

Non-linear relationship between Capital Structure and Firm Value Nexus: An Empirical Study in Egyptian Capital Market

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Abstract:

This paper sheds light to the non-linear relationship between leverage and firm performance in the Egyptian capital market. To do this, Egyptian listed firms observed over the period 2010-2019 are exploited, totalling 780 observations. Using a **system GMM estimator** and **quadratic regression**, a U-shaped relationship between leverage and the performance of Egyptian firms was found. This result is described by the fact that there is an optimal threshold of leverage on firm performance, below which the performance of Egyptian firms increases. However, the performance of these firms is reduced as a result of the rise in financing costs and information asymmetry, once the exposure of

debt ranges to a certain threshold. Therefore, the predictions of the Trade-off theory are admitted. In addition, lagged values and control variables are robust determinants of present values of firm performance. Though, the outcomes of the previous published papers in the developed countries favored trade-off theory as it possibly provides a better account for capital structure choices, *conversely*, pecking order theory is slightly preferred for developing countries. This study provides a much more challenging confirmation that the trade-off theory is more preferred for MENA countries taking the Egyptian context as an example for the MENA region.

Keywords: Leverage; Firm performance; Egyptian Context; System GMM, Quadratic regression.

1. Introduction

Nowadays, the effects of capital structure on corporate performance has been the front topic of much research in the literature of corporate finance. By explanation, the optimal combination of equity and long-term debt is the meaning of capital structure. It is only one compartment of financing decisions for the financing of durable assets. This financing decision is made by managers whose purpose is to increase opportunities for growth and reinvestment. This maximises the value of the firm (David & Olorunfemi (2010)). In fact, the disagreement between

researchers on the influence of debt on firm performance has been observed both theoretically and empirically.

Theoretically, number of theories clarify the relationship among the performance and capital structure in recent decades. According to the significance study of Modigliani & Miller (1958), the capital structure does not have an impact on the firm's value. Therefore, there is a dichotomy amongst the real and the financial spheres. Nevertheless, the founding theory of Modigliani & Miller (1958) was later rejected because it is depend on the hypothesis of a capital market paramount. This is certainly in contradiction with reality. In order to fill the gap, other theories on the topic have been developed, which are based on the hypothesis of imperfect capital markets. These theories are activity theory (Jensen & Meckling (1976)), trade-off theory (Kim, 1978, Karus & Litzberger (1973)) and pecking order theory (Myres & Maljuf (1984)). To the extent that agency theory is concerned, it postulates the presence of an optimal capital structure that minimizes conflicts of interest between stakeholders. Enabling the maximization of the firm's value. As well as, Trade-off theory also assumes the existence of an optimal capital structure. According to this theory, the optimization of the capital structure involves a trade-off between the benefits (tax savings (Modigliani & Miller (1963)) and the debt fees (bankruptcy and agency costs (Kim (1978)),

Kraus & Litzenberger (1973) and Bradley et al. (1984)). This is likely to enhance the firm's value. The pecking order theory proposes the existence of a hierarchical financing order, starting with internal financing and then recourse to external financing (Myers & Majluf (1984)). In accordance, there is no optimum capital structure.

Empirically, there is no agreement among researchers on the presence of a unique relationship amongst leverage and firm performance. Opposing views and mixed results were observed in this area. The presence of positive relation amongst capital structure and firm performance have displayed by several authors. Nevertheless, others founded the opposite. Certainly, empirical investigations in this field continued to progress. Moreover, some studies revealed non-linear relationship among the capital structure and performance of Egyptian firms, while relying on different econometric techniques (Berger & Bonaccorci de Patti (2006), Margaritis & Psillaki (2010), Matemilola et al. (2014), Jaisinghani & Kanjilal (2017), and Khémiri Noubbig (2020)).

