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Investigation of Optimal Capital Structure: A Panel Threshold Regression Analysis over Egyptian Non-Financial Firms

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Abstract:
The purpose of this quantitative research is to investigate whether non-linear effects of capital structure choice on firm value are present for the Egyptian non-financial firms, and if yes, investigate the existence of an optimal capital structure that maximizes firm value.

The authors employ the advanced panel threshold regression developed by Hansen (1999) to investigate the existence of threshold(s) effect of firm leverage on firm value. This estimation technique is superior over the traditional non-linear regressions and has been extensively used to estimate threshold effect in different financial applications.

This research is intended to fill literature gap where there is lack of empirical studies investigating the existence of optimal capital structure in Egypt. Too, inclusion of political uncertainty among controlling variables falls outside the conventional use of firm-specific variables; the action that best suits the Egyptian market that was subject to political changes during the past years. Outcome of this study shall contribute to better understanding of implications of the choice of capital structure as one of the important and complex decisions in finance.

Research results revealed robust, linear and negative effect of firm leverage on firm value in the presence of four controlling variables (firm size, assets growth, sales growth and political uncertainty). Firm value is found to be affected by firm size, assets growth and political uncertainty.

Keywords: Optimal capital structure, Information asymmetry, Political uncertainty, Fixed-effect panel threshold regression, Egypt.

1. Introduction

Capital structure is one of the key areas in finance due to its long term impact on the business success. The choice of the source of finance is always the most important and complex decision for financial managers due to its impact on the firm's cost and availability of capital. By definition, capital structure is the mix of debt and equity a firm chooses to finance its operations. Capital structure is usually referred to as the firm's debt to equity (firm leverage) ratio that provides an insight about the riskiness of the firm and the degree to which the firm is able to meet its obligations. This ratio is commonly considered by investors –along with other ratios- in their assessment of the worthiness of investment in specific firm(s). Optimal capital structure refers to the one that maximizes the value of the firm. Managers who work in the best interest of shareholders employ the various sources of finance to minimize the weighted average cost of capital (WACC) attempting to reach the higher value for the firm at the optimum mix of debt and equity.

Due to its high impact on firms' investment decisions and the success of the firms, capital structure has been a part and a parcel of financial managers' discussions and debates about the key determinants of the capital structure choice and the relevance of the same for the value of the firm. On the theoretical level, there are two classical explanations for capital structure decisions. The static trade-off theory suggests that there is optimal capital structure where firm value increases in response to increasing debts up to a level where bankruptcy cost offsets the benefits of tax deductibility on interest payments. On the contrary, pecking order, market timing and inertia theories promote that optimality doesn't exist, instead firms follow a hierarchal preference of sources of financing that is controlled by information asymmetry. The use of retained earnings resembles the most preferred option where information asymmetry is minimal while equity financing is decided only when it appears more valued by outsiders.

Literature is full of empirical studies that addressed the effect of leverage on profitability of the firms. Some studies simplified the relation by employing linear regression models aiming at concluding the sign of the relationship represented by the regression coefficient (see Asif & Aziz, 2016; Fosuet al., 2016). For the Egyptian non-financial firms, Eldomiaty (2008) concluded negative effect while Ebaid (2009) found weak to no impact. Empirical efforts in this regard have ignored the potential asymmetric non-linearity of the relation that is supported by the static trade-off theory and might result in proving the existence of an optimal capital structure.

In their attempts to verify the static tradeoff theory, some studies investigated the existence of optimal capital structure using non-linear regression in order to prove the inverted u shape of the relationship between firm value and debt ratio (see Yang et al. 2010). Recent studies employed the advanced panel threshold regression technique (Hansen, 1999) that has been proved to be superior over the traditional non-linear regressions as it overcomes the problems of low statistical power and biased parameter estimates(see Ahmad& Abdullah, 2013; Cuong, 2014; Ismail et al., 2014). Non-linear regression model by Hansen (1999) looks for thresholds splitting different regimes where significant changes in slope are detected.

To the authors' knowledge, there is lack of empirical studies that investigate the existence of optimal leverage in Egypt, accordingly this study targets to bridge the literature gap in this regard. Hansen (1999) model is employed in order to analyze the non-linear effect of leverage on profitability where detailed changes can be detected that are relevant to proving the existence of optimal leverage. Beside the firm-specific controlling variables, this study considers the effect of political uncertainty that is believed to be relevant to Egypt due to recent political changes. Too, data collection is designed to include sufficient years of data to capture the effect of 2008 global financial crisis.

Findings of this research shall contribute to better understanding of implications of the choice of capital structure as one of the critical decisions in finance. Analysis over Egyptian non-financial firms revealed that optimal capital structure doesn't exist, instead non-linear effect of leverage on firm value is found negative associated with change in magnitude after threshold value. Firm size, assets growth and political uncertainty proved to impact the value of Egyptian non-financial firms, while sales growth has insignificant impact.

2. Literature Review

Literature review of the capital structure topic revealed plenty of empirical studies that investigated the financing decision of the firms in different contexts. The use of advanced statistical techniques and the inclusion of variables with different proxies have differentiated some studies from others as a result of the continuous research effort and constructive criticism of previous work.

2.1. Capital Structure Theories

About the relevance of the capital structure for the firm value, MM proposition I by Modigliani and Miller (1958) stated that the value of the firm and its weighted average cost of capital (WACC) is independent of the capital structure under the assumption that markets are perfect and frictionless and there is no bankrupt cost, however this is not the case in the real world where firms pay taxes. In 1963,Modigliani and Miller relaxed their assumption and introduced corporate taxes (MM Proposition II).Modigliani and Miller(1963) argued that the benefits of corporate taxes lie in the tax deductibility on interest payments that favors the choice of debt over equity. They concluded that firm value increases in response to the increase in debt ratio and the optimal debt ratio is 100 per cent. Miller(1977) introduced the personal taxes and stated that firm value is relatively affected by personal and corporate taxes.

In 1977,the static trade-off theory is developed by Myers. Myers (1977) claimed that the optimal capital structure exists. Myers argued that firms maximize their value by trading off the benefits and costs of debt. Firms use debt to benefit from the tax deductibility on interest payments until the marginal benefit of debt is offset by the cost of debt represented by the bankruptcy cost in addition to the agency cost. Agency cost appears at high debt ratios where conflicts of interest arise between bondholders and stockholders in financial distress periods.

Agency cost theory introduced the agency cost that arises from the existence of debt and outside equity and proposed that optimal capital structure can be achieved by minimizing the agency cost. Agency cost has been analyzed by Jensen and Meckling (1976). Jensen(1986) argued that managers are likely to go for unsuccessful mergers if they have unused borrowing power and large free cash flows that's why agency cost can be reduced at higher debt ratios. As proposed by Ross (1977), there is an information asymmetry between investors and managers, Ross employed the incentive-signaling approach that suggests that increasing leverage will increase firm value since increasing leverage sends a positive signal to investors and accordingly increases the market's perception of value.

