Capital structure and firm performance: a panel causality test

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ABSTRACT

This study attempts to empirically investigate the reverse causality between firm performance and capital structure for German listed firms in the non-financial sectors over the period 1993-2016. We measure firm performance based on both financial and market indicators while capital structure is measures by leverage ratio of total debt to assets. In addition to two-step GMM estimator, panel causality test of Dumitrescu and Hurlin (2012) is performed to specify the causality direction of causation. The findings provide evidence for the existence of homogeneous causality between capital structure and the two selected proxies of firm performance. Financial performance and financial leverage can positively affect each other. Capital structure could negatively determine market performance whereas stock price has positive influence on leverage ratio. Our results rather support trade-off theory, probably indicating that non-financial firms in Germany bear more debt to benefit from tax shield.

Keywords: firm performance, capital structure, panel causality, and Germany

1. INTRODUCTION

There exists an enormous amount of literature on both empirical and theoretical backgrounds on the association between firm performance and capital structure. Scholars argue that financing decisions can influence the cost of capital and hence firms can maximize their financial performance accordingly (Myers and Majluf, 1984; Abdullah and Tursoy, 2019). Thus, corporate financing is considered as an important task practiced in financial controlling since it eventually influences shareholders' wealth. The linkage between financial leverage and firm financial and market performance has been a significant matter in the literature. This debate is reinforced by the fact that changes in leverage may influence firm performance. Here, one can raise a question of whether a reverse causal relationship exists between capital structure and firm performance (Iyoha and Umoru, 2017).

The notion of capital structure denotes the various combinations of equity and debt that a firm uses as the sources of fund for asset's financing purposes (Karadeniz et al., 2009). Empirical literature confirms that firm performance can be affected through the selection of a reasonable proportional use of both sources of fund (see, for example, Abdullah and Turgut, 2019; Saona and San Martin, 2018; Welch, 2004; Yazdanfar and Ohman, 2015). A firm has potential to maximize its performance once the financial manager could detect the possible determining factor of capital structure, i.e. the associated cost with every source of fund. Both bond holders and equity holders are faced with different level of risk and as such predict varying rate of return on their investment. Information related to cost of capital and the way it drives certain initial factors such as leverage is beneficial in planning capital structure of a firm. Moreover, capital structure with high debt enhances firm performance and shareholders wealth. The reason can be explained through the benefits of tax shield based on trade-off theory (Kraus and Litzenberger, 1973; Myers, 1984) and lower information cost of debt as stated by pecking order theory (Lemmon and Zender, 2016; Myers and Majluf, 1984).

Additionally, firm performance denotes the ability and capability of a firm to effectively, efficiently and competitively exploit the accessible resources to accomplish the targeted objectives (Peterson et al., 2003; Verboncu and Zalman, 2005). Providing the argument that optimal capital structure enhances performance of an organization, it follows thus that firm performance might similarly influence the organizations' financial leverage. Scholars empirically found that firm performance is one of the key factors that can determine capital structure mix (see, for instance, Cevheroglu-Acar, 2018; Iyoha and Umoru, 2017; Koralun-Bereznicka, 2018; Titman and Wessels, 1988; Vo, 2017). This argument could be explicated via the trade-off theory stating that firms with high profitability face reduced bankruptcy costs and therefore have greater willing to borrow (Fama and French, 2002). Additionally, the pecking order theory confirms that firms commonly select internal sources of fund over the external ones (Myers and Majluf, 1984).

The connection between leverage and firm performance has been broadly considered in the past studies. Nonetheless, the bidirectional causality between the two variables is rarely considered in the literature. A simultaneous-equations bias may occur when a study does not take the reverse causality into account if capital structure influences firm performance (Iyoha and Umoru, 2017). Thus, this paper aims to empirically explore the causal linkage between firm performance and capital structure mix. The key objective of this paper is to identify the direction or causation between capital structure and firm performance in the case of German firms. Furthermore, this study uses Generalized Method of Moments (GMM) to study the impact of each of firm performance and capital structure on one other through two separate GMM models. Lastly, this study also applies a pairwise Dumitrescu-Hurlin panel causality approach to evaluate the direction of causation for firm performance and capital structure in the case of non-financial companies quoted in Germany. In doing so, it can significantly contribute to the current literature.

The reminder of the article is prepared as follows. Section 2 reviews the most related literature. The research data, model specification and methodology are described in section 3. Section 4 is on analysing the empirical findings and discussions, and section 5 presents the conclusion.