In view of this, it is important to refer to the theories concerned to the optimisation of the capital structure. More specifically, it is a matter of using trade-off theory. In this case, it is necessary to question the existence of a non-linear relationship among the capital structure and performance of Egyptian firms. Consequently, it is noted that there are a contradicting evidence

regarding the relationship among capital structure and a firm's financial performance. In addition, the studies examining the performance implications of capital structure varieties are massive in advanced markets, while empirical studies about such allegations in emerging or transition economies like Egypt are a few. In such a country as Egypt, (Eldomyaty.,(2007)) claimed that the Egyptian capital market is inefficient, incomplete, and experiences an advances level to the information asymmetry than the capital markets in developed countries. Financing decisions can be incomplete due to the market environment, which makes them subject to a large degree of irregularities. So, it is of great importance to explore the validity of debt finance companies' performance relationships in Egypt's unique economic conditions. This leads us to try to find an answer to the study question, which is, to what extent the capital structure enhance the firm profitability in the Egyptian context?. Initially, although Egypt has gone through a phase of transition of the economic system to capitalism and an open market, the decision-making has been controlled by the government that supports the improved level of financial leverage especially that of the company that underwent privatization in the mid-1990s. Secondly, compared with developed markets, the stock market in transitional economies has been characterized with higher growth potential, higher volatility, lower investor protection, illiquid stock market, relatively weak corporate governance and lower

levels of disclosure (Soliman, 2013; Chau and Gray, 2010). Third, the information asymmetry in transitional market is relatively higher than that of developed market. Fourth, the increased economic growth and the high expected returns due to high volatility, attracted international organizations and investors' attention towards emerging market such as Egypt (Yassin, 2021).

The rest of this paper is organized as the following. The second section depicts the review literature on the capital structure and performance of the company. The third section introduces the methodology, data, variables, and method of analysis. Sections 4 and 5 of the paper present the results of the research and discussion. The article determines with a discussion of theoretical limitations, implications, and future guidelines for research.

2. Literature Review and Hypothesis Development

2.1. Theoretical Structures

Meanwhile the publication of Modgilaini & Miller's Theorem (1958), the theme of capital structure and corporate performance has been a real echo in the literature of corporate finance. Based on the hypothesis of the absence of capital market imperfections, Modigliani & Miller (1958) found that capital structure has no effect on the firm's value.¹ The conclusion reached

¹ Ideal financial markets are depict by the obscurity of information asymmetry, costs of agency, transaction and bankruptcy and taxes, etc.

by the authors is that the values of the debt- and non-indebted firm are equals. However, Modgilaini & Miller's (1958) theorem was rejected due to the relaxation of certain hypotheses. More specifically, since the consideration of the role of corporate taxes in the determination of financing decisions, several theories have been developed (see Modigliani & Miller (1963) on tax savings). These theories can be categorized into two classifications. The first classification includes the theories related to information asymmetry, such as signal theory (Ross (1977), pecking order theory (Myers.(1984) and Myers.& Majluf.(1984)) and market timing theory (Baker.&Wurgler.(2002)).

While, the second classification includes the theories based on the optimisation of the capital structure, namely agency theory (Jensen.& Meckling (1976) and Jensen (1986)) and Trade-off theory (Kraus.& Litzenberger (1973) and Bradley et al. (1984)). According to agency theory, it predicts that there is an ideal level of capital structure below, that debt minimizes the agency costs related to equity. These costs result mainly from a conflict of awareness between shareholders and managers (Jensen (1986) and Stulz (1990)). However, above this level debt increases the costs of agency related to debt, resulting from vertical alliances (interest contradict) amongst shareholders and fund lenders (Jensen & Meckling (1976)). In this case, to minimise total agency costs, it is paramount to determine an

optimal level of capital structure. This will in turn allow the maximisation of firm value.

As for the trade-off theory, it is a real enrichment of agency theory. It explains how firms need to take better financing strategies for the purpose of raising their value. The prosperity of this strategy demands a return to the optimisation of the capital structure (Myers (1984) and Bradley. et. al. (1984)). According to Kraus. & Litzenberger (1973) and Bradley et al. (1984) it is important to make a trade-off between the benefits of debt and its costs in order to have an optimal capital structure. The profits of debt arisen from tax savings (Modigliani & Miller (1963)), and the costs result from the costs of bankruptcy and agency (Kim (1978), Kraus & Litzenberger (1973) and Bradley. et. al. (1984)).

2.2. Empirical evidence

The association between capital structure and firm performance has been the subject of numerous empirical studies. Specifically, research in this area began by examining the linear relationship between leverage and corporate performance for both advanced and developing countries. Some researchers have found a negative relationship between leverage and firm performance (see, for example, Majumdar & Chhibber (1999) in the Indian context and Zeitun & Tian (2007) in the Jordanian context). However, others have asserted the opposite (see

Abor (2005) for the Ghana case and Berger & Bonaccorsi di Patti (2006) for the US paradigm).