Pecking order theory (information asymmetry theory) (Myers, 1984) suggests that there is no target capital structure due to the existence of information asymmetry. The theory suggests that there is a hierarchical preference of firms for choosing the sources of finance. Firms tend to initially use retained earning where information asymmetry don't exist and then use debts if additional funds are needed and finally issue equity to cover the remaining fund requirements. Myers (1984) argues that debt is preferred over equity as shareholders shall require a higher rate of return because issuance of new equity is usually perceived that the firm is overvalued; accordingly investors will force a lower value to the new equity issuance. The pecking order theory has been highly supported by a lot of studies. Chen et al. (1998) studied 200 Dutch firms for the period from 1984 to 1995 and concluded that Dutch firms seems to prefer to finance their activities through retained earnings instead of issuing debts or equity. Gunay (2002) analyzed 96 Turkish firms for the period from 1991 to 2001 and concluded that Turkish firms are better represented by the pecking order theory and that the static trade off theory is irrelevant. Sen and Oruc (2008) further confirmed the same findings in their study on 75 Turkish firms for the period from 1993 to 2007.Further evidence has been provided by Schoubben and Hulle (2004) that supported the pecking order theory in their analysis of the Belgian firms for the period from 1992 to 2002. Saeed (2007) studied 22 listed companies in the energy sector of Pakistan for the period from 2001 to 2005 and results were confirming the firms' preference toward the use of internal financing over equity and debt issuing.

Some researchers have provided empirical evidences that are not supporting the pecking order theory. Galpin (2004) analyzed firms from the Standard and Poor's compustat database and concluded that the theory is not applicable on the studied sample. Elsas et al. (2006) studied 185 US firms for the period from 1989 to 1999 and concluded that the pecking order and market timing theories apply to the data set but they are transitory. Vasiliou et al. (2009) found that Greek firms (represented by 89 firms) do not follow the pecking

order theory through qualitative questionnaire and quantitative analysis. Theyquestioned the researches that argue that pecking order theory is applicable if leverage is negatively correlated with profitability and recommended future researches in this regard considering that the data set used might not fully represent the order of financing preferences of the firms.For the Egyptian firms, Eldomiatyand Ismail (2005) concluded that capital structure decisions follow the underlying assumptions of both the pecking order and trade-off theories.

Supporting the idea of the non-existence of optimal capital structure, the market timing theory developed by Baker and Wurgler (2002) used an external finance-weighted average of market-to-book ratio in order to capture equity market-timing attempts and concluded that firms slowly adjust toward a target leverage ratio and they only choose equity financing when it appears more valued by financial markets. Too, inertia theory developed by Welch (2004) further supported that firms slowly adjust toward a target leverage ratio as they consider stock price movement prior to deciding to choose equity financing.

Opposing explanations of the different theories trigger the motivation to test the existence of optimal capital structure in Egypt. Existence of optimal leverage is clearly promoted by the static trade-off theory where firms benefit from tax deductibility on interest payments until excessive use of debt induces bankruptcy cost. Pecking order, market timing and inertia theories suggest another explanation based on information asymmetry that drives the capital structure decision in hierarchal preference. The highest preference goes to the source associated with minimal information asymmetry (retained earnings)while equity financing is the last resort. Continuous monitoring of financial markets for the selection of the right timing of equity issuance is intended to overcome/minimize the effect of Information asymmetry.

2.2. The Impact of Firm Leverage on Firm Value

A lot of empirical studies have tackled the impact of capital structure on firms' profitability and concluded mixed results.

Some studies concluded a positive impact of increasing leverage on firm performance. Abor (2005) analyzed five years of Ghanaian Listed companies where short term debts represent 85 per cent of total debts. Aborfound a positive impact of short term and total debt ratios on return on equity (as a proxy for profitability) while the relation is negative between long term debt ratio and return on equity. Chowdhury, A. and Chowdhury, S. (2010)studied 77 companies listed in Bangladesh stock exchange (Dhaka stock exchange and Chittangong stock exchange) and found a positive impact of debt ratio on profitability (represented by share price). Margaritis and Psillaki(2010) studied the French manufacturing firms and concluded that capital structure has a positive impact on profitability. Amarjit et al. (2011) analyzed 272 American listed firms at the New York stock exchange for the period from 2005 to 2007 and found that the capital structure in terms of short and long term debt ratios do impact the firms' profitability with positive relationships. They used the firm size and sales growth as moderating variables in the regression equation. Asifand Aziz (2016) analyzed 20 Pakistan quoted firms representing the cement sector for the period from 2006 to 2015 and concluded that debt ratio has a positive effect of firm value represented by economic value added.

A negative effect of firm leverage on firm performance is reported by some studies. Chiang et al. (2002) found that profitability (represented by profit margins) is affected negatively by leverage ratio for 18 developers and 17 contractors from Hong Kong.Oyesola and Awolowo (2009) studied 50 non-financial listed Nigerian firms for the period from 1990 to 2004 and found a positive impact of short term debt ratio on profitability while total debt ratio shows a negative impact on profitability.Soumadi and Hayajneh (2012) studied 76 listed Jordanian firms for the period from 2001 to 2006. They concluded that leverage affects performance negatively. They also concluded that high financial leverage firms behave the same way like the low financial leverage firms in terms of the leverage impact on performance. They observed as well that there is no significant difference between high growth firms and low growth firms in the context of the impact of leverage on performance.Leon (2013) investigated 30 listed firms in Sri Lanka for the period from 2008 to 2012. He concluded that leverage impacts significantly the return on equity negatively while no relationship is detected between leverage and return on assets.A recent study by Fosu et al. (2016) analyzed the effect of information asymmetry and firm leverage on firm value of UK firms for the period from 1995 to 2013. They concluded that firm leverage impacts firm value negatively. They also concluded that information asymmetry has a negative effect on firm value and that this effect decreases as firm leverage increases.

Couple of studies analyzed the firm leverage-firm performance relationship in Egypt. Eldomiaty (2008) analyzed 99 Egyptian non-financial firms for the period from 1998 to 2004 and concluded a negative effect of debt ratio (measured as the total debts divided by total assets) on market value of the firm. Ebaid (2009) studied the non-financial Egyptian firms for the period from 1997 to 2005 and found that capital structure decision has weak to no impact on firm performance expressed by return on equity, return on assets and gross profit margin. Appendix 1 summarizes the results of the empirical studies that investigated the impact of leverage on profitability.

As mentioned earlier, the above studies simplified the impact of firm leverage on firm value in linear models ignoring the potential asymmetric non-linearity of the relationship; accordingly researches started to investigate the potential non-linearity in different contexts (discussed in the next section).

2.3. Existence of Optimal Capital Structure

Following the opposing implications of the different theories of capital structure, empirical studies have shown mixed results about non-linearity of the impact of capital structure on firm value as well as the existence of optimality.

