fosu 2013; Bandyopadhyay and Barua 2016; Ibhagui and Olokoyo 2018; Margaritis and Psillaki 2010), we measure leverage using the book value of total debt to the book value of total assets.

3.2.3 Control variables

For the purposes of the current study, we examine whether the capital structure decision increases firm performance. In order to precisely capture that relationship, we control for a number of variables in our multivariate regression model aiming to control for firm characteristics, consistent with the literature (Bandyopadhyay and Barua 2016; Basit and Hassan 2017; Jouida 2018; Le and Phan 2017). Those control variables are growth rate, dividend to price ratio, and firm size. IFRS is a dummy

variable controlled for to capture the financial and accounting regulatory changes in the German stock market. Moreover, stock return might influence firm's financial performance (Huang et al. 2011; Kurniaty et al. 2018), therefore, another dummy variable (MAR) is introduced to capture the possible impact of stock price movements (ups and downs) on the accounting performance. Table 2 provides details of the variables used in the study along with their measures and calculating formulas.

Generally, we expect a significant impact of growth rate, dividend, and firm size on firm performance. Margaritis and Psillaki (2010) argued that larger and more profitable companies are usually well-managed and, in turn, they are more efficient. However, dividend is positively associated with firm performance (Khan et al. 2016), because dividend payments potentially enhance the market perspective about the company and this leads the firm's return to increase.

3.3 Method

Our research model follows Le and Phan (2017) and Wahba (2014), who suggested a linear relationship between capital structure and firm performance based on the following equation:

$$FP_{(t)j} = \beta LEV_{(t)j} + \gamma X_{(t)j} + \varepsilon_j$$

where $FP_{(t)j}$ is the financial and market performance of firm j at time t, $LEV_{(t)j}$ is the leverage ratio for firm j at time t, X represents a vector of controls (growth, dividend, size and IFRS and MAR dummy variables) and ε_j is the stochastic error term.

In order to examine the direction and level of the relationship between the variables, we undertake multiple regression analysis on the panel data. This is conducted after restricting for company features. The pooled Ordinary Least Square (OLS), Random-Effect (RE), Fixed-Effect (FE) and Generalised Methods of Moments (GMM) estimation approaches are frequently used methods for panel data estimation (see, for instance, Chadha and Sharma 2015; Dawar 2014; Vo and Ellis 2017).

OLS estimators are unbiased and consistent if the residuals are autonomous to the vector of explanatory and control variables. However, it is common to observe

Table 2 Descriptions of variables

Variable	Type	Measure	Description
ROA	Dependent	Financial performance	Net income/total assets
ROE	Dependent	Financial performance	Net income/total equity
Stock price	Dependent	Market performance	Price per share in stock market
Capital structure	Explanatory	Leverage	Total debt/total assets
Growth	Control	Sales growth	Current period sales—prior period sales/prior period sales
Dividend ratio	Control	Dividend	Share's dividend/share's market price
Total assets	Control	Firm size	ln (total assets at year-end)
IFRS	Dummy	Financial regulatory change	Before and after Jan. 1st, 2005
MAR	Dummy	Stock return	Ups and downs in stock prices

firm-specific effects in non-experimental studies (Le and Phan 2017). In such a case, RE and FE models are more effective than pooled OLS because they account for specific error components at the firm level. The Hausman specification test is usually used to identify the best model between RE and FE. However, the potential problems of autocorrelation and heteroscedasticity cannot be overcome by the RE and FE models. Additionally, Roberts and Whited (2013) claimed that the most important and pervasive issue confronting empirical finance research is endogeneity, which the RE and FE models are unable to account for. Therefore, the GMM is recommended as a proper alternative.

This study performs the panel two-step first difference GMM of Arellano and Bond (1991) to deal with the possible endogeneity issue (Bandyopadhyay and Barua 2016; Fosu 2013; Le and Phan 2017) between firm performance and leverage. As instruments, the first differenced lagged value of financial performance variables is used with their past levels. In doing so, the GMM technique uses a series of instrumental factors produced by the lagged variables, which can also solve the issue of endogeneity for other independent variables, not only for total debt ratio (Roodman 2009). Thus, the endogenous variable would not be correlated to the error term because it will be predetermined (Bandyopadhyay and Barua 2016). As model diagnostics, Hansen J-statistic and the Arellano-Bond test for autocorrelation errors will be performed. Hansen J-statistic assesses the orthogonality condition for the instruments, while the Arellano-Bond test is used to ensure that the residuals are not correlated.