On one hand, several studies such as Roden & Lewellen, (1995) in 48 US firms, Dessi & Robertson, (2003) in UK firms from the period of 1976 to 1989, and Arbiyan and Safari (2009) in Iranian listed firm from (2001-2007) revealed a positive relationship between capital structure and profitability. These findings were supported by Champion. (1999); Ghosh et al., (2000); Hadlock. and. James, (2002) suggested corporations with high level of profitability use high level of debts. In addition, Gill et al., (2011) in New York stock exchange during (2005-2007), and Aburub (2012) in Palestine stock market also showed a positive relationship between capital structure and firm performance. On the other hand, other studies revealed a negative relationship between the capital structure and firm's performance such as Kester, (1986) in the US and Japan; Friend & Lang, (1988), and Titman & Wessels, (1988) from the US firms; Rajan. & Zingales, . (1995) in the G-7 countries; Dawar, (2014) in India; Wald (1999) in the developed countries; Sadeghian et al., (2012) in Tehran Context; Zeitun and Tian (2007) In Jordanian market. In addition, Deesomsak. et al., . (2004); Karadeniz. et. al., . (2009) and Huang & Song, (2006) revealed that there is a negative connotation amongst leverage and financial performance in the China firms.

However, empirical studies have developed in this area. Moreover, it largely focuses on the issue of non-linearity among leverage and firm performance, thus supporting the validity of agency and trade-off theories. Using various econometric techniques, some researchers have found an optimal capital structure threshold. Starting with the state of advanced economies, Berger & Bonaccorsi de Patti (2006) and Margaritis & Psillaki (2010) find a nonlinear relationship between capital structure and corporate performance in the United States and France. The authors provided validity of the agency theory. The identical result has been confirmed for developing economies. More specifically, several researchers have shown a nonlinear relationship between debt and firm performance (see among others Lin & Chang (2011) (Taiwan case) and Matemilola et al (2014) (South Africa case)). They conclude that the Trade-off theory is closely related to the Taiwanese and sub-Saharan African contexts.

Recently, other studies have provided support for theories about capital structure optimization. In a study of Vietnamese companies, Le & Phan (2017) showed that a nonlinear relationship appears when company performance and debt are measured by return on equity (ROE), total debt and short-term debt, respectively. The authors confirmed the validity of the agency theory. However, they have not identified which theory is most appropriate in the Vietnamese context. In addition,

Jaisinghani & Kanjilal (2017) has examined the nonlinear relationship between leverage and firm performance in India. They concluded from their study that there is an optimal limit for debt, confirming the predictions of barter theory. Finally, Khamiri and Noobg (2020) demonstrate that an ideal debt threshold of 5.531 (~\$252 million), is lower (higher) than the performance of small (large) sub-Saharan African firms (increases) when debt increases. The authors confirmed the validity of some theories regarding the sub-Saharan context, including the trade-off theory.

In summary, although the previous literature has addressed the issue of non-linearity amongst the capital structure and company performance, it is still restricted. The results of these experimental analysis appear to be diverse. Some results are reliable with trade-off theory and others with agency theory. For instance, it can be concluded that either theory is uniformly better than the other. Furthermore, we note that researchers have not yet analysed the non-linear relationship between debt and company performance in the Egyptian context. To enrich the existing literature, we will examine the nonlinear relationship amongst capital structure and the performance of Egyptian companies. We develop the following three hypotheses constructed on the aforementioned review of the nonlinearity test between leverage and performance:

Hypothesis 1.

"There" is a non-linear relationship between the capital structure and economic performance in Egyptian listed firms.

Hypothesis 2.

There is a non – linear relationship between the capital structure and financial performance in Egyptian listed firms.

Hypothesis 3.

There is a non – linear relationship between the capital structure and firm value in Egyptian listed firms.

3. Research methodology

3.1. Data and sample

To build our database, the population consists of 222 companies listed on the Egyptian Stock Exchange, as measured by the Egyptian Stock Exchange in 2019. We removed all financial and banking sectors from our sample because their capital structure is governed by separate regulatory requirements. Second, we excluded all companies with missing data in order to operate on a balanced board. This led to the development of a sample of 78 non-financial companies listed in Egypt from 2010-2019. The choice of this period is very important because it allows us to take into account the application of International Financial Reporting Standards (IFRS), and the Egyptian revolution (2011). This is likely to affect the financial reports of Egyptian companies. Plus, we chose the Balanced Palette for consistent, more robust results. Accounting data are

collected from each company's financial statements for each year. It is extracted from three main sources which are data stream, and annual disclosure books in the Egyptian Stock Exchange. The final sample includes 780 observations for 78 companies across 11 industries for a 10-year period from 2010-2019 as displayed in Table 1.