Yang et al. (2010) analyzed 37 firms in Taiwan for the period from 1987 to 2007 and proved the inverted u shape of the relationship between firm value and debt ratio. They used return on equity as a proxy for the firm value and debt to equity ratio as a proxy for the debt ratio. They used non-linear regression (quadratic function) to investigate the existence of optimal capital structure. Regression analysis showed that the capital structure at which the firm value is maximum equals to 34.31 per cent.

The advanced panel threshold regression (Hansen, 1999) is widely employed to test the threshold effect of leverage on firm value based on the number of thresholds and patterns of the different regimes of the relationship. Results were mixed, some studies proved the existence of optimality (Cuong, 2014; Ismail et al., 2014) while others concluded the non-linear effect but patterns don't resemble optimal leverage (Feng & Chang, 2011; Ahmad& Abdullah, 2013).

Neih and Lu (2004) concluded that optimal capital structure exists at 21.65 per cent in their study on 821 A-shares of Chinese listed firms for the period from 1998 to 2002. They further concluded that triple threshold exists between debt ratio and firm value at 21.65 per cent, 35.05 per cent and 51.93 per cent where four regimes are detected all with positive but decreasing slopes that indicate that the benefits of debt decrease as leverage ratio increases. Chenget al. (2010) provided further evidence over 650 A-shares of Chinese listed firms for the period from 2001 to 2006 and concluded that optimal capital structure exists at 70.48 per cent for. They used firm size, sales growth and assets growth as controlling variables. Findings revealed triple thresholds shaping four regimes, two of which have positive slopes in a decreasing pattern, the last two have negative slopes in a decreasing pattern. Cuong (2014) studied 92 Vietnam's seafood processing enterprises for the period from 2005 to 2011 and concluded that optimal capital structure exists at 57.93 per cent. He used return on equity and BVE (Book Value of Equity + Long term Debt) as proxies for firm value and included firm size and sales growth as control variables. Two thresholds are detected when firm value is represented by return on equity that results in three regimes (first regime is showing positive coefficient while the other two regimes are negative with decreasing slopes). When firm value is represented by BVE, three thresholds are detected (first regime is showing positive coefficient while the other three regimes are negative with decreasing slopes). Finally, Ismail et al. (2014) analyzed 46 textiles Pakistan listed firms for the period from 2007 to 2012 and concluded the existence of optimal leverage in three thresholds relationship. Ismail, A., et al. used firm size, sales growth and market value to book value of equity as controlling variables. They used Tobin's Q as a proxy for firm value. Results showed first three regimes with positive coefficients and varying slopes while the last regime shows negative coefficient however, only second and last regimes' coefficients are significant.

Couple of studies found that optimal leverage doesn't exist. Nieh et al. (2008) studied 143 electronics listed companies in the Taiwan stock exchange for the period from the first quarter of 1999 to the third quarter of 2004. They used return on equity and earnings per share as proxies for firm value. Results using earnings per share showed insignificant threshold that failed to prove non-linearity. Using return on equity, optimality is not proved where single threshold effect is significant but coefficient of first regime is insignificant. Feng and Chang (2011) studied 196 Taiwanese listed companies for the period from 1993 to 2005. They employed firm size, sales growth, age of the firm, risk and industry average as controlling variables and used Tobin's Q as a proxy for firm value. Results of panel threshold regression revealed two thresholds at 9.86 per cent and 33.33 per cent where first two regimes are positive while the last regime is insignificant. Accordingly, optimal leverage is not concluded yet the relationship is non-linear. Similar findings are concluded by Ahmad and Abdullah (2013) who examined the 467 Malaysian listed firms for the period from 2005 to 2009. They included asset growth, sales to income growth and market value to book value of equity as controlling variables. They found single threshold effect of firm leverage on firm value (represented by return on equity) at firm leverage equals to 64.33 per cent. They further concluded decreasing slopes but the slope of the second regime is insignificant indicating that there is no relationship in the second regime. Appendix 2 summarizes the results of the empirical studies that investigated the existence of optimal capital structure.

2.4. The Effect of Political Uncertainty

Impact of political uncertainty on the capital structure decision and profitability has been extensively researched. Desai et al. (2008) studied a panel of data for US firms doing abroad direct investment for the period from 1982 to 1999 based on the annual survey of the Bureau of Economic Analysis. They concluded that US firms decreases their leverage in countries with high political risk. They measured the political risk based on the international country risk guide (ICRG). Durnev (2010) studied 47808 firms from 79 countries for the period from 1980 to 2006 and concluded that election uncertainty significantly reduces firm performance due to inefficient capital allocation. He explained the reason behind the decline in profitability is the reduction in the amount of information contained in the prices of stocks due to election uncertainty. Julio and Yook (2012) found that political uncertainty affects the firms' investment decisions negatively. Pastor and Veronesi (2013) concluded that political news that result in high political uncertainty result in an increase in risk premium, they further concluded that the increase in risk premium in weak economic conditions is higher than in good economic conditions.

In his study of the impact of political uncertainty in the period of Australian federal election on the market uncertainty, Smales (2014) concluded that high political uncertainty results in a decline in the issuance of government debts, a decrease in the levels of outstanding debts decline, decreasing demand on debt issuance and demanding higher yields. Chau et al. (2014) studied the effect of political uncertainty due to recent revolutions in the Arab region on the stock market volatility in the MENA region. They found that market volatility increased especially the Islamic indices due to recent revolutions. Francis et al. (2014) concluded that the cost of debt increases in response to policy uncertainty. They quantified the impact that 11.90 basis points of additional spread are experienced by firms that are exposed to one standard deviation increase in political exposure. Furthermore they concluded that policy uncertainty significantly decreases the speed of adjustment towards target leverage. Finally, Waisman et al. (2015) analyzed the relationship between political uncertainty of US presidential elections and corporate bond spread and found that spread of corporate bonds increased by 34 basis points.

The role of financial institutions has been also studied recently. Gul et al. (2015) concluded that countries that have strong political rights experience negative relation between dividends and stock markets liquidity. Boubakri et al. (2015) studied 31 countries and concluded that due to agency problems in politically connected firms, they hold more cash in comparison to non-connected firms.

Due to the presented effect of political uncertainty on firm performance and capital structure decisions, the political dimension is considered in this research in controlling the relationship under study.

