







# “The moderating role of firm size and interest rate in capital structure of the firms: selected sample from sugar sector of Pakistan”

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<b>ARTICLE INFO</b>	Sarfraz Hussain, Abdul Quddus, Pham Phat Tien, Muhammad Rafiq and Drahomíra Pavelková (2020). The moderating role of firm size and interest rate in capital structure of the firms: selected sample from sugar sector of Pakistan. <i>Investment Management and Financial Innovations</i> , 17(4), 341-355. doi: <a href="https://doi.org/10.21511/imfi.17(4).2020.29">10.21511/imfi.17(4).2020.29</a>
<b>DOI</b>	<a href="http://dx.doi.org/10.21511/imfi.17(4).2020.29">http://dx.doi.org/10.21511/imfi.17(4).2020.29</a>
<b>RELEASED ON</b>	Tuesday, 15 December 2020
<b>RECEIVED ON</b>	Wednesday, 15 July 2020
<b>ACCEPTED ON</b>	Wednesday, 18 November 2020
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<b>JOURNAL</b>	"Investment Management and Financial Innovations"
<b>ISSN PRINT</b>	1810-4967
<b>ISSN ONLINE</b>	1812-9358
<b>PUBLISHER</b>	LLC “Consulting Publishing Company “Business Perspectives”
<b>FOUNDER</b>	LLC “Consulting Publishing Company “Business Perspectives”



NUMBER OF REFERENCES

66



NUMBER OF FIGURES

1



NUMBER OF TABLES

5

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## BUSINESS PERSPECTIVES



LLC "CPC "Business Perspectives"  
Hryhorii Skovoroda lane, 10,  
Sumy, 40022, Ukraine  
[www.businessperspectives.org](http://www.businessperspectives.org)

**Received on:** 15<sup>th</sup> of July, 2020

**Accepted on:** 18<sup>th</sup> of November, 2020

**Published on:** 15<sup>th</sup> of December, 2020

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**Conflict of interest statement:**

Author(s) reported no conflict of interest

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# THE MODERATING ROLE OF FIRM SIZE AND INTEREST RATE IN CAPITAL STRUCTURE OF THE FIRMS: SELECTED SAMPLE FROM SUGAR SECTOR OF PAKISTAN

## Abstract

The selection of financing is a top priority for businesses, particularly in short- and long-term investment decisions. Mixing debt and equity leads to decisions on the financial structure for businesses. This research analyzes the moderate position of company size and the interest rate in the capital structure over six years (2013–2018) for 29 listed Pakistani enterprises operating in the sugar market. This research employed static panel analysis and dynamic panel analysis on linear and nonlinear regression methods. The capital structure included debt to capital ratio, non-current liabilities, plus current liabilities to capital as a dependent variable. Independent variables were profitability, firm size, tangibility, Non-Debt Tax Shield, liquidity, and macroeconomic variables were exchange rates and interest rates. The investigation reported that profitability, firm size, and Non-Debt Tax Shield were significant and negative, while tangibility and interest rates significantly and positively affected debt to capital ratio. This means the sugar sector has greater financial leverage to manage the funding obligations for the better performance of firms. Therefore, the outcomes revealed that the moderators have an important influence on capital structure.

**Keywords** profitability, tangibility, Non-Debt Tax Shield, liquidity, exchange rate

**JEL Classification** G32, L11, L14

## INTRODUCTION

The sugar industry of Pakistan participates in a significant portion of the overall economy. Sugarcane is Pakistan's fourth largest cultivated cash crop. An agriculture-based industry provides employment for the rural landless population and greatly impacts the country's economy. There has been a renewed interest worldwide in identifying the factors affecting optimum capital structure decisions in manufacturing sectors. The main goal of enterprises is to maximize shareholders' wealth using mixed financing sources, including equity capital, retained profits, issuance of ordinary shares, preferred shares, and debt capital. Banks, individuals, financial institutions, and insurance firms have issued debt capital. Borrowing companies may take advantage of the tax shield using debt resources if they have operating profits, but it raises bankruptcy risks. Direct and indirect costs include the risk of bankruptcy. Indirect costs emerged due to shifts in corporate practices concerning long-term investments. Consequently, the potential advantages of leverage are minimized due to bankrupt costs, which are deemed highly leveraged companies to be an incredible risk. Modigliani and Miller (1958) claimed that a company's investment strategy should be focused solely on those factors which would improve a company's net

worth or profitability. They also described a more sustainable capital structure and indicated that leverage and firm value were negligible. Ibrahim and Lau (2019) studied the determinants of financial leverage and suggested that tangibility is a significant positive association to debt ratio while liquidity and profitability observed a significant negative association. In the Pakistani context, which comprises a growing sector of sugar, the key objectives of this study are to contribute and extend the literature in exploring the relationship between macroeconomic factors and capital structure. This study is designed as follows. The following segment will review the literature. Thereafter, the methodology and the proposed theoretical model analyze the empirical results and originate a conclusion based on the findings.

## 1. LITERATURE REVIEW

Modigliani and Miller (1958) clarified the capital structure value; although this assumption is only effective in perfect market conditions where all shareholders have free access to the financial data. There is no tax difference between zero transaction costs and profits and capital gains. Although several studies have been conducted on the determinants that define the capital structure, Sari and Sedana (2020) interred the effect of profitability and capital structure. They revealed a clear positive association between the variables of profitability and the capital structure of samples taken. Chen and Duchin (2019) noted that operating leverage showed a negative association between profitability and leverage statically. Operating leverage decrease optimal financial leverage and enhance profitability. They demonstrated outcomes using the capital-labor ratio of US enterprises. An. Chakrabarti and Ah. Chakrabarti (2019) revealed a significant negative association between debt ratio and profitability.