The relationship between firm performance and capital structure is investigated based on the following multivariate regression models and the results are then analysed accordingly:

$$\begin{aligned}\Delta ROA_{(t)j} = {} & B_0 + B_1 \Delta TDR_{(t-1)j} + B_2 GROW_{(t)j} + B_3 \Delta DIV_{(t)j} + B_4 \Delta \ln SIZE_{(t)j} \\ & + B_5 IFRS + B_6 \Delta TDR_{(t-1)j} \times IFRS + B_7 MAR + \varepsilon_j \end{aligned} \tag{1}$$

$$\begin{aligned}\Delta ROE_{(t)j} = {} & B_0 + B_1 \Delta TDR_{(t-1)j} + B_2 GROW_{(t)j} + B_3 \Delta DIV_{(t)j} + B_4 \Delta \ln SIZE_{(t)j} \\ & + B_5 IFRS + B_6 \Delta TDR_{(t-1)j} \times IFRS + B_7 MAR + \varepsilon_j \end{aligned} \tag{2}$$

$$\begin{aligned}\Delta lnP_{(t)j} = {} & B_0 + B_1 \Delta TDR_{(t-1)j} + B_2 GROW_{(t)j} + B_3 \Delta DIV_{(t)j} + B_4 \Delta \ln SIZE_{(t)j} \\ & + B_5 IFRS + B_6 \Delta TDR_{(t-1)j} \times IFRS + \varepsilon_j \end{aligned} \tag{3}$$

where $ROA_{(t)j}$ is the ratio of return on assets to measure the financial performance of firm j in year t; $ROE_{(t)j}$ is the ratio of return on equity also to measure the financial performance of firm j in year t; whereas $lnP_{(t)j}$ is the natural log of stock price per share to measure firm j market performance in year t; $TDR_{(t-1)j}$ is the lagged book value of total debt to the book value of total assets for firm $_j$ at time t. The lagged value of TDR assists with addressing any potential opposite causality between capital structure and firm performance (Bandyopadhyay and Barua 2016); $GROW_{(t)j}$ is the change in total sales between year t and year $t-1$ for firm j; $DIV_{(t)j}$ is the dividend per share to price per share at the end of year t for firm j; $lnSIZE_{(t)j}$ is the natural log of the book value of total assets to measure firm size at the end of year t for

firm *j*; *IFRS* is a dummy variable which gives 0 to pre-IFRS adoption period and 1 to post-IFRS adoption period; $\Delta TDR_{(t-1)j} \times IFRS$ is an interaction term: measure of capital structure and IFRS adoption, aiming to better capture the moderating role of IFRS adoption on the relationship between capital structure and firm performance; *MAR* is a dummy variable which gives 0 to the downs in firm's stock price and 1 to the ups; Δ is the annual change in the variables; and ε_j is the random error term.

3.4 Panel unit root test

Based on the literature, we are initially subjecting the study variables and data to a unit root test. This is essential to determine the nature of the data we are dealing with and to ascertain the existence of the potential relationship between the variables in the long run. Levin, Lin and Chu (2002) suggested a common unit root test for panel data that assumes there is an identical autoregressive lag length, AR(p), across cross-sections. Nonetheless, the individual unit root test allows for heterogeneous AR(p) across cross-sections (Im, Pesaran and Shin 2003). The two tests (LLC and IPS) similarly use a null hypothesis of non-stationarity. Both unit root tests are used in this study to increase the robustness of the results. Several test models are conducted to select the appropriate lag length and to confirm whether the intercept and time trend need to be included. The autoregressive coefficient is controlled to be similar through all units in the panel data test. The findings (see Table 3) reveal that all the series are integrated or stationary at level because the probabilities of both the *t* test and w-test are lower than 1%. In other words, we can reject all the null hypotheses of having a unit root. This specifies the fact that the results we obtained from hypotheses testing can hold in the long run.