3. Data and Variables

3.1. Data Collection and Period of Study

As proposed by Hansen (1999) and illustrated by Wang (2015), panel threshold regression requires balanced panel data, that is all included variables have to be measured for all companies in all years. Financial data are collected for all non-financial companies (194 companies) listed in the Egyptian stock exchange, but missing values are detected for some companies and in some years. In order to satisfy the balanced panel data condition, the authors selected all possible non-financial companies with non-missing data for the longer possible period in an attempt to cover all political and macroeconomic events (Egyptian revolution and 2008 global financial crisis). This revealed 67 non-financial companies listed in the Egyptian stock exchange for the period from 2003 to 2014 resembling 804 observations. The 67 non-financial companies represent 35 per cent of all non-financial listed firms and provide a good representation of the non-financial sector. Out of the selected 67 non-financial companies, 12 are included in EGX30 index that contains top 30 companies in terms of liquidity and activity, representing 50 per cent of all included non-financial companies in the index. The sample also includes 35 non-financial companies in the EGX100 index, representing 42 per cent of all included non-financial companies in the index. The selection also covers the different non-financial sectors (as shown in figure 2) in reference to the Egyptian exchange sector index that tracks the different sectors in the Egyptian market.
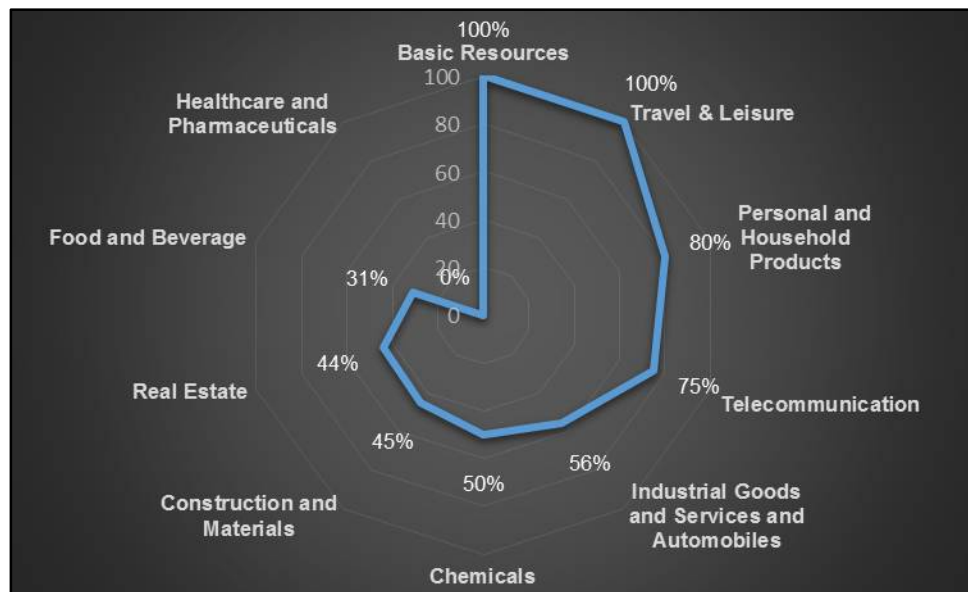

Figure 1: Distribution of the sample in terms of percentage covered for each sector
Source: Prepared by the authors.

3.2. Variables and proxies

Optimal leverage as proposed by the static trade-off theory exists at a point where extra use of debts doesn't add to the firm value, or in other words induces bankruptcy cost that is no more weighted by the benefits of tax deductibility on interest payments. Accordingly, testing the existence of optimal leverage requires analyzing the non-linear relationship of firm leverage effect on firm value.

In order to provide the best representation of the variability in the dependent variable (firm value) in response to the threshold effect of firm leverage, the authors study the most employed set of controlling variables (firm size, assets growth and sales growth) as reviewed in literature(see Cheng et al., 2010; Ahmad& Abdullah, 2013; Cuong, 2014).Political uncertainty effect is also considered among controlling variables in anticipation of its potential effect on the value of Egyptian firms in response to the witnessed political changes that faced Egypt in the past years. The below chart depicts the trend of Egypt's ICRG (international country risk guide) – political index. This index has been widely used in literature to measure political uncertainty especially by IMF researchers.

Figure 2: Trend of Egypt's ICRG-political index
Source: www.prsgroup.com

Couple of declines in Egypt's ICRG-political index is noticed. One major decline on 2011,that is believed to be due to Jan 25th revolution. Sowers and Toensing (2012) stated that 2011 witnessed the beginning of political and social major restructuring in Egypt. Another decline is noticed on 2007in response to labor strikes. Beinin and El-Hamalawy(2007) described the strike as the longest and strongest wave of worker protest in Egypt.

Financial ratios are formulated to represent variables under study based on available financial data from financial statements for non-financial companies for the period from 2003 to 2014. Construct validity is secured through choosing proxies to measure variables that are supported by literature (as mentioned in the below table) and can be collected reliably from financial disclosed data.

Variable	Proxy	Empirical Support
Firm Value	Net income to total assets	Neih and Lu (2004) and Oyesola and Awolowo (2009)
Firm Leverage	Book value of total debts over total assets	Cuong (2014) and Ismail et al. (2014)
Firm Size	Natural log of total assets	Cheng et al. (2010) and Cuong(2014)
Assets Growth	Annual percentage change in total assets	Cheng et al. (2010) and Ahmad and Abdullah (2013)
Sales Growth	Annual percentage change in net sales	Cheng et al. (2010) and Cuong(2014)
Political Uncertainty	ICRG-Political Index	Desai et al. (2008)

Table 1: Used proxies for variables under study.

4. Research Methodology
In order to investigate the existence of optimal capital structure and to ensure high internal validity, the authors employ the advanced panel threshold regression developed by Hansen (1999) that has been extensively used in literature to estimate the thresholds of the different regimes for non-linear relations (see Yang et al., 2010; Cheng et al., 2010; Feng& Chang, 2011; Ahmad& Abdullah, 2013; Cuong, 2014; Ismail et al., 2014).

4.1. Panel Threshold Regression: Methodology and Applications
Since developed, Hansen (1999) model has been widely used to estimate the thresholds of the different regimes for non-linear relations. This model is superior over the traditional non-linear regressions as it overcomes the problems of low statistical power and biased parameter estimates.

Panel threshold regression partitions the non-linear curve into a set of linear lines (as shown in figure 4). The proposed regression steps detect changes in the slopes of the linear lines and accordingly define the different regimes. Panel threshold regression would be similar to the ordinary linear model if the threshold value is known. Since threshold value is unknown, nuisance parameter problem is introduced that makes the threshold's estimator distribution nonstandard (see Wang, 2015). To overcome this problem, Hansen (1999) recommended the bootstrap method to test the significance of the threshold effect where the constructed p-values from bootstrap are asymptotically valid (Hansen, 1996). Bootstrap is recommended using cluster resampling with replacement.