Shah and Khan (2017) noted that the leverage ratio is inversely associated with the current ratio and profitability. However, the leverage ratio is favorably influenced by tangibility, firm size, and Non-Debt Tax Shield. The profitability effect is substantially poor, while the impact of tangibility, liquidity, Non-Debt Tax Shield, and size is highly significant. As suggested by Nasution, Siregar, and Panggabean (2017), tangible assets have a positive effect on the capital structure, while Non-Debt Tax Shield and profitability have a negative impact on the capital structure. Besides, these factors together have a major impact on the capital structure. Almendros and Mira (2016) revealed that financial distress has a significant and positive association with Non-Debt Tax Shield. Goh, Tai, Rasli, Tan, and Zakuan (2018) performed research on

the capital structure and its factors in Malaysian firms from 2011 to 2014 and revealed that firm's Non-Debt Tax Shield and profitability are negatively related to firm debt. Lei (2020) also disclosed the important positive relationship between corporate capital structure and Non-Debt Tax Shield.

Vo (2017) suggested the coefficients are significant and negative in the short-term firm leverage. According to Eysimkele and Koori (2019), the debt financing and efficiency of the Nairobi securities exchange-listed agricultural companies, Kenya, has revealed a negative relationship between long-term debt and profits while being stable in the short and medium term. A further negative association is also observed in size, liquidity, and short-term debt. Ibrahim (2017) provides evidence that liquidity, size, profitability, and leverage have a significant negative impact on firm value.

Céspedes, Chang, and Velasco (2017) suggested that the real exchange rate could affect credit constraints, and a novel leverage ratio also affects. As per the study, uncertainty in the exchange rate influences foreign trade in the lengthy period and seems to have no impact in the short term (Nguyen & Do, 2020). Submitter, Sari, Siska, and Sulastri (2019) studied the moderating effect of size and revealed that size offers a moderating influence on the link between profitability, tangibility, liquidity, and capital structure efficiency, and this moderation is significant in large corporations. L. Chen and S. Chen (2011) suggested that firm size is the moderator variable and affects the relationship between leverage and profitability. In the first stage, the moderating effect happens. Mirza (2015) noted that firm size positively affects firm leverage. Muigai and Muriithi (2017) study the capital structure and indicated that firm size has a major moderating impact on the combination of financial instability and corporate capital structure.

Al-Hunnayan (2020) found that the leverage relates positively to the company's size and is negatively linked to its competitiveness and tangibility. Li, Krause, Qin, Zhang, Zhu, Lin, and Xu (2018) examined interest rate regulations and accomplishing transparency. The finding of the study indicates that transparency of earnings increases firm leverage and the additional research indicated that such shock occurs as a means of raising the cost of debt financing. Although information disclosure can reduce the effect of the interest rate on the capital structure, Guo and Zhao (2017) examined the capital structure determinants and showed that size and tangibility are positively related. In contrast, Non-Debt Tax Shield and profitability have a negative impact on the determinants. Yazdanfar, Öhman, and Homayoun (2019) noted that profitability, tangibility, size, and financial

crises explained the changes from the perspective of debt ratio. Rao, Khursheed, and Mustafa (2020) also explained that borrowing showed significant tangibility and firm size is negatively associated with debt ratio. Iqbal and Usman (2018) suggested that a high amount of debt and interest rates decrease equity value. Leland (1994) examined capital structure debt values and revealed that the debt ratio is explicitly linked with interest rate. Staking and Babbel (1995) focused on studying the role of capital structure and interest rate and noted that interest rate and debt have opposite effects. Bokpin (2009) examines the effect of macroeconomics variables and capital structure using a panel date unrelated regression approach of 34 emerging market countries. He indicated that the interest rate has a beneficial impact on businesses to replace long-term debt with short-term debt

**Table 1.** Empirical literature review

Author(s)	Sample	Dependent variable(s)	Independent variable(s)					Empirical methodology
Current study	29 companies in the sugar sectors	Debt to capital ratio	PA	TB	NDTS	LQ	REER	Two-step dynamic panel GMM system, robust standard error, PCSE technique, AR (1), and AR (2) for auto-detection Sargan test
Al-Hunnayan (2020)	12 banks	Leverage	-	-		+		Multivariate regression analysis using panel data
An. Chakrabarti and Ah. Chakrabarti (2019)	141 energy firms	Total debt ratio	-	IS	IS	-		Panel data techniques
Goh et al. (2018)	174 manufacturing firms	Leverage	-		-	IS		Fixed-effect regression with robust standard errors
Shah and Khan (2017)	10 non-financial firms	Leverage ratio	-	+	+	+		Fixed-effect panel estimation
Nasution et al. (2017)	36 manufacturing firms	Debt ratio	-	+	-			Multiple linear regression
M'ng et al. (2017)	475 Malaysian firms	Leverage	-	+				Ordinary Least Squares (OLS) model with fixed-effect regression
Arsov and Naumoski (2016)	172 non-financial firms	Leverage	-	-	-	-		Panel data with fixed-effect regression
Zulvia and Linda (2019)	56 manufacturing firms	Debt to equity ratio	IS	IS				Panel data, multiple linear regression analysis
Mayuri and Kengatharan (2019)	20 manufacturing firms	Debt to total assets ratio	-	-	IS	-		Fixed-effect panel estimation
Muigai and Muriithi (2017)	40 non-financial firms	Financial distress						Panel regression model for Fixed Effects and Feasible Generalized Least Squares (FGLS)
Yildirim et al. (2018)	1,406 firms	Book leverage and market leverage	-	+				Panel fixed-effect estimator on the static regression model
Ur Rehman (2016)	All textile firms	Leverage			+		-	Panel data regression (fixed-effects model)
Submitter et al. (2019)	170 manufacturing firms	Debt ratio	+		+			Panel data regression