4 Data analysis and findings

4.1 Descriptive statistics

Table 4 presents a summary of the descriptive statistics for variables as proxies of firm performance, capital structure and control variables. The level of the

Table 3 Panel unit root tests

Variables	LLC test t*	IPS test W-stat	Results
ΔROA	− 25.36***	− 31.31***	Reject null
ΔROE	− 25.90***	− 33.41***	Reject null
ΔlnP	− 23.99***	− 23.42***	Reject null
ΔTDR	− 13.71***	− 19.78***	Reject null
GROW	− 18.75***	− 20.27***	Reject null
ΔDIV	− 25.54***	− 30.64***	Reject null
ΔlnSIZE	− 14.75***	− 18.25***	Reject null

***Significant at the 1% level

Table 4 Descriptive statistics of firm performance and capital structure

	Observations	Mean	SD	Minimum	Maximum
1993–2004					
ROA	1224	0.0745	0.0867	−0.5098	0.9757
ROE	1224	0.2494	1.0244	−20.268	17.018
lnP	1224	2.7566	1.1979	0.0040	6.1944
TDR	1224	0.6495	0.1657	0.0230	0.9990
GROW	1122	0.2624	3.3542	−0.9815	88.948
DIV	1224	0.0250	0.0260	0.0000	0.4400
lnSIZE	1224	13.0683	2.1912	8.7271	18.6431
2005–2016					
ROA	1224	0.0782	0.0789	−0.4725	0.7412
ROE	1224	0.2223	1.2857	−32.704	14.594
lnP	1224	3.3405	1.3769	0.0030	6.6060
TDR	1224	0.5955	0.1699	0.0168	0.9947
GROW	1122	0.0418	0.2175	−0.9408	5.2348
DIV	1224	0.0235	0.0271	0.0000	0.6122
lnSIZE	1224	13.6616	2.4113	8.8934	19.807

variables is used in order to obtain real figures of performance and leverage. The sample is equally divided into two sub-samples based on the IFRS implementation date on January 1st, 2005. The average of the total debt ratio generally explains 64.95% and 59.55% during the periods 1993–2004 and 2005–2016, and extensively disperses from 2.3 to 99.9% and from 1.68 to 99.47%, respectively. These ratios reveal the fact that German non-financial listed firms are highly leveraged compared with those in other countries. De La Bruslerie and Latrous (2012) observed only 22% for firms in France during the period 1998–2009. Moreover, Le and Phan (2017) reported 52% for firms in the emerging Vietnamese economy during 2007–2012. The ratios also show that firm leverage declined by an average of 5.40% post-IFRS compared with pre-IFRS. This reveals that the capital of German listed firms became less leveraged after the adoption of IFRS in the country.

The average *ROA* and *ROE* overall clarify 7.45% and 24.94% throughout the first half of the period from 1993 to 2004 and extensively diffuses from −50.98% to 97.57% and from −2026.7% to 1701.8%, respectively. The mean of natural logarithm of stock price is 2.75 with a wide range from 0.004 to 6.19. These values indicate the existence of an important gap in financial and market performance amongst German listed companies over that period. However, the average of *ROA*, 7.82%, slightly increased during the second half of the period 2005–2016 and was less widely dispersed, from −47.25% to 74.12%. Similarly, the average of *lnP* increased to 3.34. Nonetheless, the average of *ROE* declined by 2.71% and was more widely dispersed. These ratios expose the fact that the average of firm performance, using the accounting measures, was similar before and after IFRS, whereas the average firm performance based on market measure significantly

increased. The figures of the control variables regarding their average remained very similar after IFRS adoption apart from the mean of sales growth rate, which declined from 26% in 1993–2004 to 4% in 2005–2016.