Table 1. Sample Selection Procedure	Number	Ratio
Number of firms listed in the stock exchange	222	100%
Less: financial, insurance, and investment firms	47	21%
Less: Companies that do not have information for at least 5 years	30	13.5%
Less: Missing Data stream information	67	30%
Total firms included in the sample after excluding the missing data	78	35%

3.2. Variables measurement

First; Firm performance measures

In proportion to the effort of Jainisghni & Kanijlal (2017) and Khémiri & Noubbigh (2020), we utilized accounting metrics for company performance, namely, return on assets (ROA) and return on equity (ROE). Return on assets is deliberated by the ratio of earnings after interest. and. taxes to total. assets. For (ROE), it is equal to the ratio of earnings after interest and taxes to total equity. Additionally, we used a measure of company value because our sample consists of companies listed on the Egyptian Stock Exchange. This metric corresponds to Tobin's Q (Q) which is the market capitalization added to the long-term of

debt to the book value of total assets . The choice of this variable is important because it allows the effect of risk to be taken into account (Matemilola et al. (2014))

Second: Main Independent Variable

In our study, we measured the capital structure or leverage (LEV) by the percentage of book value of total debt to total assets of a company at the end of its fiscal year. Under the trade off theory, maximizing the value of the firm requires the use of debt. To achieve this goal, this theory predicts the optimum capital structure in which the benefits of debt (Modigliani & Miller (1963)) are equal to its costs Kraus. & Litzenberger(1973) and Jensen. & Meckling (1976) and Kim (1978), Bradley et al. (1984)). This is explained by the fact that the capital structure positively disturbs the performance of the company. However, when the capital structure exceeds the optimum, the relationship turns from positive to negative.

Third: Control variables

We include control variables to improve the explanatory power of our empirical model. This is likely to reduce endogeneity problems and the probability of omitted variables. According to Gonzalez & Gacia-Meca (2014), Khémiri & Noubbigh (2019, 2020) and Dong et al. (2020), we take into consideration the following firm-specific characteristics: firm Size, liquidity and assets tangibility.

For Firm Size (SIZE), it is calculated by the natural logarithm of total assets. This proxy is used by Matemilola et al. (2014) and Jaisinghani & Kanjilal (2017). Firm size has been used by several researchers to distinguish firm capital structures (e.g. Margaritis & Psillaki (2010), Matemilola et al. (2014), Jaisinghani & Kanjilal (2017) and Khémiri & Noubbigh (2020)).

Liquidity (LIQ) is dignified by the ratio of current assets to current liabilities (Jaisinghani & Kanjilal (2017), Khémiri & Noubbigh (2020)). There are other indicators to measure liquidity as there are other indicators that can also be used to measure liquidity. In fact, the liquidity ratio is used by researchers to control the firm's ability to invest in future projects or to distribute dividends to shareholders. Liquidity then contributes to improving the firm's performance.

Finally, the assets tangibility (TANG) is the ratio of the net property, plant, and equipment scaled by total assets (Margaritis & Psillaki (2010), Le & Phan (2017) and Khémiri & Noubbigh (2020)). This variable is used by researchers to control the efficiency and capacity of Egyptian firms to have the best technologies and vice versa.

3.2. Econometric model

The company's performance is dynamic in nature. In fact, the hypothesis that the modification process is cost-free seems unrealistic (Molinari (2013), Khémiri & Noubbigh (2018)). In this case, it is then important to choose an econometric method

that allows taking into account the dynamic nature of the company's performance. Specifically, it is necessary to use quadratic regression using the General Moments Method (GMM) to test the nonlinear relationship amongst capital structure and company performance. We find that the use of the Generalized Moment Method (GMM) developed by Arellano & Bond (1991) and later extended by Arellano & Bover (1995) and Blundell & Bond (1998) is crucial to account for the smoothing and control problem of firm effects. The estimated model is expressed as:

$$Per_{it} = \beta_0 + \beta_1 Per_{i,t-1} + \beta_2 LEV_{i,t-2} + \beta_3 LEV_{i,t-2}^2 + \beta_4 SIZE_{it} + \beta_5 TANG_{it} + \beta_6 LIQ_{it} + \varepsilon_{it} \quad (1)$$

Where,

$Per_{i,t-1}$:

indicates the performance of firm i one year ahead of firm i at the moment t

LEV : means the long – term debt of firm i at time t – 2.