2. LITERATURE REVIEW

2.1. Leverage- performance

The MM irrelevance theory of Modigliani and Miller (1958) declares that financial decision making has no substantial impact upon value under the circumstances of capital market perfection with the absence of transaction and bankruptcy costs, taxes, information asymmetry, varying borrowing costs (Le and Phan, 2017). As an empirical proposition, it is difficult to experiment the MM irrelevance theory. It seems unlikely to form a structural investigation of the theorem through regressing firm performance on capital structure measures because leverage and performance both are probably endogenous and determined by additional factors for example growth opportunities, collateral, profits (Luigi and Sorin, 2009).

However, other alternative theories, trade-off theory and pecking order theory, assert the presence of a linkage between leverage and performance and their propositions are empirically testable.

Trade-off theory proposes that an optimum capital structure created by a firm can boost firm value. The trade-off theory is initially developed out of the argument over the MM theory. The MM irrelevance theory is revised with adding corporate income tax to it. This revealed a benefit of debt in that it helped to protect income from taxes (Luigi and Sorin, 2009). The trade-off theory argues that organisations could enhance their value through trade off the benefits and costs of borrowing. The benefit of debt is thought to be the tax shield of debt which can enhance firm value through debt issuance (Myers 1984). Moreover, Modigliani and Miller (1963) emphasize that tax savings is the key benefit of debt which assists firms to reduce their total taxable income by interest payment.

Alternatively, the *pecking order theory* is advanced by Myers and Majluf (1984) which confirms that high leverage promotes the market awareness for value and, in turn, results in a reduced firm value. As reported by this theory, firms pursue a particular financial hierarchy in funding their assets. Internal financing is given priority over external method of financing and the option of debt comes before equity (Luigi and Sorin, 2009; Shubita and Alsawalhah, 2012). Furthermore, firms choose debt over equity because the asymmetric information cost of debt is lower than asymmetric information costs of equity (Lemmon and Zender 2016). The pecking order theory is criticised for not identifying the optimum capital structure. However, it gives preference to internal financing over external sources for value maximization purposes.

Empirical investigations to understand whether one of the two theories, pecking order or trade-off, is more appropriate descriptor of experimental capital structures provide evidence to support both theories (Adedeji, 2002; Fama and French, 2002; Tong and Green, 2005; Lopez-Gracia and Sogorb-Mira, 2008; Fosu, 2013; Adair and Adaskou, 2015; Serrasqueiro and Caetano, 2015; Detthamrong et al., 2017; Jouida, 2018). Thus, empirical evidence supports the hypotheses of trade-off and pecking order theories.

Wang and Wu (2014) study the association between profitability and capital structure of listed firms in the pharmaceutical industry as one of the most rapidly developed and profitable sector. The study sample consists of 141 quoted companies in Shanghai and Shenzhen stock exchanges during 2009-2011. Performing multiple regression analysis, the outcomes of the study support the presence of a negative effect of leverage upon firm performance. The authors claim that pharmaceutical companies in China rather prefer internal financing.

Herciu and Ogrean (2017) analyse capital structure mix in order to discover some optimal levels aiming to increase firm financial performance. Considering a sample of the most profitable non-financial companies in Fortune Global 500 for 2016, the study categorise the companies into clusters based on leverage ratio and industry group and compare the correlations between leverage ratio and profitability ratios. Using hypothesis testing technique, the results confirm that firm financial performance could be enhanced by employing an optimum capital structure.

Abdullah and Tursoy (2019) examine the moderating impact of 2005 implementation of IFRS (stands for International Financial Reporting Standards) on the connection between capital structure and company performance in the case of Germany. Using two-step dynamic panel GMM for a sample of firms in Germany during 1993-2016, the results of this study show a positive influence of firm financial performance on capital structure. Moreover, IFRS adoption in Germany has weakened the extent of the association between the two studied variables.

2.2.Performance-leverage

Firms could benefit of financial leverage to enhance performance. At the same time, financial performance might also affect capital structure. High profitable enterprises retain more earnings to avoid borrowing, then the leverage ratio is low (Wang and Wu, 2014). Additionally, it is easier for companies with higher profitability to obtain debt financing compared with the companies with lower profitability. Thus, a reasonable capital structure and financial performance are expected to influence each other effectively. The trade-off theory and pecking order theory can also explicate the logics of the reverse causal association between performance and leverage and there exists some empirical evidence to support.