4.2 Correlation matrix

Table 5 illustrates the correlation matrix, which measures the relationship between the variables used in the regression models. The results show that none of the correlations seem to be at a problematic level between the explanatory variables. The strongest level of correlation observed is 54.9%, which is between ROA and ROE. The correlation coefficients of ROA and ROE with TDR are significantly positive, 17.5% and 5.5% respectively. These results indicate that leverage is positively correlated to a firm's financial performance. However, firm performance based on the market measure of stock price is negatively correlated to TDR at − 15.3%. We also checked for correlations between performance measures and capital structure before and after IFRS adoption. We found similar results regarding their signs, but those correlations were all stronger in the post-IFRS period compared to pre-IFRS period by 5%, 6% and 3% for ROA, ROE and P respectively.

The results show that the dividend payout ratio is negatively correlated to all the other variables used in this study. Firm size has a negative correlation coefficient with TDR, − 11.2%. Nonetheless, positive associations are found for stock price and sales growth with firm size measured by the natural logarithm of the book value of total assets, with 20.8% and 32.7%, respectively.

It is important to note that all the correlation coefficients are moderate and the predictor variables are far from being perfectly correlated. Explanatory variables in a multiple regression model cannot be linearly expected from the others with a considerable degree of accuracy (Enders 2008). Consequently, our data does not suffer from multicollinearity problems and the predictors used in this study can be combined in one regression model.

Table 5 Correlation matrix between firm performance and capital structure

	$\Delta ROA_{(t)j}$	$\Delta ROE_{(t)j}$	$\Delta lnP_{(t)j}$	$\Delta TDR_{(t-1)j}$	$GROW_{(t)j}$	$\Delta DIV_{(t)j}$	$\Delta lnSIZE_{(t)j}$
$\Delta ROA_{(t)j}$	1						
$\Delta ROE_{(t)j}$	0.549***	1					
$\Delta lnP_{(t)j}$	0.064***	0.0004					
$\Delta TDR_{(t-1)j}$	0.175***	0.055***	− 0.153***	1			
$GROW_{(t)j}$	0.014	0.002	0.033	0.155	1		
$\Delta DIV_{(t)j}$	− 0.087***	− 0.039*	− 0.168***	− 0.115***	− 0.006	1	
$\Delta lnSIZE_{(t)j}$	− 0.057***	− 0.042*	0.208***	− 0.112***	0.327***	− 0.041**	1

***Correlation is significant at the 01% level; **Correlation is significant at the 05% level; *Correlation is significant at the 10% level

4.3 Regression analysis (GMM)

The OLS, FE and RE models assume that the explanatory variables are exogenous. Thus, those models do not account for endogeneity, which was claimed by Roberts and Whited (2013) to be an issue in empirical corporate finance studies. The estimators of OLS, FE and RE, could then be biased and inconsistent (Le and Phan 2017). The Panel GMM model explored by Arellano and Bond (1991) helps in controlling the problem of endogeneity. Therefore, we run the dynamic panel GMM technique. The system two-step GMM estimator with robust standard error is used to investigate the impact of capital structure on firm performance in German non-financial listed firms during 1993–2016 with considering the moderating impact of IFRS transition in 2005. Roodman (2009) asserted that the two-step difference GMM is efficient and robust to heteroscedasticity and autocorrelation. Moreover, to control for the probability of existing a bidirectional relationship (reverse causality) between capital structure and firm performance, we took lagged value of the leverage variable (Bandyopadhyay and Barua 2016).

Table 6 illustrates the results of the system two-step GMM estimator with robust standard error. The results of GMM emphasise that capital structure significantly and positively influences firm performance measured by the financial performance measures of ROA and ROE. Precisely, the outcomes of Model 1 show that every 1% increase in the prior period's total debt ratio would have a marginal impact on ROA to increase by about 0.32% in the 99% confidence interval level. Similarly, the outcomes of Model 2 illustrate that every 1% increase in previous ΔTDR lead to an increase in ΔROE of 1.57%. As can be observed, the impact of the leverage ratio is relatively larger on ROE compared to ROA. The standard errors for both coefficients in Models 1 and 2 are small, with 0.005 and 0.009, respectively. Therefore, the impact of capital structure is positive on financial performance for non-financial firms listed in Germany over the period 1993–2016. However, this impact tends to be negative when we measure firm performance from the market perspective. The results of model 3 illustrate that when the lagged capital structure increases by 1%, current stock price declines by 1.006%.