$LEV_{i,j,t-2}$: represents the two – year lagged long – term debt of firm i at time t – 2.

Size : is the size of firm i at time t.

TANG : are the guarantees of the firm of firm i at time t.

LIQ : is the liquidity of firm i at time t.

β_1 à β_6 : the coefficients to be estimated.

$\varepsilon_{i,j,t}$ The error term that is supposed to be independent and

identically distributed(i. i. d)

Research Results

4.1. Descriptive statistics

Table 2 summarizes the descriptive statistics for all the variables presented in our model. We present the number of observations, means, standard deviations, minimum and maximum sample variables. The mean return on assets is valued at 0.0519, while Tobin's ROE and Q are estimated at 0.100 and 0.803, respectively. This result indicates that the listed Egyptian companies achieved significant profits during the period 2010-2019. In addition, it should be noted that the average value of LEV is 0.233. This can be clarified by the fact that companies listed in Egypt use long – term debt in their capital structures. In addition, it should be noted that the control variables, presented in our model, show a positive sign throughout the 2010-2019 period.

Table 2. Descriptive statistics

VARIABLES	<i>N</i>	<i>Mean</i>	<i>S. D.</i>	<i>Min</i>	<i>Max</i>
ROA	780	0.0519	0.0650	-0.0398	0.216
ROE	780	0.100	0.119	-0.0688	0.374
Q	734	0.803	0.924	-0.151	7.046
LEV	780	0.233	0.172	0.0182	0.610
LIQ	780	1.834	1.189	0.515	5.046
Size	780	5.692	0.696	4.677	6.967
TANG	780	0.357	0.244	0.00890	0.780
OC	780	5.351	0.757	4.097	6.815

Table 3. Correlation matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) ROA	1.000							
(2) ROE	0.640*	1.000						
(3) Q	-	-	1.000					
(4) LEV	0.085*	0.127*		1.000				
(5) LIQ	-	-0.062	-0.018		1.000			
(6) Size	0.228*	0.046	0.042	-		1.000		
(7) TANG	0.233*	0.328*	-	0.051	-		1.000	
(8) OC	0.109*	0.178*	0.122*	0.115*	0.195*			1.000
	0.081*	0.255*	-	0.185*	-	0.781*	0.010	
			0.129*		0.288*			

Notes: The above-mention table show that the variables correlations for listed companies in Egypt between 2010 and 2019. The correlation was significant at the 5% level.

Table 3 presents the results of the Pearson Correlation matrix, indicating the non-appearance of multi-collinearity problems between the variables. The absence of this problem can be explained by the fact that the expected coefficients have values below 0.80.

4.2. Nonlinear relationship between capital structure and firm performance

Due to the limitations of applying the static model, whether using a fixed or random effects panel (GLS). In fact, GLS using a fixed/random influence model is likely to provide biased results due to the association between the error term and

the lagging variable. Therefore, the use of tools is justified as a result of the existence of this association problem. Accordingly, the GMM technique was proposed and developed by Hansen (1982) and refined by Arellano and Bond (1991), Arellano and Bover (1995), Holtz – Eakin. et al. (1998) and Blundell and Bond (1998). They suggested that this technique could produce unbiased, more efficient and consistent results for dynamic panel data models (Attia, 2020).

To solve the endogeneity problem, Arellano and Bond (1991) used appropriate lag periods for the dependent and independent variables as tools. However, late levels of explanatory variables may be poor tools for covariate variables that cannot be identified in the difference estimator. Hence, Arellano and Bover (1995) and Blundell and Bond (1998) overcome the shortcomings of the first difference estimator for GMM by proposing a GMM estimator for the two-step system. In fact, the lack of information about correction variables in the level model can lead to the loss of a large part of the total variance of the data (Arellano and Bover, 1995).