The *trade-off theory* expects a positive effect of profitability on leverage. It is argued that the possibility of bankruptcy moves in reverse with profitability (Fama and French, 2002). Furthermore, high profitable firms have more tendencies to bear greater debt aiming to benefit from the tax saving (Frank and Goyal, 2009). Wiwattanakantang (1999) adds that firms with high cash flow shall obtain debts more easily compare to the low profitable firms. Therefore, bankruptcy cost and agency cost imply high profitability is related with higher debt ratio. In other words, firm performance can have a positive impact on capital structure. The results of previous empirical studies could support the proposition of the trade-off theory (Adedeji, 2002; Li and Islam, 2019; Salawu and Agboola, 2008).

Whereas the *pecking order theory* argues that high profitable companies more potentially depend on earned surplus to finance their assets not external sources (Ghosh and Cai, 1999; Myers, 1984). Consequently, the effect of profitability on leverage is presupposed to be negative, holding the investment level stable (Tong and Green, 2005). Empirically, a number of study observed a negative association between the ratios of debt and profitability (Viviani, 2008; Yolanda and Soekarno, 2012; Guner, 2016; Jarallah et al., 2019; Moradi and Paulet, 2019).

Jouida (2018) examined the dynamic linkage between capital structure, diversification and financial performance for 412 financial firms in France from 2002 to 2012. This study uses panel vector autoregression model aiming to overcome the uncovered issues of the endogeneity, causality factors and the dynamics of the relationship. Controlled for the individual fixed effects, the study observed evidence of bidirectional causality between leverage and performance. Although the results of this study are robust through a number of measures of geographic divergence and activity, it recommends for future study in other markets.

Margaritis and Psillaki (2010) conducted an empirical research examining the bidirectional connection between performance and capital structure for a sample of French manufacturing firms during 2002-2005. The study uses Data Envelopment Analysis to determine the optimum boundary and employ firm efficiency based on the distance from the detected optimum frontier. In addition, this study investigates the inverse causal relationship between firm performance and financial leverage. The results of OLS and quantile regression analysis confirm the existence of a positive relationship between those two variables.

She and Guo (2018) conducted similar study for a sample of 49 global e-retailing firms over a period of five years from 2012 to 2016 and a negative reverse causality between firm performance and leverage, consistent with the pecking order theory. However, this relationship changes with the change of debt size.

3. METHODOLOGY

3.1. Data collection and sampling

The multivariate structure contains leverage ratio, return on assets, stock price and control variables. From an initial data sample covering all listed firms in Germany during 1993-2016, a number of exclusion is made. First, this study concentrates on the non-financial firms and thus the financial institutions, including insurance, banks, real estates, and security and investment, are excluded because of their different type of operations and financing policy (Abdullah and Tursoy, 2019; Abdullah, 2013; Vo and Ellis, 2017). Second, to attain balanced panel data, companies whose have their year-end financial data missing throughout the sample period are also left out from our sample. Secondary panel data was collected from DataStream. The final data sample consists of balanced 102 firms over the 24-year period.

3.2. The variables

Capital structure

The first exogenous variable we use in this study is firm capital structure. Geske et al. (2016) describe capital structure as a mixture of equity and debt a company detains to finance its activities and assets. The indicators of leverage ratios are widely depended on in the literature to capture capital structure mix. Consistent with previous studies, the current study uses total debt ratio of leverage to measure capital structure (Margaritis and Psillaki, 2010; Fosu, 2013; Ibhagui and Olokoyo, 2018). TDR is the calculation of total debt to total assets suing book values.

Firm performance

The second exogenous variable this research employs is firm performance which is measured by using the finance-based measure of return on assets. This measure is selected based on its common use in the literature (see, for example, Fosu, 2013; Hull and Dawar, 2014; Jouida 2018; Le and Phan, 2017). ROA is calculated through net income of a particular financial year over total assets at the end of the same fiscal year. Moreover, aiming to capture market perspective, stock price is used to measure firm market performance, following Kalkan et al. (2014), Gok and Peker (2017), and Abdullah and Tursoy (2019).

Control variables

In order to avoid omitted-variable bias and precisely capture that association between leverage and firm performance, we control for some firm characteristics in our regression models. This is consistent with the literature (Abdullah and Tursoy, 2019; Jouida, 2018; Le and Phan, 2017; Margaritis and Psillaki, 2010; Salim and Yadav, 2012; She and Guo, 2018). This study controls for growth and firm size. Table 1 gives more details.