over equity. Goel (2019) studied the determinants of the capital structure of 255 non-financial companies using panel regression and observed negative relationship between interest rate and debt level. This study aims to fill this information gap by analyzing whether and if so, the study moderator variables, i.e., the company's interest rate and scale, have a direct impact on the capital structure by using other macroeconomic variables in 29 companies in the sugar sector of Pakistan, as these variables were not used before as moderator in this type of research in Pakistan according to the best knowledge of authors. Table 1 Empirical literature review shows other studies conducted on capital structure and the signs of findings.

Several abbreviations were used to save space in creating a table of studies in the literature. PA = profitability, TB = tangibility, NDTs = Non-Debt Tax Shield, LQ = liquidity, REER = exchange rate. The positive sign (+) in the table indicates a positive association here between variables and the response variable, whereas the negative sign shows a negative relationship between the dependent variable(s) and the variables. The IS abbreviation (Insignificant) shows that a significant result is not obtained.

## 2. HYPOTHESES OF THE STUDY

Based on the previously discussed aims, the following hypotheses concerning the sugar sector are described:

- H<sub>1</sub>: There is a positive relationship between debt to capital ratio and profitability of the Pakistani sugar sector.*
- H<sub>2</sub>: The interest rate has a significant moderating influence on the relationship between*

*debt to capital ratio and profitability of sugar firms.*

*H<sub>3</sub>: The firm size has a significant moderating influence on the relationship between debt to capital ratio and profitability of sugar firms.*

*H<sub>4</sub>: There is a positive correlation between debt to capital ratio and liquidity of the Pakistani sugar sector.*

*H<sub>5</sub>: There is a significant relationship between debt to capital ratio and the Non-Debt Tax Shield of the Pakistani sugar sector.*

*H<sub>6</sub>: There is a positive correlation between the debt to capital ratio and the exchange rate of the Pakistani sugar sector.*

## 3. METHODOLOGY

This section of the study describes analytical techniques for examining patterns, variables, the development of research assumptions, and the interdependence of interest rate and firm size on its capital structure.

### 3.1. Data and sample

The study sample included 29 registered Pakistani businesses working in the sugar sector. The first sugar sector was undertaken to avoid specious findings or some situations, such as the impact of interest rate on the firms' capital structure formation. The major focus of the study here is the moderating effect of the firm size and interest rate on capital structure, the net decision on profitability and tangibility, and the focus of macroeconomic variables (exchange rate and interest rate) on debt to capital ratio. They tend to be influenced and

Source: Authors.

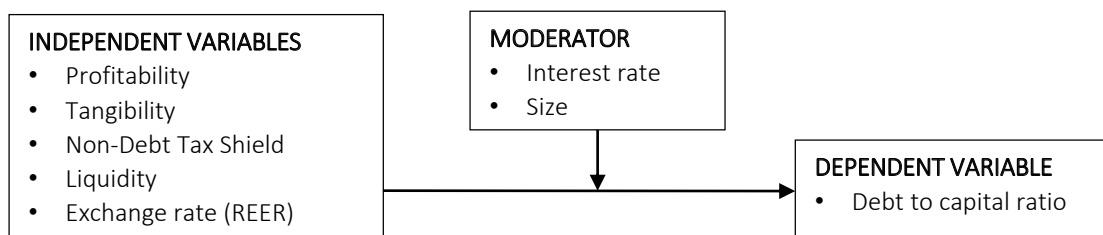


Figure 1. Conceptual framework

involve business administration regarding debt management and other decisions regarding capital structure, which can fluctuate around different manufacturing sectors. All selected firms are listed on the Karachi Stock Exchange (KSE). The selected sample describes six years from 2013 to 2018, and the data were collected from the State Bank of Pakistan Department of Statistics.

### 3.2. Tools and techniques

For assessing the impact of interest rate and firm size as moderate with debt to capital ratio, mean, standard deviation, and coefficient of variance are used. The coefficient of correlation is applied to get the association between firm size and debts to capital ratio and interest rate with debt to capital ratio. In the case of a static panel, to manage the robust standard error, a PCSE technique is used, where it covers the problem of autocorrelation and a heteroscedasticity problem after applying the correlation(ar1). During the analysis with linear and nonlinear regression analysis, to test the regression T-test results instead of the Z-value, the “small” option is used in system GMM regression. For “robustness,” PCSE helps manage the heteroscedasticity and autocorrelation consistency (HAC) problem as well. The no-diff Sargan command is used to prevent the recording of a certain difference in Sargan statistics. An orthogonal option is used for transmitting orthogonal variations transform rather than the first difference.