Hansen(1999) model has been repeatedly used in many financial studies that require an identification of the borders between different regimes in non-linear relations. For example, the impact of ownership concentration on the firm value (Feng& Chang, 2008) and the analysis of the non-linear relationship between tourism and economic growth (Chang et al., 2010).
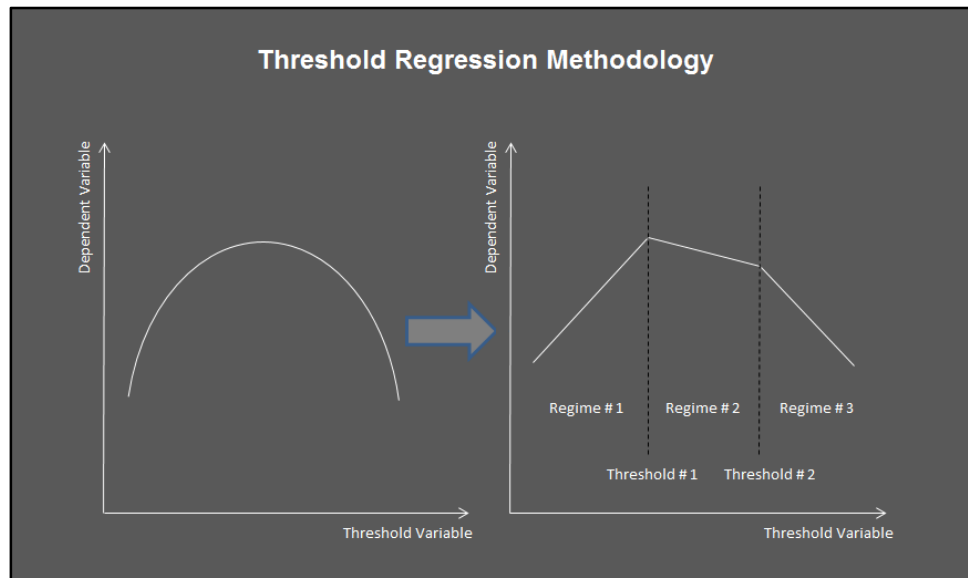
Figure 3: Threshold regression methodology.
Source: Prepared by the authors.

4.2. Model Specifications
The effect of capital structure on firm value can be expressed in single threshold regression as follows:

$$FV_{it} = \begin{cases} \mu + \beta1\ FL_{it} + \theta1\ FS_{it} + \theta2\ AG_{it} + \theta3\ SG_{it} + \theta4\ PU_t + \varepsilon_{it}\ (FL_{it} \leq \gamma) \\ \mu + \beta2\ FL_{it} + \theta1\ FS_{it} + \theta2\ AG_{it} + \theta3\ SG_{it} + \theta4\ PU_t + \varepsilon_{it}\ \ (FL_{it} > \gamma) \end{cases} \quad (1)$$

Where,
FV_{it} is firm value (the dependent variable).
FL_{it} is firm leverage (the threshold variable).
FS_{it} is firm size (controlling variable).
AG_{it} is assets growth (controlling variable).
SG_{it} is sales growth (controlling variable).
PU_t is political uncertainty (controlling variable).
μ is a given fixed effect used to grasp the heterogeneity of different firms under different operating conditions.
γ is the hypothesized specific threshold value.
$\beta1$ is the threshold coefficient when the threshold value is lower than γ.
$\beta2$ is the threshold coefficient when the threshold value is higher than γ.
$\theta1$ represents the coefficient estimate of firm size.
$\theta2$ represents the coefficient estimate of assets growth.
$\theta3$ represents the coefficient estimate of sales growth.
$\theta4$ represents the coefficient estimate of political uncertainty.
ε_{it} is the process of white noise.
i represents different firms and **t** represents different periods.

4.3. Dependent Variable: Firm Value (FV)
Firm value and profitability have been of interest for researchers who studied profitability as one of the determinants of capital structure while other studies considered the reverse way of the relation in their studies for the impact of capital structure on firm performance. Some researches considered return on equity to represent the firm value and profitability (see Yang et al., 2010; Cuong, 2014) while others used return on assets(see Flannery& Rangan, 2005; Ebaid, 2009). Couple of studies added earnings per share and Tobin's Q for further evidence on concluded results (Feng& Chang, 2011; Ismailet al., 2014).
The proxies used to represent the profits are different as well where Chiang et al. (2002) and Ebaid (2009) used Profit Margin, Amarjit et al. (2011) used earnings before interest and taxes (EBIT)/total equity and Neih and Lu (2004) and Oyesola and Awolowo (2009) used net income/total assets. The choice is mainly based on the scope of the research; researches that used EBIT are primarily addressing the impact of leverage on the profitability of firms while researches that targeted to test the static trade-off theory intentionally used net income in order to count for the effect of tax deductibility on interest payments. The authors use return on assets (as the ratio of net income to the total Assets) as proxy for firm value following Neih and Lu (2004) and Oyesola and Awolowo (2009).

4.4. Threshold Variable: Firm Leverage (FL)

Capital structure has been used with various proxies in different contexts in literature. Too, there are some debates around the use of the book or market values of the debt ratio and the use of the different leverage ratios to proxy for the firm's leverage. Most of the empirical studies have used the book value of debt ratio like the recent one by Ismail et al. (2014). Myers (1977) supported the argument of using the book value of debt as it is related to the value of assets in place while Taggart (1977) found that there is very little to choose between book and market value formulations.

Debt to equity ratio has been used by couple of studies (see Eldomiaty& Azim,2008; Yang et al., 2010) while debt to assets ratio has been used more frequent (see Yang et al.,2010; Cheng et al., 2010) while Eldomiaty and Azim (2008) studied the short and long term debt to equity ratios separately.

The authors use the book value of total debts over total assets, the proxy that has been widely used in literature(Ahmad& Abdullah, 2013; Cuong, 2014; Ismailet al., 2014).

4.5. Controlling Variables

In the context of investigating the existence of optimal capital structure, firm size has been one of the most studied controlling variables. The results of the effect on firm value are mixed. Cheng et al. (2010) and Feng and Chang (2011) reported negative effect of firm size on firm value. On the other side, Cuong (2014) and Ismail et al. (2014) concluded positive effect confirming the claim of Abor (2005) that large size firms record higher profitability than small size firms.

Another key controlling variable is the assets growth. Firms that have higher growth in assets enjoy higher profitability (Abor, 2005). Nieh et al. (2008), Cheng et al. (2010) and Ahmad and Abdullah (2013) employed assets growth as one of the controlling variables and concluded positive effect, however Nieh et al. (2008) concluded insignificant effect when return on equity is used as a proxy for firm value while effect was positive when earnings per share is used. Growth in sales has been also employed by some studies due to its effect on firm value. Nieh et al. (2008), Cheng et al. (2010), Feng and Chang (2011) and Ismail et al. (2014) reported positive effect indicating that growing firms in term of sales are profitable while Cuong (2014) reported insignificant effect on firm value represented by return on equity and BVE. Finally, political uncertainty impacts firm value negatively (see Durnev, 2010; Julio& Yook, 2012). In Egypt, uncertainty is expected to impact firm value due to the presented decline in ICRG-political index in figure 2.

4.6. Research Hypotheses

The authors formulate the below hypotheses to test the existence of threshold effect that implies non-linearity of the relationship between firm value and firm leverage. In case non-linearity is proved, existence of optimal capital structure is then decided based on the analysis of slopes of the different regimes of the panel threshold regression.

- Ho: Threshold effect doesn't exist in the effect of firm leverage on firm value.
- Ha: Threshold effect exists in the effect of firm leverage on firm value.