Moreover, the first GMM difference estimator was found to have significant sampling biases when explanatory variables persist over time (Blundell and Bond, 1998). To solve these problems, Arellano and Bover (1995) and

Blundell. and. Bond (1998) proposed a System GMM estimator. This estimator has several advantages. First, it can control for time-specific effects and eradicate cross-sectional dependency in data and country by including dummy time variables. Second, differences despite levels of explanatory variables do not necessarily correlate with the country-specific fixed effect (Khemiri, Nobg, 2018). As a result, the study proposes to implement a system GMM estimation tool for a sample of Egyptian firms from 2008-2017 to mitigate dynamic heterogeneity, concurrency, and unobserved heterogeneity over time.

Following Roodman (2009b), we ran the "xtabond2" command to perform a GMM system estimation using Stata software. In this study, we follow up with post-estimation specification assays. Specifically, we use Hansen's test for over definition constraints and Arellano. and. Bond. (1991) test, AR(2), for the lack of autocorrelation in second difference errors.

Discussion of results

Table (4) below conclusions the results obtained by system GMM method and practice regression.

It can be revealed that the coefficients of the lagged variables (ROA_{t-1}) and (Q_{t-1}) positively and significantly affect the current performance (Per_t) at the 1% level (see columns 1 and 3). However, the coefficient of the lagged variable (ROE_{t-1}) is negative and statistically significant at the 5% level. This result

indicates that when the performance of the lagged Egyptian firms (measured by ROA or Tobin's Q) increases, the present performance also increases. On the other hand, when the performance of delayed Egyptian firms (measured by ROE) increases, the current performance of Egyptian firms decreases (see column (3)). This decrease could be attributed to the cost of debt financing, which seems to be expensive for Egyptian firms.

In the three columns, it can be seen that $LEV_{i,t-2}$ negatively and significantly affects the performance of listed firms in Egypt. In contrast, $LEV_{i,t-2}^2$ is a positively and statistically significant related to the performance of firms. It follows from this the existence of a non-linear association amongst debt and the performance of Egyptian firms. At this level of analysis, it is important to calculate the marginal effect by $dPer/dLEV$.

Specifically, for column 1 (Per is measured by ROA), there is an optimal LEV threshold of 0.278. From this result it follows that there is an optimal debt threshold underneath which Egyptian firms fail to maximise their economic returns. The inability of Egyptian companies to take advantage of access to external financing in order to finance their projects and improve their performance is often clarified by the existence of great financing and agency costs. In the presence of information asymmetry, borrowers grant quite high credits in order to protect themselves against default risks. In this case, some Egyptian firms find themselves unable to borrow sufficient funds to

maximize their performance. However, beyond a threshold which is equal to 0.278 (27.8%), debt is an efficient source of financing, thus supporting Egyptian firms to grow and maximize their performance. In order to do this, businesses get credits to tap into tax savings. Then they try to offset the costs arising from the debt, while efficiently driving their own profits (economic returns). Our findings are consistent with those found by Le & Phan (2017), Jaisinghani & Kanjilal (2017), Oyakhilome et al. (2018) and Khémiri & Noubbigh (2020). In fact, the trade-off theory has approved the validity of the existence of an optimal debt **threshold which supports H1 hypothesis.**

For column 2 (Per is measured by ROE), there is an optimal LEV threshold of 0.558. More specifically, the existence of a negative relationship amongst debt and the performance of Egyptian companies can be clarified by the fact that the deterioration of the financial performance of these companies is related to the poor economic return and the high costs arising from debt. In this case, below the debt threshold of 0.558 (55.8%), debt is not a suitable source of shareholder wealth maximization. However, by exceeding this limit, they are allowed to take full advantage of the tax savings. This is likely to lead some companies listed in Egypt to use debt to increase their wealth. This finding is in line with the findings of El Khamiri and Noobj (2020). Thus, the trade-off theory and the H2 hypothesis are accepted.

Similarly, in column 3 (Per is measured by Tobin's Q), we find the estimated optimal LEV threshold of 3,024. The existence of an ideal debt limit indicates that Egyptian companies with a debt level of less than (equivalent to 3.024) do not have enough debt in their capital structures to maximize their market values. This can be attributed to agency costs and debt cost arising from asymmetric information. However, above this limit, they can borrow to take advantage of debt (tax savings) and thus increase their market values. Our results are consistent with those of Al Khamiri and Noobg (2020). This further proves the **acceptance of the trade-off theory and the H3 hypothesis.**

Concerning the control variables, they are all significant. They are robust determinants of firm performance.