### 3.3. Variables

An experimental variable counts in the investigation and it is considered during the experiment. The experimental variable replies to the explanatory variable. It is determined because it “depends” on the fluctuations in an explanatory variable. In this research, the debt to capital ratio (DCR) is used as the scope of the business capital structure, and hence it is the response variable. The idea of applying this variable is because the research attempted to connect the organization’s operational success or failure besides an operational ratio, and it has extreme relation with other operational variables. DCR is calculated as non-current liabilities plus current liabilities to capital employed. This study tries to relate exactly how much debts a firm can obtain through their investment in cur-

rent assets, manage their current liabilities. It may be desirable to start by concentrating on observing each component of a debt capital ratio because profitability is the output of any firm’s profit and loss account. Normally net profit is obtained after the calculation of all tax and interest expenses calculations. The primary purpose of this study is to find profoundly capital structure in the context of financial needs and the outcomes of this balancing situation between internal and external funds into a business operation, so it should be focused on profit and loss account sincerely because it has roots to increase the firm’s economic productivity. Predictor or regressor variables are average profitability, firm size, tangibility, Non-Debt Tax Shield (NDTS), and liquidity. Profitability is a proxy of return on equity, calculated as (net profit before tax / total assets), whereas the size is calculated natural log of net sales. Liquidity is the ratio between current assets to current liability. Tangibility is (fixed assets after depreciation / total assets), but NDTS is the output of depreciation expenses of fixed assets / total assets. The exchange rate is a real effective exchange rate (REER) and revolves around the economy, while the interest rate is offered by the different commercial banks of the economy-related data collected from the State Bank of Pakistan.

### 3.4. Empirical model

The paper explores how variables impact the company’s debt to capital ratio (DCR) using the panel data analysis of cross-sectional time-series data ended in 2013–2018. DCR will be used as a response variable with a combination of variables; hence, DCR can be interpreted as follows:

$$DCR = F \left( \begin{array}{l} \text{Profitability, Tangibility,} \\ \text{Non-Debt Tax Shield,} \\ \text{Liquidity, ExR, Size, Irate} \end{array} \right). \quad (1)$$

#### 3.4.1. Static panel model

A simple linear regression equation is as follows:

$$Y_{it} = \alpha_{it} + \beta_{it} (X) + \varepsilon_{it}. \quad (2)$$

Static linear models stand accessible in the subsequent empirical equations (3) and (4):

$$\begin{aligned}
 DCR_{it} = & \beta_{it} + \beta_1 (\text{Profitability}_{it}) + \\
 & + \beta_2 (\text{Size}_{it}) + \beta_3 (\text{Tangibility}_{it}) + \\
 & + \beta_4 (NDTS_{it}) + \beta_5 (\text{Liquidity}_{it}) + \\
 & + \beta_6 (\text{ExR}_{it}) + \beta_7 (\text{Irate}_{it}).
 \end{aligned}
 \tag{3}$$

**3.4.2. Static model interest rate as the interaction effect**

$$\begin{aligned}
 DCR_{it} = & \beta_{it} + \beta_1 (\text{Profitability}_{it}) + \\
 & + \beta_2 (\text{Size}_{it}) + \beta_3 (\text{Tangibility}_{it}) + \\
 & + \beta_4 (NDTS_{it}) + \beta_5 (\text{Liquidity}_{it}) + \\
 & + \beta_6 (\text{ExR}_{it}) + \beta_7 (\text{Irate}_{it}) + \\
 & + \beta_8 (\text{Irate} \cdot \text{Size}_{it}) + \varepsilon_{it}.
 \end{aligned}
 \tag{4}$$

where  $i$  ( $i = 1 \dots 29$ ) is the intercept for every firm,  $t$  ( $t = 2013 - 2018$ ) characterizes the years examined, and  $\beta$  are the coefficients for each regressor variable, including  $\varepsilon_{it}$  as the disturbance term. Different approaches will be used to examine the static panel models examined: Pooled Ordinary Least Squares (OLS), Random Effects (RE), Fixed Effects (FE) with  $n$  firm-specific intercepts. Fixed-effects models investigate the relationship between input variables and output variables in different things, considering that the business has its characteristics that influence the association of concerning variables. On the other hand, random-effects models indicate random variation across organizations, unassociated with input variables. Breusch and Pagan multiplier test tells us that the random-effects model is appropriate between OLS and Random Effects, while the Hausman test explains the finest model from the second twofold model. Ultimately, to fix autocorrelation and heteroscedasticity problems, 5<sup>th</sup> to 7<sup>th</sup> regression models were used, especially regression with two-step system GMM required getting improvements in the estimated model. Tables 4 and 5 (see column 4) show a regression for Panel Correction Standard Error (PCSE).