In case single threshold is found statistically significant, the authors conduct the same analysis to test the existence of double thresholds as depicted in equation # 2 and triple thresholds in equation # 3.

$$FV_{it} = \begin{cases} \mu + \beta1\ FL_{it} + \theta1\ FS_{it} + \theta2\ AG_{it} + \theta3\ SG_{it} + \theta4\ PU_t + \varepsilon_{it} & (FL_{it} \le \gamma1) \\ \mu + \beta2\ FL_{it} + \theta1\ FS_{it} + \theta2\ AG_{it} + \theta3\ SG_{it} + \theta4\ PU_t + \varepsilon_{it} & (\gamma1 < FL_{it} \le \gamma2) \\ \mu + \beta3\ FL_{it} + \theta1\ FS_{it} + \theta2\ AG_{it} + \theta3\ SG_{it} + \theta4\ PU_t + \varepsilon_{it} & (FL_{it} > \gamma2) \end{cases} \quad (2)$$

$$FV_{it} = \begin{cases} \mu + \beta1\ FL_{it} + \theta1\ FS_{it} + \theta2\ AG_{it} + \theta3\ SG_{it} + \theta4\ PU_t + \varepsilon_{it} & (FL_{it} \le \gamma1) \\ \mu + \beta2\ FL_{it} + \theta1\ FS_{it} + \theta2\ AG_{it} + \theta3\ SG_{it} + \theta4\ PU_t + \varepsilon_{it} & (\gamma1 < FL_{it} \le \gamma2) \\ \\ \mu + \beta3\ FL_{it} + \theta1\ FS_{it} + \theta2\ AG_{it} + \theta3\ SG_{it} + \theta4\ PU_t + \varepsilon_{it} & (\gamma2 < FL_{it} \le \gamma3) \\ \mu + \beta4\ FL_{it} + \theta1\ FS_{it} + \theta2\ AG_{it} + \theta3\ SG_{it} + \theta4\ PU_t + \varepsilon_{it} & (FL_{it} > \gamma3) \end{cases} \quad (3)$$

5. Empirical Results

5.1. Descriptive Analysis

The following table summarizes descriptive parameters of variables under study. Mean value of profitability is 0.05 indicating that non-financial firms record on average a net income of 5 per cent of total assets. Mean value of firm leverage shows 0.21 indicating that firms finance their assets with 21 per cent of total assets from debts. Annual growth in assets and sales are on average 12 per cent and 29 per cent respectively.

Variable	Obs	Mean	Std. Dev.	Min	Max
Firm Value	804	0.05	0.08	-0.38	0.7
Firm Leverage	804	0.21	0.17	1.00E-07	0.72
Firm Size	804	13.6	1.64	10.31	18.37
Assets Growth	804	0.12	0.37	-0.55	5.04
Sales Growth	804	0.29	1.6	-0.95	26.31
Political Uncertainty	804	0.5	0.04	0.44	0.55

Table 2: Summary of descriptive parameters

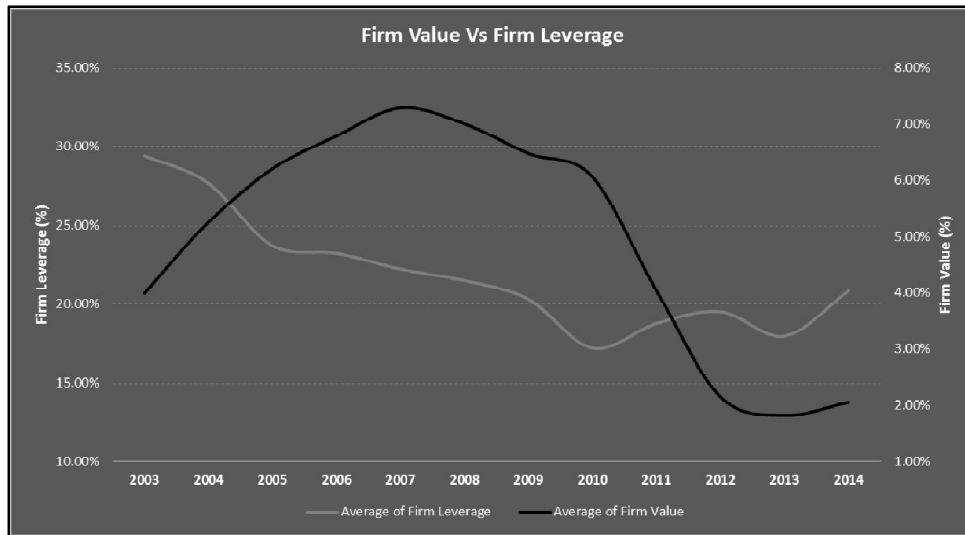The following chart shows trend of mean of firm value vs firm leverage that is showing opposing trends.

Figure 4: Firm value vs firm leverage
Source: Prepared by the authors.

Figure 5 depicts trend of mean of firm value vs ICRG-political index. Two declines for firm value are noticed. One major decline is associated with sharp decline in the ICRG-political index of Egypt in response to Jan 25th revolution on 2011 (see Durnev, 2010; Julio& Yook, 2012). Another decline is seen on 2008 that can be due to the global financial crisis (Dekle& Hoontrakul, 2004).
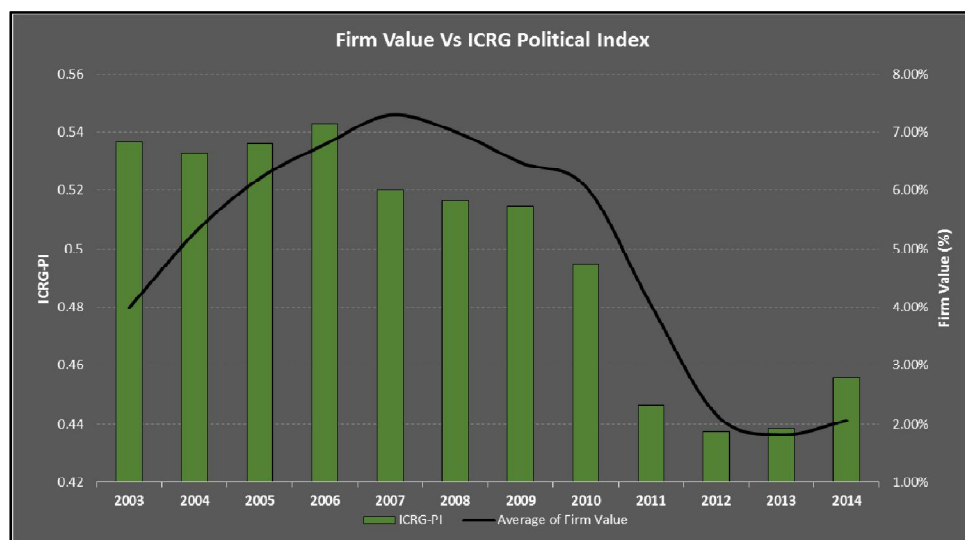

Figure 5: Firm value vs ICRG-political index
Source: Prepared by the authors.