Table 1: Variables' description

Variable	Abb.	Measurement	Calculation
Stock price	SP	Market performance	Natural log. of share price in stock market
Return on assets	ROA	Financial performance	EBIT / book value total assets
Capital structure	TDR	Leverage level	Total debt / book value total assets
Total sales	GROW	Firm growth rate	Current sales – prior sales / prior sales
Total assets	SIZE	Firm size	Natural log. of total assets at year-end

3.3. Method

Numerous studies have been carried out examining the association of firm performance with capital structure through using dissimilar econometric models. Scholars have empirically examined this relationship for diverse industries and in different economies. Nevertheless, to our knowledge, no study has investigated the causal association between firm performance and capital structure for Germany by utilizing pairwise Dumitrescu-Hurlin panel causality testing approach. Germany is selected as one of the most developed countries whose listed non-financial firms are greatly levered, as claimed by Abdullah and Tursoy (2019). Thus, the benefits of this study would be large and it will be a valuable literature resource.

Consistent with Fosu (2013) and Le and Phan (2017), the current research run the Arellano and Bond (1991)'s two-step GMM technique to account for the potential endogeneity problem. Roberts and Whited (2013) emphasised that endogeneity issue is very common when conducting an empirical research in finance. As instruments, the dependent variable's first differenced lagged value is utilised alongside their prior levels. To attain that, the GMM approach employs a sequence of instrumental elements created through the lagged value of the variables, which could account for the endogeneity problem for the control variables a long with the independent one (Roodman, 2009). Consequently, Bandyopadhyay and Barua (2016) assert that the endogenous variable will be predetermined and there will be no correlation of it with the residuals. Regarding the model diagnostics, the autocorrelation errors of Arellano-Bond test along with the Hansen J-statistic are implemented. The prior test is performed to guarantee that the error terms are not serially correlated, whereas Hansen J-statistic evaluates the condition of orthogonality for the instrument factors. The estimated equations of the study are formed in the following models.

Leverage-Performance Model

This model is run to verify the influence from capital structure to firm performance. The ratio of total debt to total assets measures leverage and is the independent variable, whereas firm performance measures are the dependent variables of two separate models. According to the trade-off theory and pecking order theory, it is hypothesized that financial leverage could either positively (H_1) or negatively (H_2) influence firms performance. The regression model will be formed based on the following hypothesised relationship:

$$FP = f(LEV, X) \qquad (1)$$

Then, the econometric model is formed accordingly as follows:

$$FP_{j(t)} = \alpha_0 + \alpha_1 LEV_{j(t-1)} + \gamma_1 X_{1\,j(t)} + \varepsilon_j \quad (2)$$

Where α_0 is a constant; $\alpha_1>0$ shows a positive effect of debt ratio on performance while $\alpha_1<0$ shows a negative effect; $FP_{j(t)}$ represent performance of firm j during t measured by ROA to represent financial performance and stock price (SP) to represent market performance; $LEV_{j(t-1)}$ denotes the lagged ratio of financial leverage for firm j at year-end t measured using total debt to total assets at their book values. The first differenced leverage ratio, suggested by Bandyopadhyay and Barua (2016), helps with controlling any possible reverse causality between *LEV* and *FP*; X_1 is a vector of controls that potentially influences firm performance including size and sales growth; and ε_j is the random error term.

Performance-Leverage Model

This model is utilised to examine the effect on financial leverage from firm performance. Consistent with the trade-off theory and pecking order theory, it is hypothesized that firm financial performance could either positively (H_1) or negatively (H_2) influence capital structure. The regression model will be formed based on the following hypothesised relationship:

$$LEV = f(FP, X) \qquad (1)$$

Then, the econometric model is formed accordingly as follows:

$$LEV_{j(t)} = \beta_0 + \beta_1 FP_{j(t-1)} + \gamma_2 X_{2\,j(t)} + \omega_j \quad (2)$$

Where β_0 is a constant; β_1>0 shows a positive effect of performance on leverage whereas β_1<0 shows a negative effect; The first differenced value of *FP* assists with controlling the probability of existing inverse causality between *FP* and *LEV*; X_2 consists of similar vectors as X_1 that are connected to the measure of capital structure; and ω_j is the random error term.