**3.4.3. Dynamic panel model**

Many businesses, banking, economics, and finance matters are character-driven and use panel data arrangements to agree with adjustments. It is essential to allow dynamics in the primary pro-

cess for the constant estimation of other parameters. The dynamic connections are described by the carriage of a lagged dependent variable with the regressors, i.e.

$$Y_{it} = \delta Y_{i,t-1} + \beta x_{it} + \mu_{it},
 \tag{5}$$

$$\begin{aligned}
 DCR_{it} = & \beta_{it} + \beta_1 (\text{Profitability}_{it}) + \\
 & + \beta_2 (\text{Size}_{it}) + \beta_3 (\text{Tangibility}_{it}) + \\
 & + \beta_4 (NDTS_{it}) + \beta_5 (\text{Liquidity}_{it}) + \\
 & + \beta_6 (\text{ExR}_{it}) + \beta_7 (\text{Irate}_{it}) + \mu_{it}.
 \end{aligned}
 \tag{6}$$

**3.4.4. Dynamic model interest rate as the interaction effect**

$$\begin{aligned}
 DCR_{it} = & \beta_{it} + \beta_1 (\text{Profitability}_{it}) + \\
 & + \beta_2 (\text{Size}_{it}) + \beta_3 (\text{Tangibility}_{it}) + \\
 & + \beta_4 (NDTS_{it}) + \beta_5 (\text{Liquidity}_{it}) + \\
 & + \beta_6 (\text{ExR}_{it}) + \beta_7 (\text{Irate}_{it}) + \\
 & + \beta_8 (\text{Irate} \cdot \text{Size}_{it}) + \mu_{it},
 \end{aligned}
 \tag{7}$$

where  $\delta$  is a scalar,  $x_{it}$  is  $1 \cdot K$ , and  $\beta$  is  $K \cdot 1$ . The  $\mu_{it}$  go when a one-way disturbance component model  $\mu_{it} = \lambda_i + \varepsilon_{it}$  the error term  $\mu_{it}$  is de-integrated into  $\lambda_i$  and  $\varepsilon_{it}$ , where  $\lambda_i$  is the individual specific effect to cover the specific heterogeneity and  $\varepsilon_{it}$  is the error term. The empirical model is considered to promote investment variables. Because equity can range from investment to firm equity to debt in both directions and vice versa, these restrictions can be synchronized through the error term. Time-oriented firm individualities (unobserved specific effects  $\lambda_i$ ), such as demographics and geography, can remain integrated through descriptive variables. The presence of the lagged measured variable leads to autocorrelation. There are at least two reasons for a small period measurement ( $T = 6$ ), then a firm's measurement ( $N = 29$ ) in the panel data set: the possibility of simultaneous error control makes it possible for some predictor variables to be endogenous (associated). Controlling the firm's exact impact, which is due to the dynamic assembly of the regression calculation, the firm's specific dummies cannot be used.

According to Blundell and Bond (1998), based on system GMM estimator, level and differ-

**Table 2.** Descriptive statistics

Variables	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis
DCR	1.64	1.21	27.52	0.13	2.72	7.26	63.61
Profitability	26.41	12.51	328.74	0	46.43	4.05	21.72
Size	15.12	15.16	17.76	11.69	0.99	-0.22	4.27
Tangibility	0.536	0.51	0.948	0.17	0.189	0.14	2.138
NDTS	0.284	0.238	1.007	0	0.186	1.422	5.406
Liquidity	1.078	0.916	7.934	0.064	1.018	4.317	26.621
ExR	4.65	4.663	4.706	4.593	0.039	-0.187	1.66
Irate	0.08	0.075	0.095	0.065	0.013	0.083	1.403

ential equations have been merged. The rear differential of the regressors is used as an extra instrument for level equations. Here are two types of GMM estimator: one-step and two-step. Academically, two-step estimation is much more effective than one-step estimation since it practices the maximum weight matrix. A minor cross-section measurement might (1) cause standard errors, (2) influence estimation parameters (Windmeijer, 2005), and (3) cause a weak extraordinary identification test (Bowsher, 2002). Rodman (2009) explained that the source of these difficulties is device expansion, an answer that cuts the measurement of the adjustable instrumental combination. Blundell and Bond (1998) and Alonso-Borrego and Arellano (1999) show that if the dependent and explanatory variables determined and running continuously over time or almost behaving a random walk, the variance of these components, in differences is performing as a weak instrument for regression (Nyblom, 1989). This is either due to the autoregressive approximation of the parameter union or the variability of the separate impact rises, increasing when idiosyncratic error varies. Therefore, to reduce the potential error and barriers related to difference estimators, Blundell and Bond (1998) projected a GMM method by merging differences and regressions crosswise levels.

In calculating the regression of differences, the means on behalf of regression in levels are lagged differences (transformed), in which the reliability of GMM estimation is contingent on double descriptive diagnostics tests. Sargan tests of excessive instrument restrictions are valid and fail to throw away the hypothesis will mean instruments used in the model are correct, and the

research model is properly well-defined. Serial correlation tests are for the error term (Arellano & Bond, 1991). One must reject  $H_0$  that means the absence of first-order autocorrelation (AR (1)), and not rule out the nonappearance of 2<sup>nd</sup> order serial connection (AR (2)). Windmeijer (2005) derives a close derivation of this limited sample bias and applies it to the two-step GMM estimation variable variance-covariance matrix (VCE) defining VCE (robust). Reliable estimates of what has been corrected are robust to heteroscedasticity. The output of the Sargan test does not indicate that when the errors are heteroscedastic, the Sargan stat is not presented after the description of the VCE (robust). A healthy form of the Arellano-Bond test for autocorrelation has been developed after defining VCE (robust).