Table 4. Nonlinear relationship between leverage and company performance: System GMM and quadratic regression

VARIABLES	(1) ROA	(2) ROE	(3) Q
L.ROA	0.379*** (0.0245)		
L.ROE		-0.0333** (0.0133)	
L.Q			0.138*** (0.00473)
LEV	-0.114*** (0.0366)	-0.202** (0.0931)	-0.666** (0.282)
LEV2	0.196*** (0.0574)	0.380** (0.155)	1.845*** (0.508)
LIQ	0.00657*** (0.00106)	0.00868*** (0.00126)	-0.0257** (0.00978)
Size	0.0384*** (0.00386)	0.0543*** (0.00447)	-0.435*** (0.0371)
TANG	-0.0589*** (0.0109)	-0.0561*** (0.00783)	0.155 (0.110)
OC	0.00480 (0.00464)	0.0409*** (0.00462)	0.241*** (0.0232)
Constant	-0.197*** (0.0270)	-0.412*** (0.0312)	1.775*** (0.249)
Observations	702	702	702
Number of firms	78	78	78
AR(2) test (p - value)	0.555	0.377	0.265
Hansen test (p - value)	0.415	0.907	0.525

Standard errors in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 5. Descriptions of variable

VARIABLES	Descriptions	Acronyms
Return on assets	The ratio of earnings after interest and tax to total assets	<i>ROA</i>
Return on equity	The ratio of earnings after interest and tax to total equity	<i>ROE</i>
Tobin's Q	The ratio of market capitalization plus the book value of long-term debt to the book value of total assets	<i>Q</i>
Leverage	The ratio of the book value of total debts to book value of total assets	<i>LEV</i>
Size	The natural logarithm of total sales	Size
Tangibility	The ratio between fixed assets and total assets	TAN
Liquidity	The ratio of current assets to current liabilities	LIQ

6. Conclusion

To verify the relationship between the capital structure and corporate performance, we directed an econometric investigation of sample panel data covering the period between 2010 and 2019 for a sample of 780 listed companies in Egypt. On this basis, we used dynamic GMM methods and quadratic regression methods.

The results achieved by these two methods display the existence of an optimal capital structure threshold. This translates into the fact that there is a non-linear relationship amongst debt and the performance of Egyptian companies. Specifically, the negative relationship among the capital structure and the company's operating debt performance as a factor that aggravates the risk of bankruptcy and financial suffering for companies due to asymmetric information. However, this effect diminishes gradually as firms grow, and finally disappears when debt surpasses optimum.

In this case, the debt allows Egyptian companies to profit from tax savings. So it leads them to improve their performance. In this statement, the expectations of **Trade-off theory** fit the Egyptian context. Control variables are also important.

To our information, we can see that the study results obtained by GMM can be considered as the most appropriate method. They confirm the perspective advocated by agency theory and barter theory. In addition, the results of the quadratic regression indicated a non-linear relationship amongst capital structure and profitability (ROA, ROE, and Tobin's Q). These results confirm the results of current studies conducted in developed countries that favoured the application of the barter theory.

In summary, it is recommended that managers of Egyptian firms set an optimal debt threshold. Nevertheless, the determination of this threshold depends on the performance measure chosen, as such a complementarity between the company's performances measures can help in making the right financing decisions. At this stage, it should be noted that the complementarity between the different measures of the performance of the firm should be taken into consideration. To accurately measure performance, accounting indicators (ROA and ROE) should be used to measure past performance. However, market-based indicators (Tobin's Q) should also be quantified to avoid possible performance. In emerging and developing countries, managers **must take into account the stability of the macroeconomic**

environment, In addition, the regulatory authorities must establish fiscal and monetary policies. This would facilitate and help companies to choose an appropriate financing policy by matching the profits and costs of debt.

There are restrictions to this research. Initially, the study is applicable to a single country in an emerging market. Second, when the results of the study are only applicable to large publicly traded companies and companies listed in Egypt, there may be no justification for generalizing outside these limits. More research will be needed to replicate the results in private companies or companies outside of Egypt. Third, the study also excluded the banking and financial industries due to the different regulations and policies that govern these industries, and the study proposes additional years of data and countries in the MENA region to expand the study and provide additional insights into different market responses. The study can also investigate the impact of ownership structure as well as the capital structure, on the company's performance. We focus on high-volume firms and eliminate some industries, providing an opportunity for future investigation to scrutinize the relationship amongst leverage and performance in SMEs and industries excluded from this study.

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