5.2. Testing the Existence of Single Threshold
This research employs fixed effects estimation techniques. Fixed effects seems more appropriate as data collection process relies on balance sheets and financial statements of firms under study, while random effects usually fits studies that involve unobserved heterogeneity. As discussed by Green and Tukey (1960), one major distinction between fixed and random effects has to do with sample size. They argued that the larger the sample with respect to the population, the more appropriate to use fixed effects. Reflecting this to research settings, sample representation of the population is relatively high and would also improve by using bootstrapping in the part investigating the existence of optimal leverage. Hausman test is used to support the choice of fixed effects estimation.

The below table depicts the results of Hausman test. Results reject the null hypothesis that difference in coefficients is not systematic, accordingly fixed effects estimation can be used.

chi2(5)	Prob>chi2
16.96	0.0046

Table 3: Results of Hausman test.

xthreg command is employed following Wang (2015) with 500 bootstraps. Results of single threshold estimator (reported in table 4) show that Fstat = 11.59 indicating that single threshold does not exist at 5 per cent significance level; accordingly the authors failed to reject the null hypothesis Ho of the linear relationship.

Threshold Estimate			Models Stats				
Threshold Value	Lower	Upper	Fstat	Prob	Crit10	Crit5	Crit1
0.17	0.15	0.18	11.59	0.236	14.76	17.87	25.08

Table 4: Results of single threshold estimation at 0.95 confidence interval.

Regression coefficients are then analyzed for further explanation of the relationship as presented in table 5.

Dependent Variable ''Firm Value''		Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
Threshold Variable ''Firm Leverage''	1st Regime ($\beta 1$)	-0.4	0.06	-6.36	0.000	-0.51	-0.27
	2nd Regime ($\beta 2$)	-0.22	0.02	-11.67	0.000	-0.26	-0.19
Controlling Variables	Firm Size ($\theta 1$)	0.02	0.005	3.51	0.000	0.008	0.03
	Assets Growth ($\theta 2$)	0.02	0.006	3.26	0.001	0.008	0.03
	Sales Growth ($\theta 3$)	0.001	0.001	1.24	0.214	-0.0009	0.004
	Political Uncertainty ($\theta 4$)	0.7	0.07	10.61	0.000	0.57	0.83

Table 5: Results of regression coefficients

Analysis of the regression coefficients reveals that all controlling variables significantly affect firm value except sales growth that is showing insignificant coefficient. Results also show that firm leverage affects firm value negatively (threshold effect is not significant though).

5.3. Robustness Check
In order to reach robust and consistent conclusion, the authors run non-linear regression for the effect of firm leverage on firm value in the presence of the same four controlling variables. Non-linear regression is run to check for quadratic and cubic effects.

The following table summarizes the results of third degree polynomial non-linear regression.

Dependent Variable ''Firm Value''	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
Firm Leverage^3	-0.33	0.42	-0.78	0.433	-1.165	0.5
Firm Leverage^2	0.37	0.38	0.98	0.329	-0.38	1.13
Firm Leverage	-0.3	0.1	-3.12	0.002	-0.49	-0.11
Firm Size ($\theta 1$)	0.01	0.003	3.88	0.000	0.006	0.02
Assets Growth ($\theta 2$)	0.02	0.006	3.58	0.000	0.01	0.03
Sales Growth ($\theta 3$)	0.001	0.001	1.06	0.289	-0.001	0.004
Political Uncertainty ($\theta 4$)	0.64	0.06	10.86	0.000	0.53	0.76
_cons	-0.39	0.06	-6.38	0.000	-0.51	-0.27

Table 6: Results of non-linear regression

Results reveal that neither cubic nor quadratic effect of firm leverage is significant. Consistent with the results of panel threshold regression, coefficient of the linear effect of firm leverage is significant and negative. Results related to the effects of controlling variables are also consistent with those from panel threshold regression.

6. Discussion of Findings
Implementation of fixed effect panel threshold regression over 67 non-financial listed companies revealed that threshold effect of firm leverage on firm value in the presence of four controlling variables (firm size, assets growth, sales growth and political uncertainty) is not significant. Robustness check is carried out using non-linear regression where results provided consistent conclusion about the linear effect of firm leverage on firm value and cleared any doubts about existence of non-linear patterns. Accordingly, the researcher failed to reject the null hypothesis Ho1 of the linear relationship.
The concluded linear and negative effect don't support the existence of optimal capital structure as proposed by the static tradeoff theory. Instead, the results support the pecking order theory (Myers, 1984) that suggests that existence of information asymmetry drives a hierarchical preference of firms for choosing the sources of finance, firms tend to initially use retained earning where information asymmetry don't exist and then use debts if additional funds are needed and finally issue equity to cover the remaining fund requirements. The negative effect of information asymmetry on firm value has been concluded empirically by Fosu et al. (2016) over UK firms.

The concluded negative effect of firm leverage on firm value supports the results of Eldomiaty (2008) in the Egyptian context and studies by Chiang et, al. (2002), Oyesola and Awolowo (2009), Soumadi and Hayajneh (2012) and Fosu et al. (2016) in different markets, however this research provided further evidence as it employed the fixed effect panel threshold regression to count for the potential asymmetric non-linearity of the relationship that has been overlooked by these studies that employed linear regression models. Among the studies that employed fixed effect panel threshold regression, Nieh et al. (2008) concluded similar results that don't support the existence of optimal leverage when EPS is used as proxy for firm value.

Couple of theories also supported the idea of the non-existence of optimal capital structure. The market timing theory developed by Baker and Wurgler (2002) concluded that firms adjust toward a target leverage ratio and they only choose equity financing when it appears more valued by financial markets. Too, inertia theory (Welch, 2004) further supported that firms adjust toward a target leverage ratio as they consider stock price movement prior to deciding to choose equity financing.

As presented in table 5, coefficients of firm size ($\theta 1$) and assets growth ($\theta 2$) are 0.02 indicating positive and significant effect on firm value; the results that are consistent with results of studies by Cheng et al. (2010), Ahmad and Abdullah (2013) and Cuong (2014). Coefficient of sales growth ($\theta 3$) is found positive and insignificant indicating that growth rate of sales doesn't impact firm performance; same results are concluded by Cuong (2014). Finally, coefficient of ICRG-political index ($\theta 4$)is 0.7and significant indicating a negative effect of political uncertainty on firm value as concluded by Durnev (2010) and Julioand Yook (2012). The concluded negative effect is also emphasized by the trend of firm value vs ICRG-political index presented in figure 6 that is showing a major decline in firm value associated with a sharp decline in the ICRG-political index of Egypt in response to Jan 25th revolution on 2011.

7. Conclusion

Investigation of the effect of capital structure choice on the value of Egyptian non-financial firms in a fixed effect panel threshold regression revealed robust, linear and negative effect of firm leverage on firm value. As proposed by the pecking order theory Myers (1984), the existence of information asymmetry can explain the concluded negative effect of debt on profitability of the firms. Accordingly, it can be concluded that there is no optimal target leverage ratio as explained by the static tradeoff theory, instead firms choose equity financing based on stock price movement (inertia theory by Welch (2004)) and choose equity financing when it appears more valued by financial markets (market timing theory by Baker and Wurgler (2002)).