### 3.5. Descriptive statistics

Table 2 summarizes the values used in the current work as descriptive statistics for the variables employed in the study. The average debt to capital ratio for the sample is 1.64, which deviates within the range of 2.72, while the average profitability is 26.425. The capital structure measure shows that sugar companies have a moderate debt ratio. The mean value of size is 15.118, the average value of the exchange rate is 4.65 and interest rate is 0.08, while tangibility, NDTS, and liquidity have mean values of 0.536, 0.28, and 1.08, respectively. Tangibility suggested that the sugar sector of Pakistan owns a very low volume of fixed assets to current assets. The skewness of leverage of 7.26 shows that the distributions of leverage are approximately symmetric, while size and exchange rate are negatively skewed. The kurtosis leverage values lie between 63.61 and 1.40 for the whole sample.



**Table 3.** Correlation matrix

Variables	DCR	Profitability	Size	Tangibility	NDTS	Liquidity	ExR	Irate
DCR	1.000							
Profitability	0.296***	1.000						
Size	-0.364***	-0.089	1.000					
Tangibility	0.227**	-0.073	-0.273**	1.000				
NDTS	0.050	-0.051	-0.120	-0.072	1.000			
Liquidity	-0.256***	-0.119	-0.043	-0.439***	0.338***	1.000		
ExR	-0.062	-0.083	-0.015	0.006	0.047	0.058	1.000	
Irate	0.146	0.036	0.046	-0.086	-0.135	-0.061	-0.421***	1.000

### 3.6. Correlations

The correlation analysis Results are presented in Table 3 where debt to capital ratio is a dependent variable and independent variable, are as follows: profitability, size, tangibility, NDTS, liquidity, exchange rate, and interest rate. To explore the correlation between DCR and profitability, it has a positive and significant impact, while liquidity has a significant and negative association with DCR. Overall variables significantly correlated with DCR. Tangibility, NDTS, and interest rates are positively correlated with DCR, while exchange rate, liquidity, and size are negatively and significantly correlated.

## 4. RESULTS AND DISCUSSION

Panel A, Panel B, and Panel C employ simple static patterns. Results are presented in Table 4, which are consistent with my reported findings the linear regression model using one static panel and dynamic panel analysis where the debt to capital ratio is used as a dependent variable. In contrast, profitability, tangibility, NDTS, liquidity, exchange rate, size, and interest rate are used as the empirical research model's dependent variables. At the same time, size and interest rate are used as interaction with debt to capital ratio. Multicollinearity tests were obtained through variance inflation factor (VIF) to the panel data where the mean value of  $VIF > 10$  means there is a multicollinearity problem in the panel (Singla, 2020). The initial reports of different independent variables are the results in the first column for Pooled Ordinary Least Squares (OLS), second column Random Effects (RE), then in the third column, the Fixed Effects (FE) regressions at the second stage. One uses the techniques to robust the standard error with the techniques of autocorrelation parameter is high,

and the standard errors are large than for model exclusive of serial correlation, which is to be possible if there is a serial correlation. Column 4 (Hambuckers & Ulm, 2020) makes a case in contradiction of estimating panel exact AR parameters instead of one autocorrelation (AR) parameter for all panels. Outcomes from the two-step system GMM regression are included in the last column. The coefficient of determination, known as adjusted  $R$ -squared, suggests that different explanatory variables best explain the statistical models, and the model is best fit to data, and there are no multicollinearity problems in all the sample data as indicated by the variance inflation factor (VIF) statistics values. Profitability, size, NDTS, liquidity, ExR, have a negative influence on debt to capital ratio, while tangibility and interest rate has a positive effect on debt to the capital ratio in case of a fixed-effects model. Using the PCSE technique to manage the problem of serial correlation, it was reported through the Wooldridge test and heteroscedasticity test as significant. It was then adjusted with PCSE in static panel data and reported that profitability and NDTS had changed their signs from negative to positive. It shows that PCSE effectively covers the problem of serial correlation and heteroscedasticity. In the case of system GMM, the value profitability rotates position and becomes positive, which means that one can infer after applying system GMM with a positive influence on debt to capital ratio.

The OLS model explains profitability, size, tangibility, NTDS, liquidity, exchange rate, and interest rates to explain the disparity in debt to capital ratio. The fixed-effect model revealed that profitability, size, and NDTS are negative, while tangibility and interest rates significantly positively affect the debt to capital ratio as it is the best choice. PCSE is always a good technique to overcome the problem with heteroscedasticity and serial corre-

**Table 4.** Linear regression model

Variables	(1)	(2)	(3)	(4)	(5)
	OLS	RE	FE	PCSE AR (1)	Two-step system GMM
DCR = L					-0.226*** (0.124)
Profitability	0.0144*** (0.00437)	0.00176 (0.00520)	-0.0268*** (0.00691)	0.00419** (0.00208)	0.0100 (0.0110)
Size	-0.885*** (0.212)	-1.088*** (0.269)	-1.718*** (0.476)	-0.805*** (0.308)	-4.922*** (0.761)
Tangibility	1.057 (1.254)	2.189 (1.391)	6.100*** (1.851)	1.863*** (0.609)	11.83*** (3.150)
NDTS	1.950* (1.141)	1.170 (1.373)	-3.594* (2.124)	0.845 (0.557)	-6.168* (3.511)
Liquidity	-0.653*** (0.235)	-0.512** (0.254)	-0.335 (0.288)	-0.504*** (0.109)	-0.598 (0.636)
ExR	2.500 (5.523)	0.628 (4.740)	-1.552 (3.998)	-3.938*** (1.124)	-3.149 (6.915)
Irate	38.47** (17.55)	34.13** (15.29)	32.54** (13.01)	17.45*** (2.928)	45.73* (23.37)
Constant	-0.481 (26.63)	11.44 (23.02)	31.04 (19.81)	29.91*** (6.970)	83.13** (33.31)
Observations	142	142	142	142	113
R-squared	0.301	0.277	0.395	0.146	
Number of firms	29	29	29	29	29
<b>Diagnostic checks</b>					
Breusch and Pagan LM test for random effects					(10.65***)
Hausman test					(100.77)***
Multicollinearity test (VIF)					1.26
Heteroscedasticity test					14030.39***
Wooldridge test					1.033/ (0.3186)
Sargan test $\chi^2(8)$ / (p-value)					(7.715) (0.462)
Arellano-Bond test AR (1) (Z) p-value					(-1.458) (0.145)
AR (2) (z) p-value					(-1.085) (0.278)