Causality Model

The study further aims to detect the direction of causality amongst the selected variables of the study. We perform Dumitrescu and Hurlin (2012) panel causality test which supports the existence of heterogeneity across the cross-sections. In this model, the null hypothesis of homogeneous non-causality is tested through a simple approach against the alternative one of heterogeneous non-causality. No causality there exists in any cross sections, according to the null hypothesis of the DH panel causality test. However, the alternative hypothesis allows for a partial presence of causality in some cross-sections. The test is performed on the first difference data series because it is originally aimed to test the short-run dynamics between variables (Hoffmann et al., 2005; Lopez and Weber, 2017). Schwarz information criterion (SIC) is used in selecting the proper lag length for this test. The underlying regressions write:

$$FP_{j(t)} = \alpha_{1i} + \sum_{i=1}^{n} \gamma_{1it} FP_{j(t-p)} + \sum_{i=1}^{n} \beta_{1it} LEV_{j(t-p)} + \sum_{i=1}^{n} \theta_{1it} X_{j(t-p)} + \varepsilon_{1\ j(t)}$$

$$LEV_{j(t)} = \alpha_{2i} + \sum_{i=1}^{n} \gamma_{2it} LEV_{j(t-p)} + \sum_{i=1}^{n} \beta_{2it} FP_{j(t-p)} + \sum_{i=1}^{n} \theta_{2it} X_{j(t-p)} + \varepsilon_{2\ j(t)}$$

Where $FP_{j(t)}$ and $LEV_{j(t)}$ indicate the observations of two panel variables that are stationary. The *j* subscripts attached to coefficients illustrate that the coefficients are permitted to vary across firms, however, are presumed time-invariable. In this test, the panel should be balanced and the lag order p is expected to be alike for all firms.

4. EMPIRICAL RESULTS AND ANALYSIS

4.1. Panel unit root test

Since selecting the proper unit root test to estimate the data is very challenging (Tursoy and Faisal, 2016), we run several tests of unit root to examine the stationarity of the data. This would aid in improving the robustness of the chosen variables (capital structure, firm performance and the controls). We make our decisions regarding the order of integration based on the similar results of at least two of the unit root tests. In the circumstance of panel data, the Augmented Dickey and Fuller (ADF) (1981), Levin et al. (LLC) (2002), and Im et al. (IPS) (2003) are the most frequently used tests to check for stationarity of data in literature. ADF and IPS assume individual non-stationary test for panel data and allow for heterogeneous AR(p) in cross sections whereas LLC assumes a common non-stationary test that permits for identical autoregressive lag length in cross sections. In all the three tests, the null hypotheses of non-stationarity are identically set. The tests are performed with the inclusion on individual intercept. Moreover, Schwarz information criterion is used in the selection of the proper lag length.

Table 2 illustrates the summary of the three-unit root tests. The results verify that all the series are stationary at level or integrated since the p-values of the t test, w-test and Chi-square are below the 5% level. Therefore, we rejected the null hypotheses of non-stationary for the selected variables. This indicates that the outcomes we found from hypotheses testing could maintain in the long-term.

Table 2: Panel unit root tests

	ADF Chi-square	IPS W-stat	LLC t-stat	Result
ROA	753.50***	-18.9***	-16.5***	H_0 is rejected
lnSP	251.08**	-1.78**	-5.45***	H_0 is rejected
TDR	285.03***	-2.68***	-2.36***	H_0 is rejected
SIZE	321.62***	-2.40***	-8.59***	H_0 is rejected
GROW	1427.2***	-34.4***	-61.1***	H_0 is rejected

, and * significant at 5% and 1% levels respectively.

4.2.Descriptive statistics and correlations

Table 3 specifies a summary of the descriptive statistics for the selected variables of the study and the correlations matrices between the pair of the variables. ROA and SP are proxies of firm performance from both financial and market perspectives respectively. Their sequence arithmetic means are 0.08 and 3.05. TDR is the measurement of leverage which represents capital structure mix for the sample firm. However, SIZE and GROW are control variables to control for some firm characteristics.

The arithmetic mean of the used leverage ratio generally explains 62% during the period, and widely scatters between the min 2.3% and the max 99.9%. This specifies the fact that non-financial firms listed in Germany on average tended to finance 62% of their capital through debt and the reminder through equity.

Table 3: Descriptive statistics and correlation coefficients

	Mean	SD	Max.	Min.	Obs.	1.	2.	3.	4.	5.
1. *ROA*	0.08	0.08	0.98	-0.51	2448	**1.00**				
2. *lnSP*	3.05	1.32	6.61	0.003	2448	0.22	**1.00**			
3. *TDR*	0.62	0.17	1.00	0.02	2448	-0.43	-0.26	**1.00**		
4. *SIZE*	13.36	2.32	19.8	8.73	2448	-0.01	0.30	0.11	**1.00**	
5. *GROW*	0.35	2.87	66.2	-33.8	2346	0.09	-0.03	-0.01	0.03	**1.00**

In addition to descriptive statistics, table 3 also illustrates the correlation coefficients. Correlation matrix initially measures the association between each pair of the variables of the study. Enders (2008) argued that predictor variables combined in a regression model should not be linearly forecasted from the other explanatory variables with a significant extent of accurateness i.e. they must not be perfectly correlated. In other words, a moderate correlation coefficient is allowed between the predictor variables combined in a regression model.