Sales growth is positively correlated with financial performance in a way that a 1% increase in growth leads to a rise of 0.002% in ROA and 0.43% in ROE. Nonetheless, sales growth has a negative impact on stock price. These coefficients are significant at the 1% level. The impact from the dividend payout ratio on firm performance is negative with a marginal impact of −0.28%, −2.69% and −4.95% on ROA, ROE and P, respectively. We can also see that the impact of size, measured by the book value of total assets, is significant and negative on firm's financial performance, but positive on market performance. This indicates that accounting performance declines with the increase of size and conversely, market performance increase with the increase of size. This may imply that German non-financial firms rely heavily on debt to grow (i.e., an increase in assets mostly comes from an increase in liabilities, not equity). Moreover, market performance has a positive, but small, impact on financial performance, according to the coefficients of MAR in models 1 and 2.

Table 6 GMM model with robust standard error

	(1) *ΔROA is dependent*		(2) *ΔROE is dependent*		(2) *ΔlnP is dependent*	
	Coefficient (SE)	*t*-statistic	Coefficient (SE)	*t*-statistic	Coefficient (SE)	*t*-statistic
$\Delta TDR_{(t-1)j}$	0.322 (0.005)	66.93***	1.567 (0.009)	169.2***	− 1.006 (0.053)	− 18.81***
$GROW_{(t)j}$	0.002 (0.0001)	25.68***	0.428 (0.005)	88.03***	− 0.048 (0.005)	− 9.239***
$\Delta DIV_{(t)j}$	− 0.281 (0.014)	− 20.28***	− 2.689 (0.019)	− 139.7***	− 4.946 (0.119)	− 41.67***
$\Delta lnSIZE_{(t)j}$	− 0.005 (0.002)	− 3.233***	− 1.918 (0.007)	− 267.9***	0.854 (0.023)	37.70***
IFRS	0.017 (0.001)	25.34***	0.610 (0.009)	67.72***	0.048 (0.002)	22.90***
$\Delta TDR_{(t-1)j}$*IFRS*	− 0.060 (0.001)	− 46.76***	− 1.225 (0.006)	− 188.9***	0.025 (0.005)	4.999***
MAR	0.007 (0.001)	7.811***	0.119 (0.002)	53.16***		
$\Delta ROA_{(t-1)j}$	− 0.329 (0.001)	− 436.8***				
$\Delta ROE_{(t-1)j}$			− 0.604 (0.0001)	− 3483***		
$\Delta lnP_{(t-1)j}$					− 0.013 (0.005)	− 2.644***
No. of Observations	2128		2128		2142	
Hansen J p value	0.292		0.333		0.373	
AR(1)	0.002		0.915		0.000	
AR(2)	0. 516		0.960		0.625	

In this table, the results of the GMM technique are reported to investigate the relationship between capital structure (CS) and firm performance (FP). CS is measured by total debt to book value of total assets, total debt ratio (TDR). FP is measured using financial measures (ROA and ROE) and market measure of stock price (P). The results are based on yearly data for non-financial firms listed in Germany between 1993 and 2016 with accounting for the IFRS transition on January 1st, 2005. Models 1, 2 and 3 consider the impact of TDR with the other explanatory variables on the different measures of firm performance ROA, ROE and P respectively. IFRS is a dummy variable that captures the effect of accounting and financial regulatory changes on FP. Additionally, the models controlled for the interaction between capital structure and IFRS adoption in order to better capture the moderating role of IFRS adoption on the effect of capital structure. MAR is another dummy variable to measure firm's market performance based on ups and downs in stock prices

Values in parentheses are robust standard errors; ***significant at the 1% level; **significant at the 5% level; *significant at the 10% level

Most importantly, the coefficients of the IFRS dummy variable are positive at the 1% significant level in all three models, indicating that firm performance measured by financial and market proxies has increased on average over the second half of our sample period 2005–2016, after the adoption of IFRS. This could indicate

that IFRS adoption led to an increase in firm performance of non-financial firms in Germany.