In regards to controlling variables, it has been concluded that firm size, assets growth and political uncertainty impact the value of Egyptian non-financial firms, while sales growth has insignificant impact. Evidence from this research highly supports the inclusion of political uncertainty among controlling variables affecting firm value; the action that best suits the Egyptian market that was subject to political changes during the past years.

8. Practical Implications and Recommendations

Capital structure is one of the complex decisions firm managers can take due to its long term implications on the firms' success. Understanding implications of capital structure choice on business profitability is beneficial for managers that shall guide them to secure the optimum and appropriate capital structure decisions of financing their operations considering all other relevant factors.

Inspired from the findings of this research, the below recommendations are formulated:

1. Managers need to consider wisely the choice of capital structure due to its proven impact on the Egyptian non-financial firms' value. Based on the concluded negative and significant impact of firm leverage on the profitability of the Egyptian non-financial firms, managers need to favor equity over debt financing as long as information asymmetry is controlled. Too, changes in firm value need to be closely monitored and periodically correlated with changes in firm-specific determinants and the country's overall political situation.
2. Results of this research promoted that pecking order theory tends to explain the leverage effect on firm value, accordingly implications of the theory would shape the below recommendations:
   - Firms need to fully utilize retained earnings before issuing debts.
   - Firms need to adopt cost efficient strategies that overcome/reduce information asymmetry between managers and investors.
3. Evidence from this research is consistent with the implications of the market timing and inertia theories, accordingly it is recommended for firms to regularly study market conditions to select the right timing of issuing equity.

9. Future Work

Further evidence about concluded results on the different industries/sectors would be potential for future work due to potential differences between sectors, however the Egyptian context is challenging in this regard where the listed non-financial companies are almost evenly distributed in each industry. This can hardly satisfy the preliminary requirements of the panel threshold regression that requires balanced data, i.e. any missing value would either delete the corresponding year from all companies or delete all year's data for the company itself. This requirement shall lessen the number of observations dramatically that wouldn't be appropriate to represent the industry under study. Data fitting techniques and grouping relevant industries might be helpful to maximize dataset size in an attempt to satisfy balanced data requirement.

Capital structure of banks and non-financial firms are significantly different due to the fact that banks have to follow some rules and regulations that protect their financial position from instability. One of these strict regulations is the minimum capital requirement that is highly required for deposit insurance. Banks do not enjoy the luxury of choice between debts and equity, instead they have to rely

more on debts in order to avoid violating the minimum capital requirements. A recent study by Ukaegbu, B. and Oino, I. (2014) analyzed the differences between the non-financial firms and financial banks in Nigeria and concluded significant differences between the two groups. They concluded that non-financial firms are likely to follow the pecking order theory since leverage is negatively impacted by profitability, while banks tend to be more leveraged when they are profitable following the trade-off theory. Further empirical researches on banks and financial firms would reveal different evidence for emerging markets and can be good topic for future work.

Egypt has witnessed significant changes in the fiscal policy where currency devaluation took place early 2015 over small steps (managed floating) followed by fee floating decision on November 2015. Currency devaluation usually involves wide and diverse effects over different economic disciplines (foreign direct investment, trading behavior, exports/imports imbalance) while the effect on the stock market remains the most timely and apparent one. Investigations of the dynamics of capital structure and its effect on value of the firms resemble a research topic that would be highly demanded in the after-devaluation period.

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Appendix 1

Summary of the results of the empirical studies that investigated the impact of leverage on profitability.

Study	Firms Under Study	Used Proxy for Profitability	Concluded Impact
Chiang et, al. (2002)	18 developers and 17 contractors from Hong Kong	Profit margin	Negative
Abor (2005)	Ghanaian Listed Companies	ROE	Positive
Eldomiaty (2008)	99 Non-financial Egyptian Firms	Market value of the firm	Negative
Ebaid (2009)	Non-financial Egyptian Firms	ROE, ROA, and gross profit margin	Weak to no impact
Oyesola and Awolowo (2009)	50 non-financial listed Nigerian Firms	Net income/total assets	Negative
Chowdhury A. and Chowdhury S. (2010)	77 companies listed in Bangladesh	Share price	Positive
Margaritis and Psillaki (2010)	French manufacturing firms	EBIT/total assets	Positive
Amarjit et al. (2011)	272 American listed firms at the New York Stock Exchange	EBIT/total equity	Positive
Soumadi and Hayajneh (2012)	76 listed Jordanian firms	ROE	Negative
Leon (2013)	30 listed firms in Sri Lanka	ROE and ROA	Negative impact on ROE and no impact on ROA
Asif and Aziz (2016)	20 Pakistan quoted firms	EVA	Positive
Fosu et al. (2016)	UK firms	Market value of assets/book value of assets	Negative

Appendix 2

Summary of the results of the empirical studies that investigated the existence of optimal capital structure.

Study	Firms under Study	Number of Thresholds	Pattern of Coefficients	Implications on the existence of optimality
Neih and Lu (2004)	821 A-shares of Chinese Listed firms	Triple	Four positive coefficients with decreasing slopes.	Optimal capital structure exists at 21.65 per cent, after which debt ratio still impacts firm value positively but with lesser gain
Nieh et al. (2008)	143 electronics listed companies in the Taiwan Stock Exchange	No threshold when EPS is used as proxy for firm value and single threshold when ROE is used	Using ROE, two negative coefficients in a decreasing pattern (-0.01 and -0.08) but first coefficient is insignificant.	Failed to prove non-linearity using EPS. Relationship is non-linear but optimality is not proved using ROE.
Cheng et al. (2010)	650 A-shares of Chinese listed firms	Triple	Two positive coefficients in a decreasing pattern followed by two negative coefficients in a decreasing pattern.	Optimal capital structure exists at 70.48 per cent.
Yang et al. (2010)	Taiwan 50 and Mid-Cap 100	N/A	Inverted U-shape relationship.	Optimal capital structure exists at 34.31 per cent.
Feng and Chang (2011)	196 Taiwanese listed companies	Double	Two positive coefficients in a decreasing pattern followed by insignificant relationship.	Relationship is non-linear but optimality is not proved.
Ahmadand Abdullah(2013)	Malaysian Listed Firms	Single	Two positive coefficients in a decreasing pattern. Second coefficient is insignificant indicating no impact after 64.33 per cent.	Relationship is non-linear but optimality is not proved.
Cuong(2014)	92 Vietnam's seafood processing enterprises	Double thresholds using ROE as proxy for firm value and triple thresholds using BE	First regime is positive sloped while the rest are negative sloped in an increasing pattern.	Optimal capital structure exists at 57.93 per cent.
Ismail et al. (2014)	46 textile Pakistan listed firms	Triple	Three positive slopes and the last regime is negative sloped. Only second and last regimes' coefficients are significant.	Optimal capital structure exists.