The results of the correlation matrix (in table 3) show that all the relationships between the explanatory variables are unlikely to be problematic. The highest level of association detected is -0.43 between TDR and ROA. SP and TDR are also negatively correlated with 0.26. Therefore, the correlations between leverage and firm performance measurements are negative at 1% level of significant. The two used measures of firm performance are correlated moderately at 22%. SIZE has a stronger association with SP 30% compare to its relationship with ROA - 1%. Moreover, growth and size are not perfectly correlated.

Since it is noted that the correlation coefficients are modest and the explanatories are unlikely to be perfectly correlated, we can claim the absence of multicollinearity issue, explained by Farrar and Glauber (1967), in our data and the selected explanatory variables could be jointly tested in a regression model.

4.3.GMM regression analysis

Aiming to control the endogeneity issue among our variables, we use the dynamic panel GMM technique of Arellano and Bond (1991). The system GMM two step estimators with robust standard error is performed to examine the effect of firm performance and capital structure on one another for non-financial firms listed in Germany over the period from 1993 to 2016. The difference GMM two-step supposed to be efficient and robust to autocorrelation and heteroscedasticity (Roodman, 2009).

Table 4 presents the outcomes of the two-step GMM estimation in three models to investigate the connection between firm performance and capital structure. Models 1 and 2 aim to capture the effect of leverage on firm financial and market performance respectively. The coefficient of TDR in model 1 points out that leverage has a statistically significant and positive affect on firm financial performance measured by ROA. Specifically, 1 per cent increase in the financial leverage of previous fiscal year leads to a rise in return on assets by 0.086% at the 1% level of significant. Regarding the impacts of the control variables, the regression outcomes show that the effects of both firm size and opportunity growth exist at the 1% level of significance. Firm size negatively influences ROA whereas the effect from growth tends to be positive. However, the coefficient of TDR in model 2 shows a negative impact of financial leverage ratio on firm market performance and with a larger marginal impact compare to its impact on ROA. Precisely, each per cent rise in TDR from prior fiscal year could possess a marginal impact on the current stock price to decline by 0.71%. The impacts of size and growth are also significant but positive on SP with a greater influence from firm size 0.51%. Thus, these results emphasise that the effect of capital structure is positive on financial performance for German listed firms in non-financial sectors during the period from 1993 to 2016. Nevertheless, this effect is negative if firm performance is measured based on the market indicators.

The purpose of model 3 is two examine reverse impact from the measures of firm performance to financial leverage. The two different measures of firm performance are included in the same model. The results confirm that firm financial and market performance can positively determine capital structure in a firm. Precisely, every 1% increase in ROA and SP results in an increase in TDR by 0.02% and 0.01% respectively at the 1% level of significant and with very low standard errors. Similarly, sales growth positively determines capital structure while firm size tends to possess a negative effect. Therefore, in addition to the influence of capital structure on firm performance, the results of GMM technique show that firm performance can also effects capital structure but with smaller marginal impacts.

Table 4: GMM estimator

	(1) *ROA is predicted*		(2) *lnSP is predicted*		(3) *TDR is predicted*	
	Coefficient (SE)	t-stat	Coefficient (SE)	t-stat	Coefficient (SE)	t-stat
$TDR_{j\,(t-1)}$	0.086 (0.001)	106.1***	-0.713 (0.083)	-8.53***		
$ROA_{j\,(t-1)}$					0.021 (0.005)	4.42***
$lnSP_{j\,(t-1)}$					0.010 (0.000)	11.37***
$SIZE_{j\,(t)}$	-0.005 (0.001)	-5.16***	0.510 (0.011)	45.89***	-0.027 (0.000)	-30.86***
$GROW_{j\,(t)}$	0.007 (0.000)	80.74***	0.040 (0.002)	18.00***	0.004 (0.000)	51.64***
$ROA_{j\,(t-1)}$	0.293 (0.003)	77.94***				
$ROA_{j\,(t-2)}$	0.090 (0.000)	158.1***				
$lnSP_{j\,(t-1)}$			0.580 (0.007)	80.78***		
$lnSP_{j\,(t-2)}$			-0.175 (0.004)	-43.10***		
$TDR_{j\,(t-1)}$					0.804 (0.004)	202.08***
No. of Obs.	2142		2142		2244	
Hansen J p-value	0.449		0.272		0.399	
AR(1)	0.004		0.999		0.000	
AR(2)	0.986				0.343	

The above table reports the outcomes of the GMM estimator with robust standard error to examine the connection between firm performance (FP) and capital structure (CS). FP is measured using both financial proxy of return on assets (ROA) and market proxy of stock price (SP). CS is measured by (TDR) book values of total debt to assets. The outcomes are based on annual figures for German listed firms in the non-financial sectors over the period 1993-2016. Models 1 and 2 specify the effect of TDR on ROA and SP respectively whereas model 3 considers the inverse effect of firm performance measures on TDR.