Notes: Standard errors in parentheses \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ . The dependent variable is DCR representing debt to capital ratio, profitability means firm financial performance, measured by net profit before tax / total assets; size represents the log of total assets of the firms; tangibility represents fixed assets after depreciation / total assets; Non-Debt Tax Shield (NDTS) represents the output of depreciation expenses of fixed assets/total assets; liquidity represents a firm's liquid position, measured by the ratio between current assets to current liability; EeR represents a Pakistani rupee vs. USD exchange rate real effective exchange rate (REER); Irate is the interest rate (KIBOR) offered by commercial bank calculated by State Bank of Pakistan and beta represents a firm's systematic risk. The numbers presented in Table 3 for each variable are coefficients. Column 3 shows the main effect of DCR; column 4 tests PCSE for the interaction effect of size and Irate; column 5 shows the main effect of the two-step system GMM.

lation with the error term and check the panel data robust standard error correction, where it was observed that the coefficients of all the variables are similar like in the fixed-effects model, except liquidity and exchange rate for the firms getting reproduced (Reed & Ye, 2007). One has applied the Breusch and Pagan Lagrange multiplier test and reported that RE is more consistent (Grozdić et al., 2020; T. Nguyen, V. Nguyen, & Tran, 2020). After it, one applied the Hausman test, which reveals that the FE model is more consistent than RE. This is all about the static panel. Hereafter

dynamic regression model techniques are applied where it covers the problem of heteroscedasticity and serial correlation more accurately (Roodman, 2006; Baum, Schaffer, & Stillman, 2003; Reed & Ye, 2011). One estimates the debt-to-capital formula specified in equations (6) and (7) use GMM system estimator (Blundell & Bond, 1998). The dependent variable has been taken lagged value to mitigate endogeneity problems and Irate\*Size used as the interaction variable, asymmetry and non-linearity were analyzed using the relationship Irate\*Size between and capital structure. The sig-

nificance of dependent lagged variables shows that system GMM is a reliable model (Heid, Langer, & Larch, 2012; Çoban & Topcu, 2013; Nguyen & Do, 2020). In column 6, tangibility and interest rate have significant value and positively influence debt to capital ratio (Bokpin, 2009). The regression findings with adjusted *R*-squared values show that for all models, the specified independent variables have meaningfully explained the variance in debt to capital ratios (Mulyadi & Sihabudin, 2020). AR (1) and AR (2) are insignificant, whereas the

Sargan test also has a consistent value. The selection of system GMM is the best fit for the selected sample data to infer the outcomes (Zhang & Wang, 2020). This model is tested using the Sargan / Hansen method for over-identification restrictions (Chatterjee, 2020). The AR (1) estimates were insignificant, whereas those for AR (2) were insignificant. The Sargan test results were insignificant, suggesting that the null hypothesis of jointly valid instrumental variables has not been ignored (Ma & Fu, 2020).

**Table 5.** Nonlinear regression

Variables	(1)	(2)	(3)	(4)	(5)
	OLS	RE	FE	PCSE AR (1)	Two-step system GMM
DCR = L					-0.145*** (0.122)
Profitability	0.0159*** (0.00416)	0.00601 (0.00499)	-0.0219*** (0.00709)	0.00949*** (0.00218)	0.0163 (0.0107)
Size	4.188*** (1.290)	3.207*** (1.177)	0.626 (1.111)	2.949*** (0.996)	1.119 (1.994)
Tangibility	1.076 (1.190)	2.178* (1.321)	6.025*** (1.814)	1.518*** (0.568)	10.37*** (3.060)
NDTS	1.761 (1.083)	1.117 (1.296)	-3.453 (2.082)	1.164*** (0.396)	-4.870 (3.396)
Liquidity	-0.550** (0.225)	-0.403* (0.244)	-0.233 (0.286)	-0.486*** (0.157)	-0.145 (0.625)
ExR	3.590 (5.247)	1.852 (4.587)	-0.671 (3.936)	-2.167*** (0.787)	-2.541 (6.643)
Irate	970.6*** (234.7)	818.6*** (211.4)	471.4** (189.3)	719.6*** (175.4)	1,042*** (309.6)
Irate*Size	-61.61*** (15.47)	-51.76*** (13.92)	-28.93** (12.45)	-46.20*** (11.45)	-65.42*** (20.28)
Constant	-82.38** (32.58)	-59.52** (29.15)	-8.827 (25.90)	-35.40** (15.05)	-11.88 (43.42)
Observations	142	142	142	142	113
<i>R</i> -squared	0.375	0.404	0.424	0.245	
Number of firms	29	29	29	29	29
<b>Diagnostic checks</b>					
Breusch and Pagan LM test for random effects					(9.29***)
Hausman test					(61.49)***
Multicollinearity test (VIF)					1.26
Heteroscedasticity test					14727.13***
Wooldridge test					0.46/(0.51)
Sargan test $\chi^2(8)$ / ( <i>p</i> -value)					(10.999) (0.2017)
Arellano-Bond test AR (1) (Z) <i>p</i> -value					(-1.639) (0.101)
AR (2) (z) <i>p</i> -value					(-0.863) (0.388)