In order to capture the moderating role of IFRS on the relationship between capital structure and firm performance, the three models in this study controlled for the interaction between TDR and IFRS. The results show that the interaction terms are significant in all three models, meaning that IFRS adoption plays an important role on the effect of capital structure. IFRS adoption negatively influenced the impact of capital structure on both measures of financial performance, while it posited a positive impact on the relationship between capital structure and firms' market performance. Table 7 further investigates this through splitting the sample study into pre-IFRS and post-IFRS periods. The results of these robustness checks also confirm that the IFRS adoption in 2005 weakened the relationship between the capital structure and financial performance of non-financial firms listed in Germany.

Table 7 GMM model with robust standard error for pre and post-IFRS periods

	ΔROA is dependent		*ΔROE is dependent*		*ΔlnP is dependent*	
	(1) Pre-IFRS	(2) Post-IFRS	(3) Pre-IFRS	(4) Pre-IFRS	(5) Pre-IFRS	(6) Pre-IFRS
$\Delta TDR_{(t-1)j}$	0.669*** (13.27)	0.258*** (38.96)	5.00 *** (15.04)	1.052*** (109.3)	0.303 (0.62)	−0.678*** (−11.14)
$GROW_{(t)j}$	0.006*** (5.23)	0.074*** (30.17)	0.613*** (7.90)	0.771*** (193.8)	−0.036* (−1.77)	0.666*** (33.27)
$\Delta DIV_{(t)j}$	0.734*** (3.60)	−0.34*** (−14.57)	−8.673*** (−10.75)	2.531*** (99.76)	−8.758*** (−6.80)	−4.835*** (−33.76)
$\Delta lnSIZE_{(t)j}$	−0.120*** (−8.75)	−0.026*** (−8.49)	−4.576*** (−30.18)	0.379*** (50.33)	1.156*** (8.16)	0.348*** (26.19)
MAR	−0.009*** (−0.92)	0.016*** (28.68)	−1.436*** (−15.48)	0.431*** (168.8)		
$\Delta ROA_{(t-1)j}$	−0.296*** (−19.48)	−0.220*** (−75.80)				
$\Delta ROE_{(t-1)j}$			−0.488*** (−206.3)	−0.712*** (−2964)		
$\Delta lnP_{(t-1)j}$					−0.047* (−1.89)	−0.016*** (−3.57)
No. of Observations	912	1214	912	1214	918	1224
Hansen J p value	0.057	0.530	0.452	0.346	0.003	0.405
AR(1)	0.004	0.002	0.020	0.171	0.003	
AR(2)	0.535	0.254	0.163	0.187	0.362	

In this table, the research sample has been split into 1993–2004 and 2005–2016 sub-periods to further examine the effect of IFRS adoption on the relationship between CS and FP. The results are based on yearly data for non-financial firms listed in Germany. Models 1, 3 and 5 consider pre-IFRS adoption, whereas models 2, 4 and 6 are for post-IFRS adoption

Values in parentheses are *t*-statistics; ***significant at the 01% level; **significant at the 5% level; *significant at the 10% level

4.4 Model diagnostics

The key diagnostic tests recommended by Arellano and Bond (1991) to check for the validity of the GMM model are the Arellano-Bond test for autocorrelation errors and the Hansen J test of overidentification. Although serial correlation is normal between the residuals in AR(1), the residuals in AR(2) must not be correlated. The null hypothesis is that the residuals are not correlated. The results of the AR(2) test reveal that we cannot reject the null hypothesis, meaning there is no serial correlation, since all the *p* values are greater than 0.1. Additionally, overidentifying restrictions need to be valid in GMM. Likewise, the Hansen J test results show that the instrument variables are valid. The null hypothesis, which states that the overidentifying restrictions are valid, is rejected when the instrument variables are not exogenous or they are mistakenly omitted from the model (Fosu 2013). The results confirm that we cannot reject the null hypothesis because the *p* values of the Hansen J-statistics are greater than 0.1 for all the GMM models, meaning that the instruments are valid.