Robust standard errors are in brackets, and ***significant at the 1% level.

GMM Model diagnostics

In order to inspect the validity of GMM estimator models, Arellano and Bond (1991) recommended two initial diagnostic tests; the overidentification test of Hansen J test and the autocorrelation errors test of Arellano-Bond. The later test allows for the presence of serial correlations between the error terms of the GMM model in AR(1) whereas the residuals should not be correlated in AR(2). The initial hypothesis of this test assumes for the absence of serial correlation between the residuals. Additionally, the former test necessitates the validity of overidentifying restrictions in the GMM model. The initial hypothesis of Hansen J test presumes that the overidentifying restrictions are valid and it can be rejected, as Fosu (2013) asserts, if the instrument variables are endogenous or if the instruments are omitted from the GMM model.

The outcomes of the two diagnostic tests are presented in table 4, bellow the results of GMM estimators. The results show that the p-values of Arellano-Bond serial correlation tests are greater than 0.1 in the three models; 0.97 AR(2) in model 1, 0.99 AR(1) in model 2 and 0.34 AR(2) in model 3. Therefore, the initial hypothesis of no serial correlation in the residuals cannot be rejected. Moreover, the outcomes of Hansen J test disclose the validity of the instrument variables. The probability values of the Hansen J-statistics are 0.45, 0.27 and 0.40 for the three GMM models respectively, i.e. greater than the 0.1. Thus, the instruments are valid and we cannot reject such hypothesis.

4.4.Dumitrescu-Hurlin panel causality

Table 5: Pairwise DH panel causality tests

	Direction of causality	W-Stat.	Zbar-Stat.	P-value
1	*lnSP* → *ROA*	2.63	1.42	0.155
	ROA → *lnSP*	4.80	9.85***	0.000
2	*TDR* → *ROA*	2.91	2.50**	0.012
	ROA → *TDR*	3.49	4.76***	0.000
3	*SIZE* → *ROA*	3.29	3.98***	0.000
	ROA → *SIZE*	5.71	13.40***	0.000
4	*GROW* → *ROA*	2.62	1.29	0.196
	ROA → *GROW*	5.09	10.73***	0.000
5	*TDR* → *LNSP*	3.83	6.11***	0.000
	lnSP → *TDR*	2.75	1.89*	0.049
5	*SIZE* → *lnSP*	4.04	6.90***	0.000
	lnSP → *SIZE*	2.84	2.22**	0.026
7	*GROW* → *lnSP*	2.70	1.60	0.110
	lnSP → *GROW*	3.29	3.85***	0.000
8	*SIZE* → *TDR*	4.75	9.66***	0.000
	TDR → *SIZE*	3.82	6.04***	0.000
9	*GROW* → *TDR*	2.95	2.54**	0.011
	TDR → *GROW*	3.90	6.19***	0.000

10	*GROW → SIZE*	3.17	3.38***	0.001
	SIZE → GROW	6.72	16.96***	0.000

This table reports the results of pairwise Dumitrescu Hurlin panel causality test. The purpose is to detect the direction of causality among the selected variables, particularly between firm performance and financial leverage. The outcomes are found on annual data for German listed firms in the non-financial sectors during 1993-2016. The lag length 2 is selected based on CIS.
*, **, and *** significant at 10%, 5% and 1% levels respectively

To detect the causality direction among the variables of the study, we run Dumitrescu and Hurlin (2012) panel causality test which supports the existence of heterogeneity across the cross sections. The H_0 presumes that homogeneous causality does not exist in any cross section. The test is originally considered to test the short-term dynamics between variables. Therefore, we performed the test on the first lagged data series, consistent with Hoffmann et al. (2005) and Lopez and Weber (2017). The appropriate lag length of 2 is selected for the causality test based on SIC. The Wbar-statistic and the Zbar-statistic are taken into account by Dumitrescu and Hurlin (2012). The former statistics considers average of the test statistics, whereas the later statistics provide a standard normal distribution.