*Notes:* Standard errors in parentheses \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ . The dependent variable is DCR representing debt to capital ratio, profitability means firm financial performance, measured by net profit before tax / total assets; size represents the log of total assets of the firms; tangibility represents fixed assets after depreciation / total assets; Non-Debt Tax Shield (NDTS) represents the output of depreciation expenses of fixed assets/total assets; Irate\*Size represents an interaction term of interest rate and size; liquidity represents a firm's liquid position, measured by the ratio between current assets to current liability; EeR represents a Pakistani rupee vs. USD exchange rate real effective exchange rate (REER); Irate is the interest rate (KIBOR) offered by commercial bank calculated by State Bank of Pakistan and beta represents a firm's systematic risk. The numbers presented in Table 4 for each variable are coefficients. Column 3 shows the main effect of DCR; column 4 tests PCSE the interaction effect of size and Irate; column 5 shows the main effect of two-step system GMM.

The interaction method is applied to check the moderator effect of interest rate and firm size on the debt to capital ratio (Youn, Hua, & Lee, 2015). One found understanding of interactions in a nonlinear model is more complicated than in a linear model, where the interaction term marginal effect is approximately equal to the interaction term coefficient. As emphasized in Ai and Norton (2003), the model is nonlinear; the interaction effect cannot be re-evaluated simply by looking at the symbol, significance, or statistical relevance of the interaction term coefficient. The interaction effect may have different signs with different covariate values, and therefore the sign does not necessarily indicate the interaction effect. The interaction term is included in

the model.  $Irate*Size$  is expected to capture the joint effects of firm size with interest rate and debt to capital ratio. Its alpha value is compared to the linear model, and here some explanatory variable coefficient value also gets changed, for example, size has a negative value in the linear model, but in the nonlinear, it gets rotate its position become positive. Similarly, the coefficient value of liquidity and exchange rate has changed very severely. Through empirical analysis about the selected sample, it was found that interest rate with firm size have an interaction effect with debt to capital ratio. It was observed from the outputs, and it infers abnormal variation in the coefficient value of different variables, which approves the moderate effect.

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## CONCLUSION

Researchers have conducted several experiments to determine what defines a firm's capital structure. Similarly, one examined the moderating effect of firm size and the interest rate on the firm's capital structure using panel data from the sugar sector of Pakistan. One has adopted a static and dynamic data panel approach. Interactive data panel models are anticipated to serial connection challenges, heteroscedasticity, and independent variable endogeneity. In this regard, applying static data panels, one uses PCSE, and for dynamic panel models, GMM estimation yields highly accurate regression results and is widely applied in research-based finance sectors. The results showed that firm size and interest rate have a strong and negative effect on its capital structure. Due to the high interest rates offered by commercial banks, large-size firms have enough relationships with consumers. They can manage their funds for loans and capital structure ratios in the firm's best interest. Higher short-term loans can accumulate more money because they lower the risk of liquidity, and it is found that moderator role interest rates affect liquidity. They can set up their funds. The Non-Debt Tax Shield is adversely linked to corporate debt ratios, and the higher Non-Debt Tax Shield is followed by lower levels of debt, thereby creating a certain replacement effect on corporate capital structure. The study findings affirm the effect of Non-Debt Tax Shield on the fundamental hypothesis. A favorable correlation is found between debt to capital ratio and tangibility, where the business collects debt to purchase tangible assets. The sample data from Pakistan is subject to a correlation test, which indicates no high correlations between the independent variables; therefore, no multicollinearity problem exists. Afterwards, it is checked with the command of VIF and found its value is less than 10, which means no multicollinearity in the model. The paper indicates that different influences, including the size, interest rate, profitability, liquidity position, influence the debt to capital ratio of the company. Managers will be considering the interest rate and the proportion of their total assets to debts of the company and other considerations in their debt finance decisions.

## AUTHOR CONTRIBUTIONS

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## LIMITATIONS OF THE STUDY

One wants to make it clear that no study can be free of obstacles, as shown in the following statements:

- The research is limited to six years of data only, i.e., from 2013 to 2018. Accordingly, a complete investigation comprising a normal time may provide somewhat mixed outcomes and could not produce significant inferences.
- This research is based on secondary data collected from the officers of the State Bank of Pakistan, according to which the nature of the investigation depends only on the accuracy of the data and the authenticity of the secondary data. The influence of the data source can affect the results of the estimation and explained the analysis results.

This research is based on twenty-nine companies of the sugar sector in Pakistan, which are also extracted from corporations registered under KSE. Accordingly, the accuracy of the decisions is based on the data of the sampled selected firms. The return can be somewhat contradictory if the potential researcher uses more time about the sampled units.

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