4.5 Results

According to the results, a positive association is observed between a firm's capital structure and its financial performance. These results are consistent with our research hypothesis, which expected the existence of a positive relationship between capital structure and firm's financial performance in German non-financial listed firms. However, capital structure is negatively related to stock price and this may support the argument that German investors observe stock market trading as gambling (Reilly and Brown 2011). The results are in line with the work of Adair and Adaskou (2015), Detthamrong et al. (2017), Jouida (2018) and Margaritis and Psillaki (2007), but are not consistent with the studies of Chechet and Olayiwola (2014), Hamid et al. (2015), Ibhagui and Olokoyo (2018) and Salim and Yadav (2012). The plausible explanations behind this positive relationship could be the benefits of the tax shield, the costs of issuing debt are lower than the cost of issuing equity, and high leverage pushes managers to concentrate on more profitable investments. As we observed, German non-financial firms are highly leveraged in that an average of 62% of their assets are financed by debt. More details regarding these explanations are given in the next section.

We observed that firm performance has increased by 12.8% over the second half of our research sample. In other words, the average return on equity during 2005–2016 was greater than the average return on equity during 1993–2016. The same is correct with regard to ROA, albeit with a smaller increase. Consistent to the expectations, IFRS adoption has a positive impact on the firm performance of non-financial listed firms in Germany. Similar results were also found by Abdullah (2013), Devalle et al. (2010) and Li et al. (2017). Moreover, the results indicate IFRS adoption weakened the relationship between capital structure and firm performance over the period 2005–2016. We also found evidence that larger firms

in Germany perform better compared to small sized companies based on the stock price. These results are in line with Margaritis and Psillaki (2010). Contrary to the findings of Khan et al. (2016), we found that dividend has a negative impact on firm performance. Consistent with the results of Gok and Peker (2017) and Kurniaty et al. (2018), we found that market performance positively affects financial performance.

5 Conclusion and discussion

The key purpose of this study is to offer empirical evidence regarding the relationship between firm performance and capital structure in Germany by taking into account IFRS adoption. The results of the empirical models support a positive association between financial performance and capital structure in German listed firms. Precisely, we found that a 1% increase in total debt ratio leads to an increase in ROA and ROE of approximately 3.6% and 32.4% respectively over the period 1993–2016. However, we found that capital structure negatively influences stock price. We also found that IFRS adoption as a key regulatory change in the German financial market has a negative impact on the effect of capital structure.

The results of this paper might be explained by different arguments. One of those opinions is that borrowing large amounts of debt would assert significant pressure on managers to concentrate more on profitable investments aiming to generate enough cash flow for interest payments and to avoid potential bankruptcy. Margaritis and Psillaki (2010) outlined that high leverage has the potential to reduce the agency costs of equity. Arzac and Glosten (2005) added the tax saving benefit of debt as another reason. The negative effect of debt ratio on a firm's market performance could indicate that German investors prefer the shares of less risky companies in regard to investment decisions. We observed that German firms are highly levered in a way that on average, over 62% of their assets is financed by debt, and the aim could be to avoid high taxation. This could further be explicated through the argument made by Eibl and Spieth (2009), who stated that German firms are more closely owned by founders rather than dispersed shareholders. Moreover, Lemmon and Zender (2016) claimed that the associated costs of issuing bonds are relatively lower than the cost of issuing equity. Therefore, German listed firms avoid that premium cost by increasing their reliance on debt, whereas investors might avoid purchasing shares of a firm associated with large debt ratios.

Although IFRS adoption is largely believed to improve the information environment in general, we found that this regulatory transition weakened the relationship between capital structure and firm performance in Germany. This might be explained by the fact that IFRS requires a high level of disclosure (Gassen and Sellhorn 2006) and therefore additional financial and non-financial information plays a significant role in the determination of firm performance rather than solely capital structure.

The limitations of this study can be highlighted in two areas. First, because of the unavailability of financial data over the studied period, we could not include all the listed non-financial firms that were operating throughout the period 1993–2016. Second, since we were only considering Germany, the impact of IFRS adoption on

the relationship between leverage and capital structure is somewhat unclear. Therefore, it is recommended that future studies should include more countries in order to be able to make a comparison concerning the impact of IFRS on that relationship. In doing so, it would be possible to overcome the generalizability issue.

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