Table 5 presents the outcomes of DH panel causality. The results support the existence of a bidirectional association between firm performance and capital structure. Specifically, a homogeneous causality found from TDR to ROA and also inversely from ROA to TDR because their p-values are smaller than 5%. Similarly, the p-values (0.000 and 0.049) indicate the existence of a bidirectional homogeneous causality between SP and TDR. ROA causes SP but SP does not cause ROA since its p-value is greater than 0.10 and, therefore, we cannot reject the hypothesis of no homogeneous causality.

Additionally, reverse causality is found between leverage and firm size, leverage and sales growth, growth and size, and stock price and size. The results show that growth opportunity variable does not cause the selected measures of firm performance, according to their high p-values. However, firm size can homogeneously cause both ROA and SP.

4.5.Discussion of results

We build our expectation regarding the association between firm performance and capital structure based on grounded theory and empirical literature. The results of GMM model 1 support a positive effect on firm financial performance from capital structure of non-financial firms listed in Germany during 1993-2016. These findings rather support the trade-off theory of capital structure, claiming that firms prefer debt to equity for the purposes of value maximization because of the tax savings benefit of debt. However, we found a negative impact from capital structure on the market indicators of firm performance, according to the results of GMM model 2. An argument which might explicate this result is rather build based on the characteristics of German investors that they believe that trading in stock market is more like gambling (Reilly and Brown, 2011). Abdullah and Tursoy, 2019) argue that investors in Germany prefer low-risk stocks when it comes to investment decisions. Our results are consistent with the findings of several past empirical studies (Berger and Di Patti, 2006;

Margaritis and Psillaki, 2007; Fosu, 2013; Adair and Adaskou, 2015; Detthamrong et al., 2017; Jouida, 2018), but are not in line with Tong and Green (2005), Salim and Yadav (2012), Serrasqueiro and Caetano (2015), Le and Phan (2017) and Ibhagui and Olokoyo (2018). Additionally, the results of model 1 and 2 imply that financial performance decreases with the rise of firm size while market measure of performance moves directly with size. This might suggest that non-financial firms in Germany depend greatly on borrowing to grow. In other words, it is rather liabilities cause assets to increase not equity.

The results of GMM models 3 specify a positive influence of firm performance on financial leverage for our sample firms over the studied period. The results of this test also support the trade-off theory, arguing that firms with high profitability have more tendencies to bear greater debt aiming to benefit from the tax savings. Moreover, those firms would have greater opportunities to attain debts easily. These results are in line with Adedeji (2002), Li and Islam (2019), and Salawu and Agboola (2008), but are not in line with Frank and Goyal (2009), Guner (2016), and Moradi and Paulet (2019).

Regarding the causality test between the indicators of capital structure and firm performance, the outcomes of pairwise DH panel causality tests reveal that there exists bidirectional causality between the selected measures of firm performance and financial leverage. This is consistent with the results of Jouida (2018), Margaritis and Psillaki (2010), and She and Guo (2018). Moreover, we found reverse causality between financial leverage and firm size, financial leverage and sales growth, growth and size, and stock price and size.

5. CONCLUSION

This paper is an empirical investigation to examine the bidirectional causality between capital structure and firm performance in the case of non-financial firms listed in Germany. Financial proxy (ROA) and market proxy (SP) are utilised to measure firm performance; financial leverage ratio (TDR) is used to gauge capital structure; and firm size with sales growth are also selected as control variables. The presupposed expectations are set based on the arguments of the trade-off theory and the pecking order theory in addition to the previous empirical evidence. Using two-step GMM estimator, the study examines the direct impact from financial leverage to firm performance and reversely. Moreover, the study performs pairwise Dumitrescu Hurlin panel causality tests to explore the reverse causality between the two selected variables in the case of Germany during 1993-2016.

The results of the empirical models highlight a positive association between financial leverage and financial performance for quoted firms in Germany. Nevertheless, we found that stock price is negatively affected by capital structure measure. Moreover, both ROA and SP can positively determine capital structure. We also found that there occurs homogeneous causality between capital structure and the two employed measures of firm performance. Our findings in a developed country rather support trade-off theory not pecking order theory. German non-financial firms borrow more in order to benefit from tax shield and avoid high taxation. The empirical results outline that non-financial firms in Germany are greatly levered, on average 62% of their total assets comes from debt financing.

To further avoid the omitted variable bias, future research might investigate the moderating effect of some macroeconomic factors on the association between capital structure and firm performance because the economic factors in a particular country are presumed to possess some influence on the corporate-level factors such as performance and significant decisions of the firms operating in that country.

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